Spillovers between Medicare and Medicaid: Evidence from the Supply-Side and the Medicaid Fee-Bump

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Abstract

This paper studies the effect of a large increase in Medicaid reimbursement rates on the volume and type of services physicians provide to Medicare beneficiaries. I find that in response to the Medicaid "fee bump," physicians that qualified for increased Medicaid fees slightly decreased the number of Medicare beneficiaries served. This spillover, however, was not uniform among Medicare beneficiaries: established patient services decreased by drastically, yet new patient services was unaffected. These results are consistent with the predictions of an extended mixed-economy model of physician decision-making.

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1 Introduction

Increasing access to health care was a main objective of the Patient Protection and Affordable Care Act of 2010 (ACA). The ACA expanded Medicaid coverage to an additional 17 million people, and recent research is generally very positive towards the impact of the expansion: more people received care, health outcomes improved, and there is little evidence that non-Medicaid populations were disadvantaged as a result of spillover (Carey, Miller, & Wherry, 2018; Alexander & Schnell, 2019; Miller, Altekruse, Johnson, & Wherry, 2019). However, these results come despite research concerning non-ACA institutional changes. Several studies (Garthwaite, 2012; McInerney, Mellor, & Sabik, 2017; Glied & Hong, 2018) find an exogenous increase in access or demand for health care among a certain group causes a decrease in the amount of health care provided to other groups.

Why did the access-increasing provisions of the ACA have a different impact, specifically regarding spillover to other populations, than non-ACA provisions? To answer this question, this paper studies changes in Medicare provider service and patient volumes in response to the payment parity provision in the ACA that increased Medicaid reimbursement significantly. I find that while physicians slightly decreased the total volume of care they provide to Medicare beneficiaries when facing increased Medicaid fees, the particular combination of services physicians provided to Medicare beneficiaries changed drastically.

In 2013 and 2014, all states with fee-for-service Medicaid programs received federal funding to increase payments to physicians for Medicaid services so that they are equal to payments to physicians for Medicare services. This nearly doubled the payment physicians received from Medicaid. Along with the contemporaneous expansion of Medicaid coverage, this so-called Medicaid "fee bump" increased the access to care and the amount of care received by Medicaid beneficiaries, and further improved health and behavioral outcomes (Maclean, McClellan, Pesko, & Polsky, 2018; Alexander & Schnell, 2019). Focusing on Medicare beneficiary utilization, Carey et al. (2018) finds no crowd out and that increasing access to care to Medicaid beneficiaries did not diminish the care received by Medicare beneficiaries.

In this paper, I take a new approach to identify spillover to Medicare by looking at *provider* outcomes. Focusing on providers allows me to exploit exogenous variation in Medicaid payment that varies across providers, along with across states and time. This permits identification of a causal effect by comparing the outcome of the same provider across time, controlling for all provider and state-year-specific heterogeneity. Furthermore, by examining provider outcomes, I can detect changes in the *service-level* provision of care to Medicare beneficiaries that may result from changes in relative service prices.

I find the existence of small overall spillover between Medicaid and Medicare. When providers are in a state that has increased Medicaid fees, they treat 0.315 (± 0.10) percent fewer Medicare beneficiaries, and receive 0.396 (± 0.13) percent less payment from Medicare. After weighting treatment by the Medicaid-to-Medicare fee ratio, the effect is a decrease in number of Medicare beneficiaries treated by 0.244 (± 0.20) percent and a decrease in Medicare payment by 1.536 (± 0.26) percent.

Focusing on the use of specific service codes reveals a moderate to large impact of the parity provision on provider's behavior. Physicians in a state that have increased Medicaid fees treat 7.248 (± 0.35) percent fewer Medicare beneficiaries with established patient services, but 1.077 (± 0.48) percent more Medicare beneficiaries with new patient services. Medicare payment from established patient services decreased by 13.39 (± 0.61) percent, and increased by 2.626 (± 1.01) percent from new patient services.

Related Literature. Recent research has generally been favorable towards both the Medicaid expansion and the accompanying increase in Medicaid payments to physicians. For example, Miller et al. (2019) find a 0.132 percentage point decrease in mortality in states that expanded Medicaid, implying roughly 15 thousand people died between 2014 and 2017 because some states did not expand Medicaid eligibility. Concerning the fee bump specifically, Maclean et al. (2018) finds that higher Medicaid reimbursement rates improved behavioral health outcomes, specifically substance use disorders and tobacco product use. Alexander & Schnell (2019) shows that higher reimbursement for Medicaid services decreased reports of providers turning away patients, increased office visits for Medicaid enrollees, and improved overall health.

An important critique of the Medicaid expansion is that increased service use by Medicaid beneficiaries may spill over and impact the access to and amount of care individuals covered by other insurers receive. Garthwaite (2012) applies the seminal model of Sloan, Mitchell, &

Cromwell (1978) to deduce that due to crowd out of private insurance, upon implementation of the State Children's Health Insurance Program, which expanded insurance coverage to low-income Americans below the age of 19, physicians that serve few Medicaid patients under 19 should decrease the quantity of medical services provided. Survey data from physicians confirm this hypothesis. In a similar analysis using a survey of beneficiaries, McInerney et al. (2017) find that a one percent increase in the Medicaid-eligible population causes a decrease in spending among Dual Eligible patients. Finally, Glied & Hong (2018) find that factors increasing demand in the non-Medicare population cause a decrease in Medicare utilization and spending, and the total quantity of services provided did not change.

Contrary to Garthwaite (2012) and McInerney et al. (2017), Carey et al. (2018) finds no evidence of spillover between Medicare and Medicaid. Using a large sample of Medicare claims, the authors find that Medicaid expansions did not reduce utilization among Medicare beneficiaries. Furthermore, Maclean et al. (2018) and Alexander & Schnell (2019) find no change in behavioral health and access to care among non-Medicaid populations due to the Medicaid fee bump in secondary analyses.

This study provides new evidence surrounding physicians' responses to changes in payment for health services and their ability to expand the capacity of their practices. While Medicare beneficiaries did not see a large decrease in care due to the Medicaid fee bump, providers decisions surrounding Medicare beneficiaries were influenced, nonetheless. I justify these findings by extending the mixed-economy model of Sloan et al. (1978). The empirical results of this paper are consistent with a model of physician decision-making where marginal revenue (or equivalently marginal cost) is heterogeneous across patients, and the Medicaid fee bump simultaneously caused a crowed out of low-marginal revenue patients and a decrease in the marginal cost of care.

2 Institutional Background

Medicaid has historically reimbursed providers at a far lower rate than Medicare and private insurance. According to Zuckerman & Goin (2012), the Medicaid-to-Medicare fee ratio averaged 59% for primary care services in 2012, and half of all states had a fee ratio below

70%. This was a central concern to policymakers when expanding Medicaid eligibility in the ACA. While Medicaid eligibility would be expanded to an additional 17 million people in 2013, providers may still decide to not treat them, given they earn nearly two times the pay for providing the same service to Medicare or privately insured beneficiaries. Accordingly, the so-called Medicaid "fee bump" was included in the ACA.[1] The provision mandates that in 2013 and 2014, for 146 primary care services and for certain provider taxonomies, the payment for those services from Medicaid will be 100% of the Medicare rate. This provision applied to every state's Medicaid program, regardless of the state's decision to expand Medicaid.[2] The federal government paid states for the full costs of the fee bump until December 2014. From 2015 onwards, states had the decision to continue the fee bump, and as of 2016, 19 states fully or partially continued increased rates, and 30 states plus Washington D.C. elected to decrease Medicaid reimbursement rates to pre-bump levels.

Increased fees were given only to certain types of providers providing certain types of services to Medicaid patients. In particular, a service provided to a Medicaid beneficiary received the Medicare payment rate if the physician rendering or supervising the service had specialty designation of family medicine, general internal medicine, pediatric medicine, a subspecialty within these designations, or at least 60% of services provided by the physician in the previous year were among the services qualifying for the fee bump. The services qualifying for the fee bump have Healthcare Common Procedure Coding System (HCPCS) Level I codes 99201-99499, 90460, 90461, and 90471-90474.[3] The first range of HCPCS codes (99201-99499) are for Evaluation and Management Services, and the others are for Vaccine Administration. Table 1 contains some examples of services with and without bumped fees. There are over 6000 unique HCPCS codes.

A few states opted to increase rates for all physician types, rather than just those specified by the ACA: Maryland did so from 2013 through 2016, and Colorado, Idaho, Indiana, Nevada, and Utah did so in 2016.

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[1]See Section 1202 of the Act.

[2]The exception to this is Tennessee, which does not have a Medicaid FFS program.

[3]HCPCS Level I codes are also known as Current Procedural Terminology (CPT) codes.

Table 1: **Procedure Code Examples**

HCPCS Code	Description	Medicaid Fee Bumped?
99202	New patient office or other outpatient visit, typically 20 minutes	Yes
99233	Subsequent hospital inpatient care, typically 35 minutes per day	Yes
99291	Critical care delivery critically ill or injured patient, first 30-74 minutes	Yes
17003	Destruction of 2-14 skin growths	No
36415	Insertion of needle into vein for collection of blood sample	No
73564	X-ray of knee, 4 or more views	No

Note: This table gives examples of services that were and were not affected by the payment parity provision of the ACA.

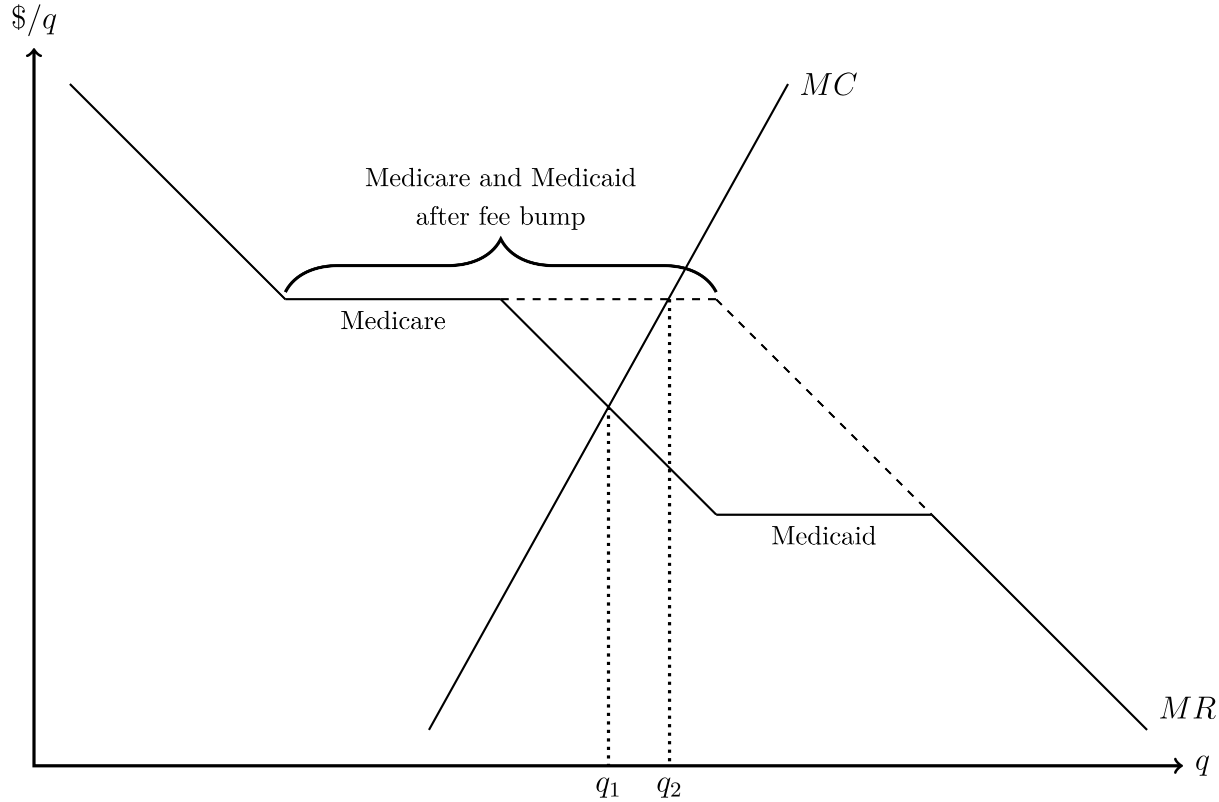
3 Conceptual Framework

The seminal work by Sloan et al. (1978) guides my predictions regarding the impact of the fee bump on provider decisions. In this model, a physician's marginal revenue MR is weakly decreasing in service volume q. In Figure 1, the flat segments represent the fee-for-service payments made by Medicare and Medicaid to physicians, and the downward sloping segments represent marginal revenue for services provided to privately insured individual and uninsured individuals. The dashed line is a provider's marginal revenue when Medicaid fees are bumped. Marginal costs are depicted by MC, and the fee bump increases service volume from q_1 to q_2. In this setting, physicians are indifferent between Medicare and Medicaid patients after the fee bump, so some Medicare patients may be replaced with Medicaid patients.

Figure 2 depicts a slightly more detailed framework, where Medicare and Medicaid patients differ by falling into the "new" and "established" patient categories. Certain evaluation and management services contain designations for "new" patients and "established" patients.[4] Because new patient services pay 30% more, it is more likely that a Medicare patient would be replaced with a Medicaid patient if the Medicare patient is established the

[4]According to the American Medical Association, a new patient is "one who has not received any professional services from the physician, or another physician of the same specialty who belongs to the same group practice, within the past three years."

Figure 1: **Provider Response to Fee Bump**



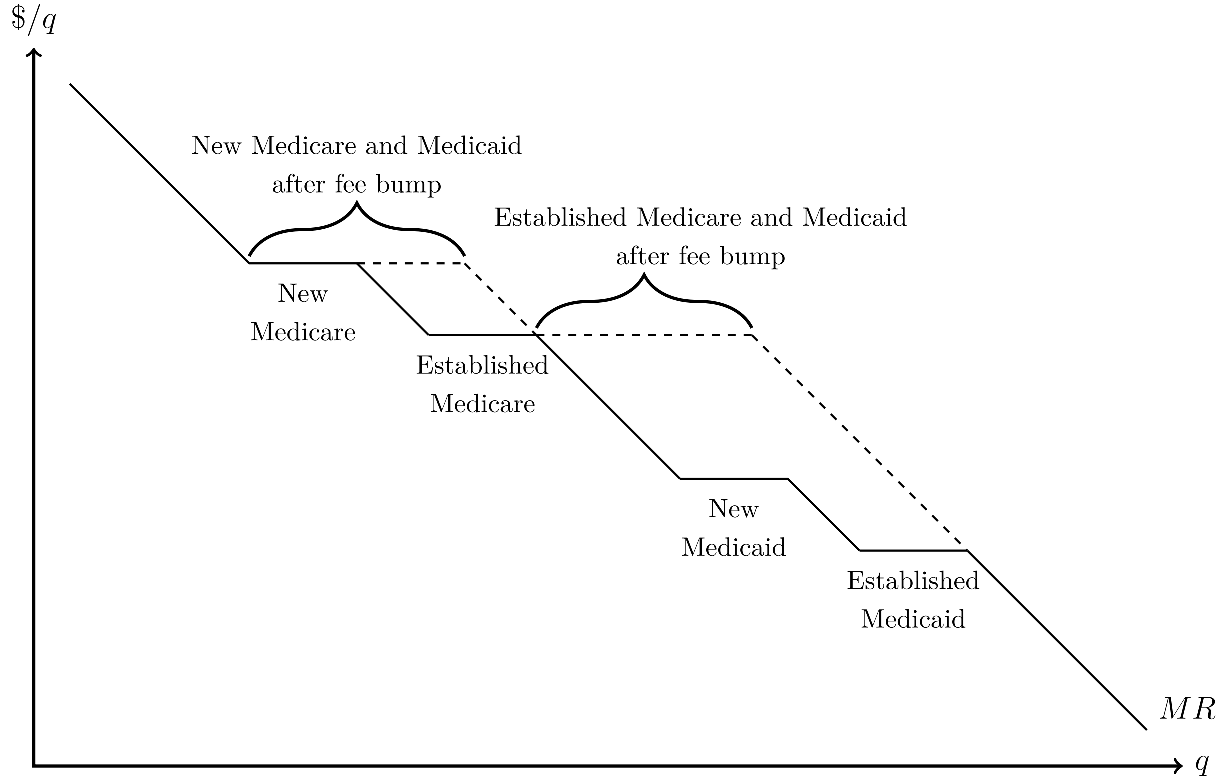
Note: This figure shows the marginal revenue (MR) of a physician for units of service q. The Medicaid fee bump increases marginal revenue for a portion of the domain of q, and equilibrium service volume increases from the intersection of MR with marginal cost (MC) at q_1 to q_2.

Medicaid patient is new. If, for example, a physician has high marginal costs, a physician that initially sees a combination of new and established Medicare patients would replace its established Medicare patients with new Medicaid patients after the fee bump. Figure 3 details this. Before the fee bump, q_3 is the optimal level of care for physician with marginal costs MC. A physician sees both new and established Medicare beneficiaries, and does not see Medicaid beneficiaries. After the fee bump, no established patients are treated, physicians see all new patient possible, and total amount of care provided increases to q_4.

4 Data

The purpose of this study is to find the impact of changing Medicaid reimbursement rates on the decisions of Medicare providers. To do so, the main source of data is the Physician and

Figure 2: **Provider Marginal Revenue with New and Established Patient Services**

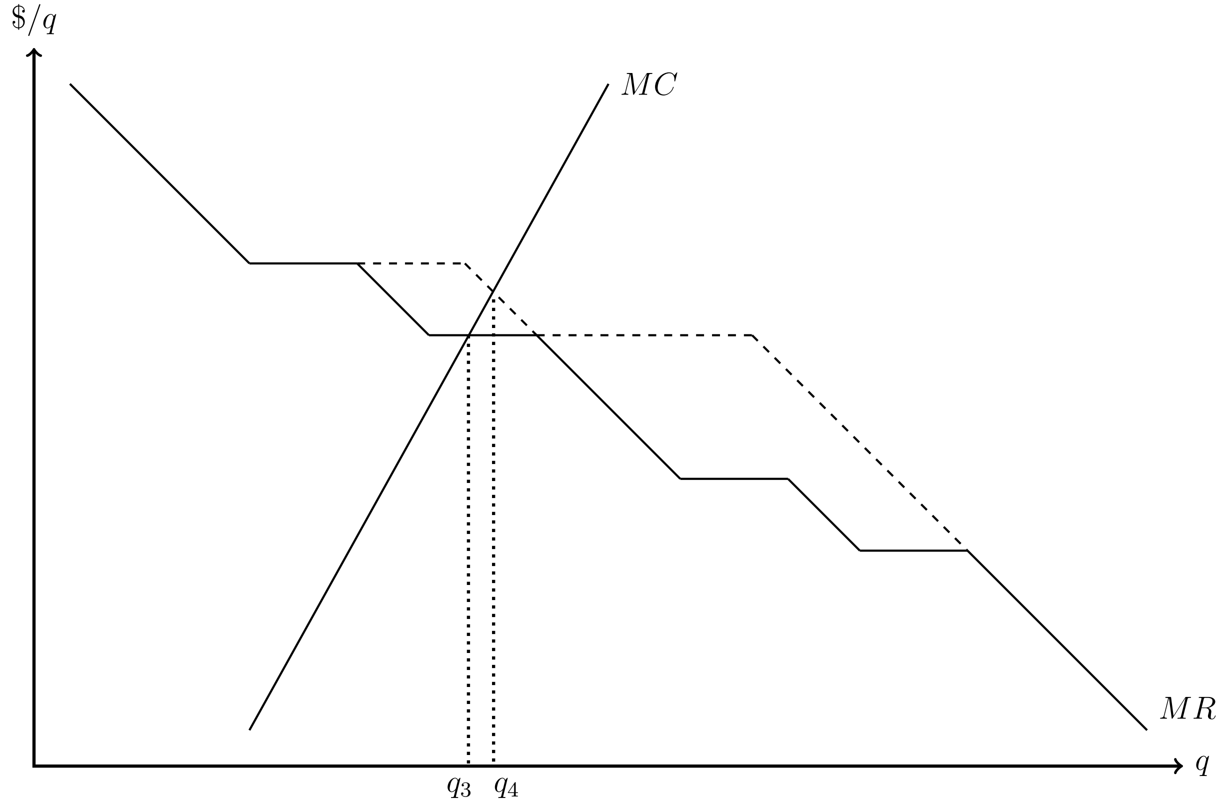


Note: This figure shows the marginal revenue (MR) of a physician for units of service q, where new Medicare and Medicaid patients offer higher marginal revenue than established Medicare and Medicaid patients. The fee bump increases marginal revenue for all Medicaid beneficiaries, and this is represented by the dashed line.

Other Supplier data (henceforth "Service Level data") from the Centers for Medicare and Medicaid Services (CMS). This data provides utilization, charge amount, and actual payment amount for nearly every Medicare Part B provider for the years 2012 to 2016. Providers are identified by a National Provider Identifier (NPI), and for each NPI, the number of unique beneficiaries, total number of services, and average payment amount for every type of service is included in the data. Combined with the Medicare Physician and Other Supplier Aggregate Table (henceforth "Aggregate Table") also from CMS, the data also contains information on the provider's gender, address, and taxonomy, along with demographic information about the Medicare beneficiaries treated by the provider.

There are numerous advantages to these data. It contains extremely detailed information on specific Medicare providers, and this will allow an identification strategy based on variation in a provider's behavior over time. In particular, taxonomy information allows

Figure 3: **Provider Response to Fee Bump with New and Established Patient Services**



Note: This figure shows that equilibrium service volume q_3 contains a combination of new and established Medicare patients before the fee bump. After the fee bump, service volume increases to q_4, and all established Medicare patients are replaced by new Medicaid patients.

me to distinguish which providers qualify for the fee bump, exogenously dividing providers into two groups that receive very different payment rates for providing the same service to Medicaid beneficiaries.

I combine the provider-level data with state level data on the Medicaid fee bump. Specifically, I use data on each state's participation in the fee bump in each year and each state's Medicaid-to-Medicare fee ratio in each year.

4.1 Dataset Construction

The Service Level data contains observations by year, NPI, and HCPCS code. An important characteristic of this data, and any public Medicare data, is that any observation providing information on 10 or fewer beneficiaries is censored. For example, if a given NPI provided 10 beneficiaries HCPCS code 99212 and 11 beneficiaries HCPCS code 99213, then the former information would be omitted from the dataset and the latter would be included. This presents possible problems when manually aggregating variables from the HCPCS level to the NPI level. Fortunately, by merging with the Aggregate Table, NPI level statistics are observed. This means, for example, the total number of unique beneficiaries treated by a given NPI in a given year is available, as well as the total number of unique beneficiaries receiving a specific service type from a given NPI in a given year. However, the total number of unique beneficiaries receiving a *combination* of service types from a given NPI in a given year isn't necessarily available. Furthermore, if a provider saw 10 or fewer beneficiaries in a given year (for all services), then they are censored from both the Service Level data and Aggregate Table.

To get state-level Medicaid-to-Medicare fee ratios, I follow Maclean et al. (2018) and use values from Zuckerman & Goin (2012), Smith et al. (2015), and Zuckerman, Skopec, & Epstein (2017). These authors first compute the simple average Medicaid and Medicare fees for seven different primary care service types (defined by HCPCS code) for every state (except Tennessee). The Medicaid-to-Medicare ratio in a state is the weighted average of the ratios of average Medicaid fees to average Medicare fees, where weights are the share of US spending on each service.

To combat the censoring issue, to account for the specific details of the fee bump law, and to handle for idiosyncrasies in policy adoption across states, I do the following. First, I keep only observations where services were provided in an office setting (rather than a facility), and only if the NPI is associated with an individual provider (rather than an organization). I drop observations for supplier and non-medical taxonomies.[5] Providers who switch taxonomy at all from 2012 to 2016 are dropped from the data. Importantly, I drop any providers that don't appear in all five years of data, since appearing in one year and not another is indicative of having near the censoring threshold amount of patients. I drop any

[5]The following types are dropped: All Other Suppliers, Clinic or Group Practice, Clinical Laboratory, Independent Diagnostic Testing Facility, Independent Diagnostic Testing Facility (IDTF), Mass Immunization Roster Biller, Mass Immunizer Roster Biller, Multispecialty Clinic/Group Practice, Portable X-Ray Supplier, Portable X-ray, Slide Preparation Facility, Undefined Physician type, Unknown Physician Specialty Code, Unknown Supplier/Provider, and Unknown Supplier/Provider Specialty. These amount to less than one out of every 2000 observations.

providers serving more than 3,000 unique beneficiaries in a year (corresponding to the 99th percentile). Finally, I exclude providers in Maryland, Colorado, Idaho, Indiana, Nevada, and Utah from the data, since these states provided increased fees to all physicians at least one year during 2012 to 2016. There is no fee-for-service component in Tennessee's Medicaid program, so it is also omitted from the data.

4.2 Summary Statistics

Table 2 presents provider statistics in the remaining sample. Of the 286,911 total providers,

Table 2: **Summary Statistics: Per-Year Provider Statistics**

	Non-PCPs	PCPs	All Providers
Number of Providers	208,413	78,498	286,911
Number of Unique Beneficiaries	553	413	512
	(526)	(290)	(473)
Number of Unique Ben. (99213 only)	122	162	134
	(182)	(151)	(175)
Number of Unique Ben. (99203 only)	30	9	24
	(63)	(32)	(56)
Total Medicare Payment Amount ($)	154,139	123,459	145,131
	(197,990)	(133,309)	(181,944)
Medicare Payment Amount (99213 only, $)	10,660	17,348	12,624
	(18,450)	(22,263)	(19,881)
Medicare Payment Amount (99203 only, $)	2,228	638	1,761
	(4,732)	(2,247)	(4,222)
Proportion of Medicare Ben. that are White	0.81	0.79	0.80
	(0.16)	(0.19)	(0.17)
Proportion of Medicare Ben. that are Male	0.41	0.41	0.41
	(0.12)	(0.10)	(0.12)
Average HCC Risk Score of Ben.	1.46	1.48	1.47
	(0.58)	(0.89)	(0.68)
N		1,098,302	

Note: This table shows mean provider service volume and patient demographics, with standard deviations in parentheses.

27% are PCPs that qualify to receive the increased Medicaid rates. Note that while non-

PCPs don't earn increased rates, nearly two thirds provided at least one service that would receive the increased Medicaid rate had their taxonomy been different.

Table 3 shows the number of states by year that had legislated increased fees and had a Medicaid-to-Medicare fee ratio greater than or equal to one. It also shows the average fee bump across states.

Table 3: **Summary Statistics: Fee Bump by Year**

Year	# States with Bumped Fees	# States with Fee Ratio$\geq$ 1	Average Fee Ratio
2012	0	2	0.71
2013	50	50	1.01
2014	50	50	1.01
2015	19	14	0.78
2016	19	4	0.72

Note: This table shows the number of states with increased fees and the average Medicaid-to-Medicare fee ratio by year for all states (including Washington, D.C. and excluding Tennessee).

5 Empirical Strategy

I use several difference-in-differences specifications to identify and investigate spillover to Medicare in response to the Medicaid fee increase. These specifications differ in treatment measurement, the variation in treatment that identifies the causal impact of treatment on the outcome variable, and the outcome variable.

5.1 Treatment Measurement

Treatment in the context of this analysis is exposure to an exogenous increase in Medicaid payment relative to Medicare payment. I measure treatment with the variable z_{st}, defined in the following ways:

1. $\underline{z_{st} = Bump_{st}}$, where $Bump_{st}$ indicates state s had *legislated* Medicaid payment parity in year t. Using this definition, the average treatment effect identified is the average change in the outcome variable to *legislated* bumped fees.

2. $z_{st} = \mathbf{1}\{FeeRatio_{st} \geq 1\}$. This variable indicates a state s that had a Medicaid-to-Medicare fee ratio equal to 1 or more in year t. Using this definition, the average treatment effect identified is the average change in the outcome variable when Medicaid fees are increased to a level *equivalent or greater* than Medicare fees. This variable is usually equal to $Bump_{st}$, though it differs for states such as Alaska, which had large Medicaid payment pre-fee bump, and for years 2015 and 2016, when several states had just partially increased fees (see Table 3).

3. $z_{st} = \mathbf{1}\{\Delta FeeRatio_{st} \geq 0.3\}$, where $\Delta FeeRatio_{st} = FeeRatio_{st} - FeeRatio_{s,2012}$. This definition follows Maclean et al. (2018), which defines "large fee bump" states as those that increased their fee ratio by more than 0.3 since 2012.

4. $z_{st} = \Delta FeeRatio_{st}$. This treatment variable, taking values other than zero and one, measures the increase in the magnitude of the Medicaid-to-Medicare fee ratio in a given state and year, and thus exploits more variation in Medicaid fees to identify the treatment effect in question.

5. $z_{st} = FeeRatio_{st}$. Using the unadjusted Medicaid-to-Medicare fee ratio as treatment simply weights states and years according to the intensity of payment parity in the state. This term exploits variation of treatment differently than $\Delta FeeRatio_{st}$, and will assist more in identifying spillover if the level of the fee ratio is more important to physicians than the change since 2012.

Along with these definitions of treatment that vary across state and time, since not all physicians qualify for increased Medicaid fees, physicians can be split into treated and untreated groups according to their specialty. Accordingly, let the variable $Qual_i$ indicate physician i is of a specialty that qualifies for increased Medicaid payment.

5.1.1 Drawbacks and Limitations

The variable $FeeRatio_{st}$ is the expenditure share-weighted average Medicaid-to-Medicare fee ratio of seven primary care services in state s and year t (see the discussion in Section 4). Because this treatment variable is aggregated to the state level, and is not a fee ratio specific to a physician, there may be a small difference in the actual ratio of Medicaid-to-Medicare fees that a physician faces and what's ultimately used in the empirical specifications. This difference exists because not every physician in a state provides the same mixture of primary care services.

While this is a limitation of this study, I use a couple strategies to rule out that the bias introduced by using a state-specific fee bump drives empirical results. First, treatment definitions under items 1 and 2 in Section 5.1 are not impacted at all by this bias, as they are, by definition, state specific.[6] Second, I use physician-specific fixed effects in one difference-in-differences specification, and this would capture any time-invariant differences between a physician's own fee ratio and the statewide fee ratio.

5.2 Difference-in-Differences Specifications

I estimate three difference-in-difference models, each differing in the variation in treatment that identifies spillover between Medicare and Medicaid.

5.2.1 Variation Across States Over Time

The first specification takes the form of the canonical difference-in-differences model by comparing the change in the outcome variable in states with bumped Medicaid fees with the change in the outcome variable in states without bumped Medicaid fees. Formally, I estimate the model

$$y_{ist} = \gamma_i + \delta_s + \kappa_t + \boldsymbol{\beta}_1' X_{ist} + \beta_2 expanded_{st} + \alpha z_{st} + \epsilon_{ist} \mid Qual_i = 1 \tag{1}$$

where y_{ist} is the outcome of provider i in state s in year t. The variables γ_i, δ_s, and κ_t are provider, state, and time fixed effects; X_{ist} is a vector of controls varying across providers, states, and time; and $expanded_{st}$ indicates state s expanded Medicaid in year t. The variable z_{st} represents exogenous treatment, and varies only across states and time. When estimating parameters in this model, I limit the sample to physicians that qualify for increased Medicaid

[6] We will see in the coming sections that the empirical results are robust to applying different treatment definitions.

fees.

5.2.2 Variation Across States and Providers Over Time

To leverage more variation in data, I include all providers in the estimation sample and use the interaction of state and time varying treatment with the variable indicating a physician qualifies for treatment, $z_{st} \times Qual_i$, as the treatment variable. This specification takes the form

$$y_{ist} = \gamma_i + \delta_{st} + \boldsymbol{\beta}' X_{ist} + \alpha z_{st} \times Qual_i + \varepsilon_{ist} \tag{2}$$

where γ_i is a provider fixed effect, δ_{st} is a state-by-year fixed effect, and X_{ist} is a vector of time varying physician characteristics. The specification in Equation 2 has several advantages over the specification in Equation 1. First, because all providers are included in the sample, the difference in outcome change between qualifying and non-qualifying physicians contributes to the estimate of the average treatment effect. Furthermore, because treatment varies across states, years, and physicians, a more general state-by-year fixed effect can be added to the specification, absorbing more confounding variation than separate state and time fixed effects.[7]

5.2.3 Variation Across Providers Over Time

To further analyze the impact of the Medicaid fee bump on provider decisions, I conduct state-specific analysis and estimate the regression

$$y_{ist} = \gamma_i + \delta_t + \boldsymbol{\beta}_s' X_{ist} + \alpha_s \left(Bump_{st} \times Qual_i\right) + \epsilon_{ist} \tag{3}$$

for all states s in the estimation sample. This specification sacrifices cross-state variation to compute an average treatment effect that varies at the state level. The advantage of this specification is that I can compare estimates of α_s to the intensity of treatment in a given state s.

[7] Including state-by-year fixed renders Medicaid expansion status of a state, $expanded_{st}$, redundant, and so this variable is omitted form the specification in Equation 2.

5.3 Outcome Variables

There are six total outcome variables y_{ist} used in this analysis.

1. Total unique Medicare beneficiaries receiving
   (a) any medical service from provider i in state s in year t
   (b) a medical service with HCPCS code 99213 from provider i in state s in year t
   (c) a medical service with HCPCS code 99203 from provider i in state s in year t
2. Total Medicare payment for
   (a) all medical service provided by provided i in state s in year t
   (b) a medical service with HCPCS code 99213 provided by provided i in state s in year t
   (c) a medical service with HCPCS code 99203 provided by provided i in state s in year t

I choose to focus my analysis on two measures of volume: total number of unique beneficiaries treated, and total payment received from CMS. The former measure has a direct relationship to Medicare beneficiaries' access to care, though may not capture all spillover if providers have a hard time adjusting the number of beneficiaries they treat. The latter, payment, addresses a more general notion of spillover, capturing revenue changes as a result of the policy.

For the measures above, I also look at narrower definitions based on HCPCS codes. The code 99213 is by far the most commonly used procedural code treating established patients, and the code 99203 is the most common for treating new patients. Both were in the group of services that received bumped fees, though breaking the outcomes down into these allows an analysis of where treatment changes, if any, were made.

To account for the right skewed distributions of outcome variables and the presence of several observations with value of zero, I apply an inverse hyperbolic sine transformation to all of the dependent variables listed above. While this transformation is unconventional, the resulting coefficients can be interpreted in the same way as if the dependent variables were logged. That is, the proportion change in the outcome variable when a provider qualifies for the fee bump is approximately $\exp(\alpha) - 1$. Furthermore, the approximation is more accurate than if the transformation $\ln(y + 1)$ were applied.[8]

5.4 Identification

The key identifying assumption of this study, and all studies that examine the consequences of the payment parity provision of the ACA, is that cross-state and intertemporal variations in the Medicaid-to-Medicare fee ratio are exogenous and unrelated to cross-state and intertemporal variations in the outcome variables. Depending on the definition of treatment z_{st}, different assumptions are required for the average treatment effect α to be identified.

When z_{st} has the definitions described in items 1, 2, and 3 in Section 5.1, I assume that a states adoption of bumped fees, whether or not the Medicaid-to-Medicare fee ratio is larger than 1, and whether or not the change in the fee ratio since 2012 is larger than 0.3 is independent of all unobserved factors contributing to the outcome variables, conditional on fixed effects and controls.

On the other hand, when z_{st} is defined according to items 4 and 5 in Section 5.1, I require different identifying assumptions. The usual strict exogeneity assumption is extended: along with the assumption that there is no unobserved factor non-randomly driving adoption of increased fees, it requires that no unobserved factor non-randomly drives the variation in the Medicaid-to-Medicare fee ratio. Specifying treatment in this way, often referred to as "continuous treatment" or "dosage," is common when available (Card, 1992; Weber, 2014), and is typically the treatment of choice in studies concerning the impact of the Medicaid fee bump (Maclean et al., 2018; Alexander & Schnell, 2019).

Time varying control variables in X_{ist} include the average risk score of beneficiaries treated by a provider, the proportion white beneficialness treated by a provider, and the proportion of male beneficiaries treated by the provider. These variables control for patient health and demographics, which may be correlated with a state's adoption of increased

[8]The proportion change approximation becomes more accurate with the dependent variable is large. For example, Bellemare & Wichman (2019) suggest using the approximation when the the dependent variable is greater than 10. The dependent variables used in this analysis all have means in the several hundreds (or greater).

Medicaid fees over time.

Ultimately, identification is impeded if physicians in states (and during years) with larger Medicaid-to-Medicare fee ratios also have larger service volume for reasons *other* than the fee bump.

6 Results

Tables 4 and 5 show the results from estimating Equation 1. Each cell in the tables contains

Table 4: **Qualifying Physicians' Response to Medicaid Rate Increase: Medicare Beneficiaries**

	Number of Unique Medicare Beneficiaries Treated		
	(1)	(2)	(3)
Treatment	Any Service	Established Patient	New Patient
$Bump_{st}$	0.190	0.324	2.837**
	(0.236)	(0.819)	(1.096)
$\mathbf{1}\{FeeRatio_{st} \geq 1\}$	0.00104	-4.354***	1.067
	(0.282)	(1.140)	(1.470)
$\mathbf{1}\{\Delta FeeRatio_{st} \geq 0.3\}$	-0.111	-2.209***	0.0680
	(0.153)	(0.545)	(0.822)
$\Delta FeeRatio_{st}$	-0.374	-4.456**	3.113
	(0.420)	(1.476)	(2.241)
$FeeRatio_{st}$	-0.374	-4.417**	3.134
	(0.420)	(1.477)	(2.242)
N	315909	315909	315909

Standard errors (clustered by provider) in parentheses. Provider, state, and year fixed effects and controls are used in every regression. All point estimates should be interpreted as percent changes in the dependent variable when a physician qualifies for the fee bump, holding all else constant. "Established" refers to services with HCPCS code 99213; "New" refers to services with HCPCS code 99203. $\Delta FeeRatio_{st} = FeeRatio_{st} - FeeRatio_{s,2012}$.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

the estimated average treatment effect, $\hat{\alpha}$. There are 30 estimates total in the two tables: the combination of six independent variables (unique number of beneficiaries given any service, an established patient service, and a new patient service; total Medicare payment for any

Table 5: **Qualifying Physicians' Response to Medicaid Rate Increase: Medicare Payment**

	Total Medicare Payment for Services		
	(1)	(2)	(3)
Treatment	Any Service	Established Patient	New Patient
$Bump_{st}$	-0.757*	0.432	5.963**
	(0.317)	(1.466)	(2.334)
$\mathbf{1}\{FeeRatio_{st} \geq 1\}$	0.0123	-7.808***	2.560
	(0.379)	(1.990)	(3.153)
$\mathbf{1}\{\Delta FeeRatio_{st} \geq 0.3\}$	0.593**	-2.574**	0.368
	(0.206)	(0.984)	(1.732)
$\Delta FeeRatio_{st}$	1.514**	-5.849*	6.710
	(0.565)	(2.651)	(4.890)
$FeeRatio_{st}$	1.513**	-5.805*	6.761
	(0.565)	(2.652)	(4.892)
N	315909	315909	315909

Standard errors (clustered by provider) in parentheses. Provider, state, and year fixed effects and controls are used in every regression. All point estimates should be interpreted as percent changes in the dependent variable when a physician qualifies for the fee bump, holding all else constant. "Established" refers to services with HCPCS code 99213; "New" refers to services with HCPCS code 99203. $\Delta FeeRatio_{st} = FeeRatio_{st} - FeeRatio_{s,2012}$.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

service, an established patient service, and a new patient service) and 5 independent variables (see Section 5.1).

Table 4 show small and imprecise changes in the unique number of Medicare beneficiaries treated by providers in states that have legislated an increase in Medicaid fees. For all services, qualifying physicians in states with increased fees treat between -0.29 percent fewer and 0.67 percent more Medicare beneficiaries (95% confidence interval). Using the variation in the Medicaid fee ratio, the average treatment effect is between a 1.21 percent decrease and a 0.47 percent increase (95% confidence interval).

The impact of the fee bump on Medicare beneficiaries is much larger and more precise when looking at services designated for established patients only. When $FeeRatio_{st}$ is treatment, providers offer the most common established patient service to 4% fewer unique beneficiaries, though offer the most common new patient service to 3% *more* new patients.

According to Table 5, Physicians qualifying for increased Medicaid fees earn 0.76% less total Medicaid payment in states that have increased fees. When using the Medicaid-to-Medicare fee ratio as treatment, the sign flips, and qualifying providers actually earn 1.5% *more* total Medicare pay in states that adopt the fee bump. Examining columns 2 and 3 of Table 5 helps to explain why: payment from the established payment service decreased, though payment from the new patient service increased. Per service payment for the established patient service is roughly 30% less than per service payment for the new patient service, suggesting that while total service volume may have decreased or been unchanged, total pay may still increase.

Tables 6 and 7 show results from the difference-in-differences specification in Equation 2. By including additional variation from non-qualifying providers and more general state-by-year fixed effects, the impact of the Medicaid fee bump on Medicare providers becomes a bit clearer. Total number of unique beneficiaries decreases slightly when treated, though unique beneficiaries receiving the established patient service decreases by nearly 10% and unique beneficiaries receiving the new patient service increases by 8.5%. Payment follows a similar pattern: once using $FeeRatio_{st} \times Qual_i$ as treatment, we total Medicare payment to treated physicians decreases by 1.5%, and payment for the established and the new patient services decrease and increase by similar amounts, respectively.

Table 6: **Provider Response to Medicaid Rate Increase: Medicare Beneficiaries**

	Number of Unique Medicare Beneficiaries Treated		
	(1)	(2)	(3)
Treatment	Any Service	Established Patient	New Patient
$Bump_{st} \times Qual_i$	-0.315**	-7.248***	1.077*
	(0.0981)	(0.350)	(0.477)
$\mathbf{1}\{FeeRatio_{st} \geq 1\} \times Qual_i$	0.00482	-4.740***	3.585***
	(0.0874)	(0.325)	(0.454)
$\mathbf{1}\{\Delta FeeRatio_{st} \geq 0.3\} \times Qual_i$	-0.130	-5.105***	3.776***
	(0.100)	(0.375)	(0.518)
$\Delta FeeRatio_{st} \times Qual_i$	-0.240	-9.927***	8.570***
	(0.199)	(0.704)	(1.064)
$FeeRatio_{st} \times Qual_i$	-0.244	-9.933***	8.554***
	(0.199)	(0.703)	(1.064)
N	1061847	1061847	1061847

Standard errors (clustered by provider) in parentheses. Provider and state-year fixed effects and controls are used in every regression. All point estimates should be interpreted as percent changes in the dependent variable when a physician qualifies for the fee bump, holding all else constant. "Established" refers to services with HCPCS code 99213; "New" refers to services with HCPCS code 99203. $\Delta FeeRatio_{st} = FeeRatio_{st} - FeeRatio_{s,2012}$.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

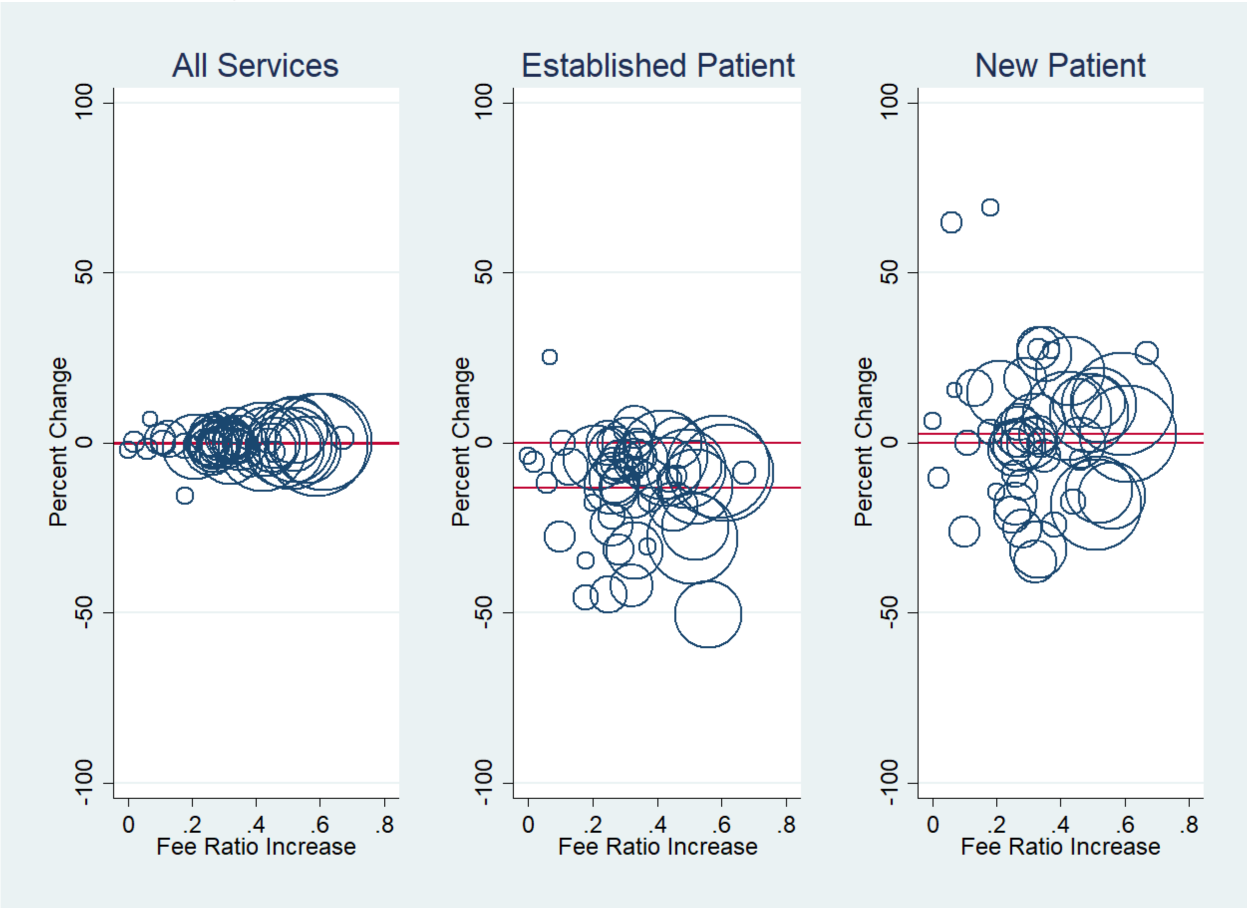
Table 7: **Provider Response to Medicaid Rate Increase: Medicare Payment**

	Total Medicare Payment for Services		
	(1)	(2)	(3)
Treatment	Any Service	Established Patient	New Patient
$Bump_{st} \times Qual_i$	-0.396**	-13.39***	2.626**
	(0.128)	(0.606)	(1.013)
$\mathbf{1}\{FeeRatio_{st} \geq 1\} \times Qual_i$	-0.684***	-9.010***	7.844***
	(0.115)	(0.578)	(0.991)
$\mathbf{1}\{\Delta FeeRatio_{st} \geq 0.3\} \times Qual_i$	-0.768***	-9.389***	8.250***
	(0.131)	(0.672)	(1.136)
$\Delta FeeRatio_{st} \times Qual_i$	-1.529***	-18.19***	19.27***
	(0.257)	(1.201)	(2.460)
$FeeRatio_{st} \times Qual_i$	-1.536***	-18.20***	19.24***
	(0.257)	(1.201)	(2.459)
N	1061847	1061847	1061847

Standard errors (clustered by provider) in parentheses. Provider and state-year fixed effects and controls are used in every regression. All point estimates should be interpreted as percent changes in the dependent variable when a physician qualifies for the fee bump, holding all else constant. "Established" refers to services with HCPCS code 99213; "New" refers to services with HCPCS code 99203. $\Delta FeeRatio_{st} = FeeRatio_{st} - FeeRatio_{s,2012}$.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figure 4: **Impact of Bumped Fees on Payment by State**



Note: This figure shows the average treatment effect (ATE) of the Medicaid fee bump on qualifying physician's payment from Medicare. Each circle corresponds to a U.S. state's treatment effect, where its size is determined by the number of observations used to compute the effect. The left panel is the ATE on payment for all services, the middle panel is the ATE on payment for a service for established Medicare beneficiaries, and the right panel is the ATE on payment for a service for established new beneficiaries. The results indicate, particularly in the middle panel, the ATE of the fee bump is stronger in states where the fee bump is larger.

Finally, Figure 4 plots the coefficients α_s (from Equation 3) against the increase in Medicaid-to-Medicare fee-ratio in state s when fees are bumped: $\max_t \{FeeRatio_{st}|bump_{st} = 1\} - \min_t \{FeeRatio_{st}|bump_{st} = 0\}$. The size of each circle is weighted by to the number of observations used to compute its corresponding point estimate. The leftmost panel of Figure 4 shows the very slight average decrease of total payment to physicians in states that qualify for the fee bump. Across all states, total payment for all services to physicians qualifying for the fee bump decreased on average by 0.396%, with a 95% confidence interval $(-0.652, -0.140)$. Roughly 57% of states had a decline, and there is a very small positive relationship between the change in payment amount and the change in fee ratio.

The middle panel, however, shows a much stronger impact of the fee bump on states. Only two of the 44 unique values of α_s are positive, implying more than 95% of states in the sample saw a decrease in payment for the established patient service to physicians qualifying for the fee bump. There is a strong negative relationship between the magnitude of the change in payment and the magnitude of the fee ratio increase. The rightmost panel effectively shows the opposite: on average, when physicians qualify for increased fees, payment for the new patient service increases. In the estimation sample, 57% of states showed this pattern.

7 Discussion

The results presented in the previous section can be summarized as follows:

1. Physicians exposed to the Medicaid fee bump decreased the unique number of Medicare beneficiaries they treat.

2. Physicians exposed to the Medicaid fee bump decreased the total payment they receive from Medicare.

3. Physicians exposed to the Medicaid fee bump decreased the number of Medicare beneficiaries given and total Medicare payment from the procedural code designated for established patients only. Physicians not exposed behave in the opposite way, increasing volume of this service.

4. Physicians exposed to the Medicaid fee bump increased the number of Medicare beneficiaries given and total Medicare payment from the procedural code designated for new patients only. Physicians not exposed behave in the opposite way, decreasing volume of this service.

Why do we see this pattern? While the mixed economy models of Sloan et al. (1978), Garthwaite (2012), and Glied & Hong (2018) predict decreases in Medicare service volume in response to access and payment increasing provisions for Medicaid, no study explains why volume of one service type could decrease while another increases.

One obvious explanation is that physicians increased the number of Dual Eligible beneficiaries, and so that would account for the large increase in new patient Medicare services. To examine this hypothesis, I estimate the model in Equation 2, with dependent variable y_{ist} equal to the percent of unique beneficiaries that are dual eligible in Medicare and Medicaid treated by provider i in state s in year t. Results are in Table 8. The point estimates

Table 8: **Provider Response to Medicaid Rate Increase: Dual Eligible Beneficiaries**

	Percent of Beneficiaries that are Dual Eligible
Treatment	(1)
$Bump_{st} \times Qual_i$	0.147***
	(0.0175)
$\mathbf{1}\{FeeRatio_{st} \geq 1\} \times Qual_i$	0.185***
	(0.0157)
$\mathbf{1}\{\Delta FeeRatio_{st} \geq 0.3\} \times Qual_i$	0.197***
	(0.0186)
$\Delta FeeRatio_{st} \times Qual_i$	0.421***
	(0.0371)
$FeeRatio_{st} \times Qual_i$	0.421***
	(0.0372)
N	954486

Standard errors (clustered by provider) in parentheses. Provider and state-year fixed effects and controls are used in every regression. All point estimates should be interpreted as percentage point changes. $\Delta FeeRatio_{st} = FeeRatio_{st} - FeeRatio_{s,2012}$.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

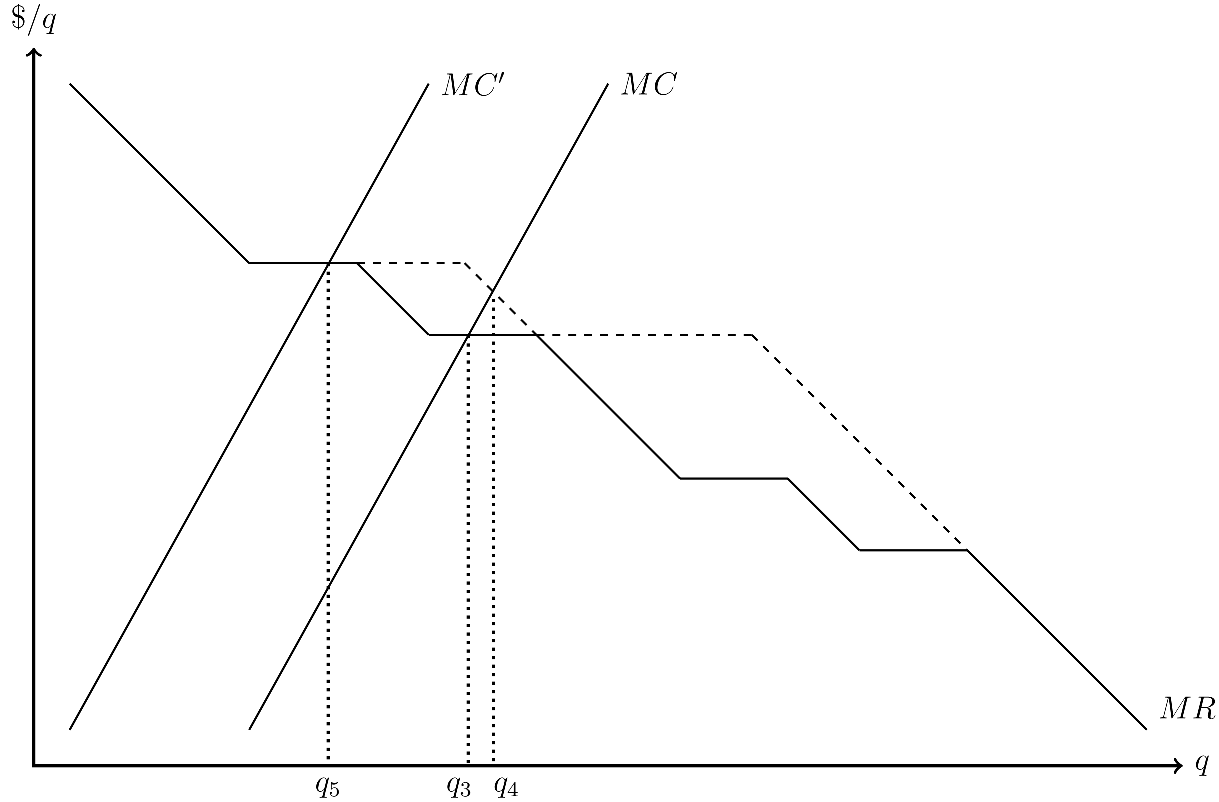
indicate that physicians qualifying for increased Medicaid fees increase the number of Dual Eligible beneficiaries that they treat by about one beneficiary on average. While positive, the magnitudes of these treatment effects are not sufficiently large to account for the size of the increase in beneficiaries that receive the new patient Medicare service.

7.1 Conceptual Framework Revisited

The model discussed in Section 3 provides a reason for why some Medicare patients are replaced by Medicaid patients as a result of the fee bump, and moreover suggest that established patients are more vulnerable than new patients. However, the empirical results of this paper suggest that provision of care to new Medicare beneficiaries increased, and this simple framework cannot justify that result.

To be specific, consider the model reproduced in Figure 5. If a physician has marginal

Figure 5: **No Provider Response to Fee Bump**

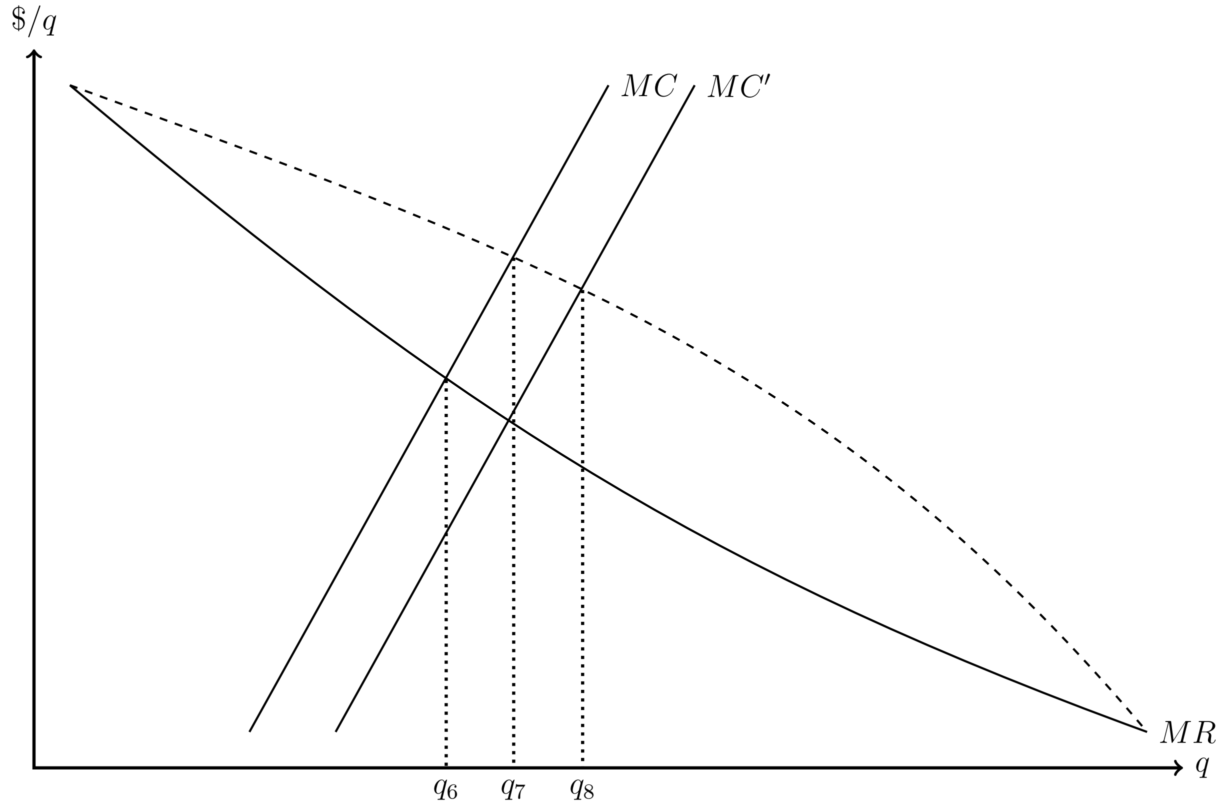


Note: This figure shows that when marginal cost is sufficiently high (MC'), the equilibrium service volume remains unchanged after the fee bump at q_5.

cost curve MC, there's no excess demand for new Medicare patient services, so new Medicare patient services would not increase, and the increase in services from q_3 to q_4 is only to new Medicaid beneficiaries. If a physician has marginal cost MC', there is excess demand, but the fee bump would leave total provision of care unchanged at q_5, and new Medicare beneficiary services would either be unchanged or decrease.

Reconciling this paper's empirical results requires a model with patients that are heterogeneous in dimensions other than Medicare, Medicaid, established, and new. Of course, physicians consistently treat established Medicare patients, and some new Medicare patients remain untreated, despite the differing reimbursement amounts. Including more patient heterogeneity essentially *smooths* the marginal revenue curves in Figures 1, 2, and 3 because the marginal unit of healthcare service goes to the patient with the highest remaining marginal revenue. The fee bump manifests as an outwards bowing of the marginal revenue curve. This is pictured in Figure 6. Beneficiaries with all types of payers span the domain of these

Figure 6: **Provider Response to Fee Bump with Heterogeneous Patients**



Note: This figure shows a physician's marginal revenue (MR) of service volume q when patients are heterogeneous. The higher marginal revenue patients correspond to lower values of q, and marginal revenue decreases smoothly. The Medicaid fee bump increases marginal revenue for some patients, effectively bowing out marginal revenue to the dashed line. Payment parity increases equilibrium service volume from q_6 to q_7, where established Medicare patients are replaced by Medicaid patients. Simultaneously, marginal costs decrease (moving the marginal cost curve from MC to MC') and equilibrium service volume increased to q_8, and more new Medicare patients are treated.

marginal revenue curves. The fee bump increases marginal revenue for serving the Medicaid portion of the population, which increases the number of services provided from q_6 to q_7. In this example, crowd out could occur to *any* non-Medicaid beneficiary, new or established, if a Medicaid beneficiary has higher marginal revenue after the fee bump.

Heterogeneous patients alone does not explain why more new Medicare beneficiaries were treated, however. This requires a subsequent decrease in marginal cost *caused* by the fee bump, pictured in Figure 6 as MC'. In this case, total quantity of services provided by a physician increases to q_8, and this increase includes both Medicaid patients and new Medicare patients.

I formalize this in the following toy model. A physician chooses services provided to new and established Medicare beneficiaries, x_n and x_e, and services provided to new and established Medicaid beneficiaries, y_n and y_e. Medicare services have prices p_n and p_e, and Medicaid services have prices $r \cdot p_n$ and $r \cdot p_e$, where r is the Medicaid-to-Medicare fee ratio. Physicians maximize utility, which is a linear combination of profit and patient utility. That is, physicians maximize

$$U(x_n, x_e, y_n, y_e) = p_n x_n + p_e x_e + r p_n y_n + r p_e y_e - C(x_n, x_e, y_n, y_e) + V(x_n, x_e, y_n, y_e) \quad (4)$$

where C is a cost function, and V is a function representing the utility a physician derives from the total utility of their beneficiaries. To guarantee an interior solution, I assume that the function $C - V$ is strictly convex over the entire domain of x_n, x_e, y_n, and y_e, and that p_n, p_e, and r are all strictly greater than zero.

Proposition 7.1 (Comparative Statics)**.** *There exists an upper bound* $\underline{W} < 0$ *such that if* $\frac{\partial^2 C}{\partial x_n \partial y_n} - \frac{\partial^2 V}{\partial x_n \partial y_n} < \underline{W}$, *then the optimal service volumes are such that* $\frac{dx_n^*}{dr} > 0, \frac{dx_e^*}{dr} < 0, \frac{dy_n^*}{dr} > 0,$ *and* $\frac{dy_n^*}{dr} > 0.$

Proof. See Appendix A. □

Proposition 7.1 states that if the marginal cost (inclusive of altruistic preferences) of care to new Medicare beneficiaries is decreasing in the amount of care to new Medicaid beneficiaries, then the fee bump increases the optimal amount of care to all Medicaid beneficiaries. A likely interpretation is that a blanket "accepting *all* new patients" policy was implemented by physicians that qualified for increased fees. Moreover, increased profit from higher Medicaid reimbursements may have been reinvested by physicians to facilitate increasing service volume, hence expanding access to more than just Medicaid patients.

Outside of this model, it's also possible that practice-level changes caused the observed differential change in service volume between new and established Medicare beneficiaries.

Because specialists do not qualify for increased fees for providing service codes indicated for new patients, the optimal response is to forward new Medicare patients to qualifying physicians, and less-profitable established patients to non-qualifying physicians, thus explaining the observed pattern in the data.

8 Conclusion

This paper shows physicians change their delivery of health services to one population in response to changes in payment for services delivered to another population. I find that physicians qualifying for increased fees under the Medicaid fee bump increased service volume to new Medicare patients, but decreased service volume to established Medicare patients. This pattern remains after looking at several different measures of service volume, as well as several different treatment definitions and using different identifying variation.

I extend the mixed-economy model of Sloan et al. (1978) to interpret the empirical results. Under the condition that patients offer heterogeneous marginal revenue to physicians, an increase in service volume to new Medicare beneficiaries and a decrease in service volume to established Medicare beneficiaries occurs if the fee bump also caused a simultaneous decrease in marginal cost. It's not clear, however, what drives this decrease in marginal cost.

References

Alexander, D., & Schnell, M. 2019, July. *The impacts of physician payments on patient access, use, and health* (Working Paper No. 26095). National Bureau of Economic Research. Retrieved from `http://www.nber.org/papers/w26095` doi: 10.3386/w26095

Bellemare, M. F., & Wichman, C. J. 2019. Elasticities and the inverse hyperbolic sine transformation. *Oxford Bulletin of Economics and Statistics*, *0*(0). Retrieved from `https://onlinelibrary.wiley.com/doi/abs/10.1111/obes.12325` doi: 10.1111/obes.12325

Card, D. 1992. Using regional variation in wages to measure the effects of the federal minimum wage. *Industrial and Labor Relations Review*, *46*(1), 22–37. Retrieved from `http://www.jstor.org/stable/2524736`

Carey, C. M., Miller, S., & Wherry, L. R. 2018, October. *The impact of insurance expansions on the already insured: The affordable care act and medicare* (Working Paper No. 25153). National Bureau of Economic Research. Retrieved from `http://www.nber.org/papers/w25153` doi: 10.3386/w25153

Garthwaite, C. L. 2012, April. The doctor might see you now: The supply side effects of public health insurance expansions. *American Economic Journal: Economic Policy*, *4*(3), 190-215. Retrieved from `http://www.aeaweb.org/articles?id=10.1257/pol.4.3.190` doi: 10.1257/pol.4.3.190

Glied, S., & Hong, K. 2018. Health care in a multi-payer system: Spillovers of health care service demand among adults under 65 on utilization and outcomes in medicare. *Journal of Health Economics*, *60*, 165 - 176. Retrieved from `http://www.sciencedirect.com/science/article/pii/S0167629617310123` doi: https://doi.org/10.1016/j.jhealeco.2018.05.001

Maclean, J. C., McClellan, C., Pesko, M. F., & Polsky, D. 2018, July. *Reimbursement rates for primary care services: Evidence of spillover effects to behavioral health*

(Working Paper No. 24805). National Bureau of Economic Research. Retrieved from http://www.nber.org/papers/w24805 doi: 10.3386/w24805

McInerney, M., Mellor, J. M., & Sabik, L. M. 2017, August. The effects of state medicaid expansions for working-age adults on senior medicare beneficiaries. *American Economic Journal: Economic Policy*, *9*(3), 408-38. Retrieved from http://www.aeaweb.org/articles?id=10.1257/pol.20150402 doi: 10.1257/pol.20150402

Miller, S., Altekruse, S., Johnson, N., & Wherry, L. R. 2019, July. *Medicaid and mortality: New evidence from linked survey and administrative data* (Working Paper No. 26081). National Bureau of Economic Research. Retrieved from http://www.nber.org/papers/w26081 doi: 10.3386/w26081

Sloan, F., Mitchell, J., & Cromwell, J. 1978. Physician participation in state medicaid programs. *The Journal of Human Resources*, *13*, 211–245. Retrieved from http://www.jstor.org/stable/145253

Smith, V., Gifford, K., Ellis, E., Rudowitz, R., Snyder, L., & Hinton, E. 2015. *Medicaid reforms to expand coverage, control costs and improve care: Results from a 50-state medicaid budget survey for state fiscal years 2015 and 2016* (Tech. Rep.). Kaiser Family Foundation.

Weber, C. E. 2014. Toward obtaining a consistent estimate of the elasticity of taxable income using difference-in-differences. *Journal of Public Economics*, *117*, 90 - 103. Retrieved from http://www.sciencedirect.com/science/article/pii/S004727271400111X doi: https://doi.org/10.1016/j.jpubeco.2014.05.004

Zuckerman, S., & Goin, D. 2012. *How much will medicaid physician fees for primary care rise in 2013? evidence from a 2012 survey of medicaid physician fees* (Tech. Rep.). The Kaiser Commission on Medicaid and the Uninsured.

Zuckerman, S., Skopec, L., & Epstein, M. 2017. *Medicaid physician fees after the aca primary care fee bump* (Tech. Rep.). Urban Institute.

A Proof

Proof. Physicians maximize

$$U(x_n, x_e, y_n, y_e) = p_n x_n + p_e x_e + r p_n y_n + r p_e y_e - C(x_n, x_e, y_n, y_e) + V(x_n, x_e, y_n, y_e) \quad (5)$$

Let $W = C - V$ represent "cost net of altruism." Therefore, a physician solves

$$\max_{x_n, x_e, y_n, y_e} p_n x_n + p_e x_e + r p_n y_n + r p_e y_e - W(x_n, x_e, y_n, y_e) \quad (6)$$

which has first order conditions

$$p_n = W_1(x_n^*, x_e^*, y_n^*, y_e^*) \quad (7)$$

$$p_e = W_2(x_n^*, x_e^*, y_n^*, y_e^*) \quad (8)$$

$$r p_n = W_3(x_n^*, x_e^*, y_n^*, y_e^*) \quad (9)$$

$$r p_e = W_4(x_n^*, x_e^*, y_n^*, y_e^*) \quad (10)$$

where W_k is the partial derivative of W with respect to the kth argument. Totally differentiating the above with respect to r:

$$0 = W_{11}(\cdot)\frac{dx_n^*}{dr} + W_{12}(\cdot)\frac{dx_e^*}{dr} + W_{13}(\cdot)\frac{dy_n^*}{dr} + W_{14}(\cdot)\frac{dy_e^*}{dr} \quad (11)$$

$$0 = W_{12}(\cdot)\frac{dx_n^*}{dr} + W_{22}(\cdot)\frac{dx_e^*}{dr} + W_{23}(\cdot)\frac{dy_n^*}{dr} + W_{24}(\cdot)\frac{dy_e^*}{dr} \quad (12)$$

$$p_n = W_{13}(\cdot)\frac{dx_n^*}{dr} + W_{23}(\cdot)\frac{dx_e^*}{dr} + W_{33}(\cdot)\frac{dy_n^*}{dr} + W_{34}(\cdot)\frac{dy_e^*}{dr} \quad (13)$$

$$p_e = W_{14}(\cdot)\frac{dx_n^*}{dr} + W_{24}(\cdot)\frac{dx_e^*}{dr} + W_{34}(\cdot)\frac{dy_n^*}{dr} + W_{44}(\cdot)\frac{dy_e^*}{dr} \quad (14)$$

Because W is convex, it is positive definite, and $W_{kk} > 0$ for $k = 1, 2, 3, 4$. First, note that if $W_{kk'} = 0$ for $k \neq k'$, we trivially have that $\frac{dx_n^*}{dr} = \frac{dx_e^*}{dr} = 0$ and $\frac{dy_n^*}{dr}, \frac{dy_e^*}{dr} > 0$. This makes sense: when the provision of services is unrelated (that is, if an additional service provided to a new Medicare beneficiary doesn't in any way impact a physician's ability to provide services to other beneficiaries), the fee bump increases the Medicaid service volume and leaves Medicare service volume unchanged. On the other hand, if $W_{kk'} > 0$ for some distinct $k = 1, 2$ and $k' = 3, 4$, then $\frac{dx_n^*}{dr}$ or $\frac{dx_e^*}{dr}$ are negative.

To obtain mixed signs, for example $\frac{dx_n^*}{dr} > 0$ and $\frac{dx_e^*}{dr} < 0$ as the empirical results indicate, we need $W_{13} \ll 0$—that is, marginal cost of providing care to new Medicare beneficiaries is decreasing in the amount of care provided to new Medicaid beneficiaries. Because W is strictly convex, it is W is positive definite, so

$$p_n \frac{dy_n^*}{dr} + p_e \frac{dy_e^*}{dr} > 0 \tag{15}$$

Now, suppose there's no $\underline{W} < 0$ small enough such that $\frac{dx_n^*}{dr} > 0$ while $\frac{dx_e^*}{dr} < 0$, $\frac{dy_n^*}{dr} > 0$, and $\frac{dy_e^*}{dr} > 0$. Subtracting the first equation from the third yields

$$p_n = (W_{13} - W_{11}) \frac{dx_n^*}{dr} + (W_{23} - W_{12}) \frac{dx_e^*}{dr} + (W_{33} - W_{13}) \frac{dy_n^*}{dr} + (W_{34} - W_{14}) \frac{dy_e^*}{dr} \tag{16}$$

$$\frac{dx_n^*}{dr} = \frac{p_n + (W_{12} - W_{23}) \frac{dx_e^*}{dr} + (W_{13} - W_{33}) \frac{dy_n^*}{dr} + (W_{14} - W_{34}) \frac{dy_e^*}{dr}}{W_{13} - W_{11}} \tag{17}$$

Note that

$$\underbrace{\frac{dx_n^*}{dr}}_{>0} = \frac{p_n + (W_{12} - W_{23}) \frac{dx_e^*}{dr} + (W_{13} - W_{33}) \frac{dy_n^*}{dr} + (W_{14} - W_{34}) \frac{dy_e^*}{dr}}{\underbrace{W_{13} - W_{11}}_{<0}}. \tag{18}$$

This means the numerator is negative, and we reach a contradiction, if

$$W_{13} < -\frac{p_n + (W_{12} - W_{23}) \frac{dx_e^*}{dr} - W_{33} \frac{dy_n^*}{dr} + (W_{14} - W_{34}) \frac{dy_e^*}{dr}}{\frac{dy_n^*}{dr}}, \tag{19}$$

so $\underline{W}$ exists. $\square$