The Effect of Nurse Practitioner Scope of Practice on Health Care Utilization and Health: Evidence from Law Changes and Patient Moves

Thomas G. Koch and Nathan Petek*
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Abstract

About half of US states require nurse practitioners (NPs) to have a contractual relationship with a physician in order to provide health care. Whether such constraints on NP scope of practice benefit patients has been unclear. We use Medicare and commercial insurance claims data along with law changes and patient moves to estimate the effect of expanding NP scope of practice on the quantity and price of health care and patient health. We find no evidence patients are harmed and some evidence of health benefits for Medicare beneficiaries, with no effect on access to outpatient care or long-term effect on office visit prices.

Keywords: Nurse practitioners, Scope-of-practice laws, utilization, health outcomes, occupational licensing

JEL Codes: I11, I18, J44

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1 Introduction

Professional licensing and quality-centric regulation generally balances a distinct trade-off. Because quality may be hard for consumers to discern, licensing could guarantee a baseline level of quality. Alternatively, licensing regimes create a barrier to entry, and may restrict access to services and competition among service providers. As a second-best result, the optimal policy balances the former against the latter.

The main policy lever for medical professional licensing in the US is the delineation of the scope of practice (SOP) legally available to medical professionals with different levels of training. Recent policy advocacy has focused on expanding the scope of practice available to non-physician health care providers, like nurse practitioners (NPs). As of January 2018, NPs could practice without state-mandated physician supervision or a contractual relationship with a physician in just under half of the states in the US (Pearson, 2004-18). Proponents of expanded scope of practice have argued that allowing NPs to practice independently will increase competition, reduce prices, and increase access to care (Adams & Markowitz, 2018; Gilman & Koslov, 2014; Xue & Intrator, 2016). However, organizations like the American Medical Association have consistently opposed independent practice for NPs and argued it could compromise patient safety (Iglehart, 2013).[1]

We measure the consequences of recent reforms to medical licensing in the United States that increased NPs scope of practice using up to 17 years of Medicare administrative data and 9 years of commercial health insurance claims. Together these data allow us to accurately measure health care utilization, health care prices, and health for patient populations that comprise a large portion of health care spending. We estimate the effect of expanding NP scope of practice using both state law changes in a difference-in-differences framework, and a patient mover design that exploits patient moves between states with different scope of practice laws conditional on the effect of moving between states with the same scope of

[1]See also, Maria Castellucci, December 14, 2017, "Advanced practitioners oppose AMA effort to limit their practice authority" *Modern Healthcare* and AMA policy "Independent Practice of Medicine by Advanced Practice Registered Nurses" H-35.988, last modified in 2018.

practice laws. An advantage of this mover design is that most states have had their scope of practice laws in place for many years, which allows for plausible estimates of the effects of independent practice in a longer-term equilibrium where the supply side of the health care market has had sufficient time to create organizational forms that reflect the possibility independent practice. Finkelstein *et al.* (2016) finds that demand for health care services adjust quickly when patients move; if so, the mover analysis reflects outcomes in the new, broader scope of practice equilibrium.

We find that expansions of NP scope of practice that have allowed nurse practitioners to provide care independently have not harmed patient safety, as organizations like the American Medical Association argued. In particular, we find no evidence that law changes that expanded NP scope of practice increased inpatient admissions, ER visits, readmissions, or deaths which all would be consistent with worse patient health. In fact, inpatient admissions and inpatient spending in the over-65 population actually fall significantly a few years after NP scope of practice is expanded, which is consistent with improved health. These null effects are not due to a lack of power and allow us to reject moderate increases in inpatient care and ER visits. However, we find the law changes did little to expand access to care as measured by office-based visits, number of filled prescriptions, and prescription spending. We find evidence of short-term reductions in average office visit prices following the law changes, but no persistent effect. We find suggestive evidence that allowing NPs autonomous practice caused a decrease in opioid use.

We check if the evidence of limited effects on access to care holds in places where we hypothesize expanded scope of practice may be more important, such as rural areas, primary care physician shortage areas, and counties where NPs are a large share of providers. We find outpatient care does not increase significantly in those areas relative to areas where we expect the effect to be smaller. Our findings using the patient mover research design are generally consistent with the difference-in-differences analysis, but they can only reject fairly large changes in our proxies for health. This design does, however, show some evidence of

increased visits to NPs who bill under their own provider number, which is consistent with the laws changes affecting practice patterns or patient utilization of providers in the longer-term. The lack of evidence of harm to patients from expanding NP scope of practice laws paired with some limited evidence of health benefits suggests states do not need to limit NPs' scope of practice in order to protect patients. Although, the fact that we cannot reject moderate health effects in the mover design suggests some caution about the very long term effects of expanded scope of practice on health.

The licensing of medical professionals, and state regulation of occupations generally, has long been a subject of interest to economists. Recent studies have exploited state law changes using a difference-in-differences design to assess the consequences of scope of practice reform (Alexander & Schnell, 2019; Hamilton III, 2017; Kleiner *et al.*, 2016; McMichael, 2018; Stange, 2014; Timmons, 2016; Traczynski & Udalova, 2018). That work found mixed effects of expanding the NP scope of practice on health care use (Hamilton III, 2017; Timmons, 2017; Traczynski & Udalova, 2018), lower prices for well-child visits (Kleiner *et al.*, 2016), reduced use of opioids (Hamilton III, 2017; McMichael, 2018), increased prescribing of psychiatric drugs in under-served areas (Alexander & Schnell, 2019), and some evidence of health benefits in the form reduced suicide rates and better self-reported mental health in underserved areas (Alexander & Schnell, 2019) and reduced ER visits for ambulatory sensitive conditions (Traczynski & Udalova, 2018). There is evidence that expanding NP scope of practice has additional benefits including reduced administrative burdens (Traczynski & Udalova, 2018) and lower cost retail clinics (Spetz *et al.*, 2013).

The most closely related work to ours is Hamilton III (2017); Traczynski & Udalova (2018); Stange (2014) who use difference-in-differences designs and state law changes to study the effect of increased NP scope of practice that allows NPs to practice fully independently (Traczynski & Udalova, 2018) or prescribe controlled substances (Hamilton III, 2017; Stange, 2014) on health care utilization (Hamilton III, 2017; Traczynski & Udalova, 2018; Stange, 2014), prices (Stange, 2014), and health (Hamilton III, 2017; Traczynski & Udalova, 2018)

largely using the Medical Expenditure Panel Survey.[2] Like Traczynski & Udalova (2018) we focus on law changes that allow NPs to practice fully independently rather than just prescribe controlled substances. Our paper makes makes a number of contributions relative to this existing work including using two large administrative claims data sets rather than survey data, which plausibly provides more accurate measures the variables of interest.[3] The administrative data also allow us to test how the effects of the policy vary in different populations, e.g., Medicare versus commercially insured patients, estimate effects on a wide range of prices, and implement the mover identification strategy which allows us to study the effects of these policy changes after the supply side of the market has plausibly adjusted to NPs having broader scope of practice.

The trade-offs in licensing for medical professionals are symptomatic of the arguments made for a broader range of professions. The growth in professional licensing across industries and occupations has been documented in White House Report (2015); Kleiner & Krueger (2013). The literature on health care provider scope of practice includes other professions (e.g., midwifery) and other types of outcomes, such as the relative income of the different professions, among other the labor market consequences of occupational licensing (DePasquale & Stange, 2016; Anderson *et al.*, 2016; Markowitz *et al.*, 2017; Perry, 2009; Kleiner *et al.*, 2016). The former studies are useful for comparing our results against other, similar policy levers.

Our paper is tied to a broader literature on the determinants of provider ability or

[2]Traczynski & Udalova (2018) focus on law changes that allow NPs to practice independently, while Hamilton III (2017); Stange (2014) focus on law changes that allow NPs to prescribe controlled substances, although Hamilton III (2017) also studies law changes that allow NPs to both practice independently and prescribe controlled substances for opioid outcomes. Stange (2014) also studies the effect of increasing the supply of NPs and PAs interacted with a time-invariant measure of SOP.

[3]We note other work has used aggregate administrative data including Timmons (2017) who used state-level Medicaid data. Alexander & Schnell (2019) have administrative data on suicides and prescription drugs, but their work is distinct from ours in their focus on mental health. Kleiner *et al.* (2016) have administrative price data, but focus on a fairly narrow set of prices, i.e., the price of a well-child visit. We are aware of a conference presentation by Ulrike Muench and Christopher Whaley in 2018 titled "The Effects of Nurse Scope of Practice Laws on Healthcare Spending, Prices, and Access" that uses Health Care Cost Institute commercial claims data to study the effect of NP SOP laws on health care utilization and prices, but we are unaware of a publicly posted version of this paper.

style and its effects patient outcomes (Agha *et al.*, 2018; Molitor, 2016; Currie *et al.*, 2016; Currie & MacLeod, 2017; DesRoches *et al.*, 2013; Tu, 2017). Our analysis using the mover identification strategy is related to a larger literature in health economics that exploits patient or provider moves to estimate plausibly causal effects on a variety of outcomes (Agha *et al.*, 2018; DesRoches *et al.*, 2013; Finkelstein *et al.*, 2016; Hull, 2018; Molitor, 2016; Tu, 2017).

2 Background

As of January 2018, NP scope of practice laws allowed experienced NPs to practice independently of physicians in just under half of US states. The details of the scope of practice laws in the remaining states vary, but they generally prevent NPs from practicing or prescribing without some sort of physician supervision or without a collaborative practice agreement with a physician (Pearson, 2004-18). These rules place nontrivial restrictions on NPs, even in states where the extent of supervision required is quite limited, because they require NPs find, and in some cases pay, physicians to sign a practice agreement (Gilman & Koslov, 2014). In states where the requirements are more onerous (e.g., require physicians to review NPs' charts), they can further restrict the supply of NPs and cause physicians to spend time on administrative tasks they might otherwise spend providing patient care (Gilman & Koslov, 2014; Traczynski & Udalova, 2018).

There are a number of plausible mechanisms through which expanding NP scope of practice could affect patient outcomes.[4] Expanded scope of practice could increase access to care by increasing the supply of NPs in an area by making those states more attractive places for NPs to practice. They could also increase the supply on the intensive margin for both NPs and physicians by reducing the amount of time spent on supervision, allowing for more efficient forms of division of labor and collaboration, and increasing the incentive to spend time on patient care. The effects of increasing the supply of care could be positive or

[4]See Markowitz *et al.* (2017) for a discussion of mechanisms that this paragraph draws on, as well as Gilman & Koslov (2014); Traczynski & Udalova (2018).

negative. Increased access to care could improve patient outcomes by providing more access to high quality providers or harm patients by entrusting their care in NPs who may have inadequate training to practice without state mandated physician supervision. In addition, the increased supply could result in increased competition between providers that raises the access to or quality of care provided by existing providers and reduces prices.

3 Data

3.1 Scope of Practice Laws

We adopt the existing practice of translating legislation governing providers' scope practice into several dichotomous outcomes. We are aided in this exercise by the existing literature (Traczynski & Udalova, 2018; Hamilton III, 2017; Kleiner *et al.*, 2016; Kuo *et al.*, 2013; McMichael, 2017), trade publications that track changes in NP scope of practice (Pearson, 2004-18), various news articles, and the laws themselves. These sources provide us with dichotomous characterizations of nurse practitioner and physician assistant scope of practice regulations along a number of dimensions. We characterize the NP regulations as whether the NP has independent prescription authority, the ability to practice independently, or both independent prescription and practice authority ("fully independent"). We follow Traczynski & Udalova (2018) in focusing our analysis on the transition from less than full independence to full independence because those transitions remove the requirement that NPs have a contractual relationship with a physician. NPs are plausibly substitutes for physicians assistants (PAs) who are mid-level practitioners that also provide health care in primary care settings. We characterize the PA scope laws by the extent to which they are allowed to practice remotely from their supervising physician and use the PA scope of practice laws as controls.

We use law changes that happened between 1999 and 2013.[5] In particular we use transi-

[5]Our outcome variable data ends in 2015 so we do not use law changes that happened after 2013 so we have a sufficient post-period to measure the effect of the law change.

tions to full independence that occurred in 2001 (Washington), 2004 (Idaho), 2010 (Colorado, Hawaii, & Maryland), 2011 (North Dakota & Vermont), and 2013 (Nevada & Rhode Island). In some of these states NPs already had independent practice authority and obtained full independence by receiving independent prescriptive authority. In other states NPs obtained both simultaneously. These states provide the variation in scope of practice laws that identifies our difference-in-differences model.

The movers model is identified off of moves between states with different scope of practice laws. During the sample period there is substantial variation in these laws. For example, during the 2005-2012 period, when we have detailed Medicare claims data, NPs are fully independent in about 29% of state-years, and have less than full independence about 71% of state-years.

3.2 Claims Data

We seek to understand the consequences associated with scope of practice regulations by constructing utilization and spending measures from the medical claims of a 5% sample of fee-for-service (FFS) Medicare beneficiaries at the beneficiary-year level from 1999-2015, more detailed Medicare beneficiary claim level data from 2005-2012, and the Truven MarketScan employer sponsored insurance (ESI) commercial claims data from 2007-2015 provided by © 2016 Truven Health Analytics Inc., an IBM Company. The MarketScan database is a convenience sample of claims from certain large private employers and managed care organizations.

Using the Medicare and MarketScan claims data to address our questions has both benefits and limitations. These data sets are complementary: they allow us to study both the elderly and the ESI population. A significant benefit of the data is that it is extensive. The samples cover over 2.5 million Medicare Fee-for-Service (FFS) beneficiaries per year and 40 million commercial patients per year. Both data sources allow us to follow beneficiaries over time. The Medicare data has some benefits over the MarketScan data in that beneficiaries

typically only exit the data due to death or conversion into the Medicare Advantage program rather than though employment changes. As are result, we can reliably follow Medicare beneficiaries when they move between states and use those moves to estimate the effects of NP SOP laws, while we cannot reliably track MarketScan patients after they move. The Medicare data also has sub-state-level geographic information about patients which allows us to study how effects of SOP laws vary with characteristics of a beneficaries' community. The limitations of the Medicare data are well-established. Because we only consider the Medicare FFS population, we not able to measure the consequences for beneficiaries on Medicare Advantage. This means we cannot estimate the effect of SOP regulations on prices in this sample because Medicare FFS is a price setter.

Annual baseline eligibility files are our first source of Medicare data. These files report when the beneficiary was on Medicare FFS, as well as the reason for their eligibility. We focus on the old-age eligible; i.e., those sixty-five years old or older who are enrolled in Medicare FFS for an entire year. These files also provide a ZIP code and state of residence, which allows us to assign them to a SOP law. We use the beneficiary geography data to identify beneficiaries that move between states and beneficiaries that live in rural counties, primary care physician (PCP) shortage counties, and counties where a large share of primary care providers are NPs.[6] We use similar files for the MarketScan specifications except we do not observe the zip code or county of residence. In the MarketScan sample we also restrict the analysis to individuals enrolled in insurance for an entire year. To limit the MarketScan data to a manageable size while keeping individuals with relatively long panels we drop individuals who are enrolled for at least three years in total and exclude patients in seven states that both do not change their SOP laws during our sample period and that not border states that change their laws.[7]

Outcomes in the Medicare data come from a variety of sources. We have annual utiliza-

[6]Rural counties are counties that were classified as rural in 2013, PCP shortage areas were defined as shortage areas in 2010, and the NP share of primary care providers in a county is also from 2010. Each of these variables was constructed using the 2015 Area Resource File.

[7]The seven states are NC, SC, GA, FL, KY, IN, and MI.

tion and chronic condition summary files from 1999-2015. More finely detailed utilization measures, such as office visits by type of provider, were captured using claim-level data aggregated to the person-year level from 2005-2012. We take a similar approach to building the MarketScan data, for which we start with enrollment data and combine that data with inpatient and outpatient claims aggregated to the person-year level. In both data sets Evaluation and Management (E & M) visits and well visits are limited to visits provided by PCPs, NPs, and PAs and are also measured by type of provider: MD, NP, and PA. These are an important measure of the amount of care provided to beneficiaries along the extensive margin, since they are often the first service provided when a patient is seen. Also, when prices are set by the market, their prices are a key outcome of that market's negotiations, since they represent a large portion of PCP revenue.

The amount of care provided by NPs appears to be significantly under counted in the claims data. We believe this is because when an NP provides services under the supervision of a physician, the care can be billed to Medicare as if the physician provided the care. Further, Medicare pays NPs 85 percent of the physicians rate, which provides a strong financial incentive for supervised NPs to bill as physicians (DesRoches *et al.*, 2013). Thus, our analyses of this data are subject to the caveat that they reflect care billed as, but not necessarily provided by, these distinct sets of providers.

We measured Medicare prescriptions using Part D and thus we are only able to observe Medicare prescriptions starting in 2006, when Medicare Part D began providing coverage for Medicare beneficiaries. For both Medicare and MarketScan we analyze the prescription data by a drug's controlled substance schedule status, which is the national standard by which drugs are grouped by their accepted medical use and their ability to create dependence.

All logged outcomes are computed as the natural log of the underlying data plus one to avoid dropping zeros. In processing the MarketScan data, after aggregating observations to the beneficiary-year level, we drop values that are likely to be errors such as negative expenditures and office visit prices under $10. We then winsorize all counts, expenditures,

and prices at the 1st and 99th percentiles of the non-zero values to adjust for implausibly small, non-zero values and implausibly large values.

4 Empirical Strategies

4.1 Difference-in-Differences

We estimate the effect of NP SOP laws on patient outcomes using a difference-in-differences design. Let y_{it} be an outcome such as outpatient visits or inpatient admissions for person i in year t, and D_{st} be an indicator for whether NPs are fully independent in state s in year t. For some law changes both practice and prescriptive authority are expanded simultaneously while in others only prescriptive authority is expanded and NPs already have independent practice authority. Our estimates are identified off a combination of those two types of law changes. We control for beneficiary characteristics using beneficiary fixed effects, γ_i, and age fixed effects, α_{it}; state characteristics using state fixed effects, δ_s, and a vector of changes in PA scope of practice laws, ρ_{st}; and time trends using time fixed effects, τ_t. An error term, ε_{it}, is assumed to be orthogonal to the regressors. In the Medicare data we also include an indicator for whether the beneficiary's county of residence is rural, r_c, but we cannot construct it in the MarketScan data because we lack county of residence information. We estimate equation 1.[8]

$$y_{it} = \beta D_{st} + \gamma_i + \alpha_{it} + \delta_s + \rho_{st} + \kappa r_c + \tau_t + \varepsilon_{it} \tag{1}$$

The parameter β is an estimate of the effect of allowing NPs full independence on our outcomes of interest. It is identified off of both law changes and people who move between states with different scope of practice laws. We use the full sample of beneficiaries in our main results, but show the results are robust to limiting the sample of beneficiaries to those who never move between states.

[8]The regression models are estimated using the Stata command reghdfe described in Correia (2016).

A key assumption required to interpret β as a causal effect of law changes on the outcomes is that absent the law changes, the trends in the outcomes in the treated and control states would be the same. We look for evidence that assumption is violated by regressing our outcomes of interest on leads and lags of the state law variable using equation 2 where the first lead is normalized to zero. We estimate only one lag for outcomes using Medicare data when the sample ends in 2012 because of limited post-law-change years, $l = 1$, and four lags for the other Medicare outcomes and the MarketScan sample, $l = 4$. The leads and a lags are constructed to only use within state-changes in SOP laws, so β_j is identified off of law changes alone, not law changes and movers.

$$y_{it} = \sum_{j=4}^{-l} \beta_j \Delta D_{s(t-j)} + \gamma_i + \alpha_{it} + \delta_s + \rho_{st} + \kappa r_c + \tau_t + \varepsilon_{it} \tag{2}$$

A pre-trend in the leads of ΔD_{st} would indicate that the common trend assumption is violated. We show that for most of our key outcomes, there is little evidence of such a trend. A possible source of bias the pre-trend analysis would miss is an event that exactly matches the timing of the law change and affects the outcomes of interest. Our year fixed effects and controls for PA law changes mean that in order for such an event to bias our results, it would have to be at the sub-national level and it could not involve changes to the scope of practice of PAs.

4.2 Movers

4.2.1 Movers Model

We model the effect of NP scope of practice laws on health care consumption and health outcomes, y_{it}, as a function of person fixed effects, γ_i, state fixed effects, δ_s, local area characteristics like ruralness, r_c, year fixed effects, τ_t, and time varying person characteristics, x_{it}, which includes age fixed effects, α_{it}, and leads and lags of an indicator for any interstate move. The independent variable of interest is still D_{st}, which capture moves between states

where NPs are fully independent and those in which they are not. It is coded as 0 for individuals who live in a state with narrow scope of practice and 1 for individuals who live in states with a broader scope of practice. It is constructed so it only uses variation in scope of practice from moves, i.e., it excludes variation in scope of practice from law changes. We only estimate this model for the Medicare data because we cannot reliably track people across moves in the MarketScan data. The sample includes all Medicare beneficiaries used in the difference-in-differences analysis who move between states zero or one times. We estimate the model using equation 3.

$$y_{it} = \beta D_{st} + \gamma_i + \delta_s + \rho_{it} + \kappa r_c + \tau_t + x_{it}\Psi + \varepsilon_{it} \tag{3}$$

The variable x_{it} controls both for the effect of increasing age on the outcomes, α_{it}, any changes in the outcomes that tend to occur around interstate moves, and for differences in the outcome between movers and non-movers because it includes leads and lags of an indicator for any interstate move.

Hull (2018) lays out the assumptions required for a mover design to identify a causal effect of treatment. In models like ours with a binary treatment, these designs identify causal effects if there are no persistent effects of the last location on the outcome; and, if but-for the move, the trends in the outcome variable would be the same for movers between states with different scope of practice laws and movers between states with the same scope of practice laws. We look for evidence the common trends assumption is violated using models with leads and lags of our treatment variables. To do so, we estimate equation 4.

$$y_{it} = \sum_{j=4}^{-4} \beta_j \Delta D_{s(t-j)} + \gamma_i + \delta_s + \rho_{it} + \kappa r_c + \tau_t + x_{it}\Psi + \varepsilon_{it} \tag{4}$$

A pre-trend in the leads of the independent variable of interest would indicate that the common trend assumption is violated. We show that for most of our key outcomes, there is no trend. A possible source of bias the pre-trend analysis would miss is an event that

exactly matches the timing of the move and affects the outcomes of interest. Our controls for leads and lags of moves eliminate that concern as long as the shock is not specific to moves between states with different SOP laws.

4.2.2 Movers Identification

The individual fixed effects, γ_i, are identified by within person variation in the panel. The time fixed effects, τ_t, the age fixed effects, α_{it}, and the indicator for a rural county, κ, can all be identified using cross-sectional variation. The state fixed effects, δ_s, are separately identified from the individual fixed effects, γ_i, using cross-state moves as long as there are individual moves involving each state. The leads and lags of interstate moves in x_{it} are identified using movers between states with the same NP scope of practice laws. The parameter of interest β is identified off of moves between pairs of states with differing scope of practice laws. A move from a state with broader to narrower scope of practice (or vice versa) of each type is sufficient to identify the parameters given there are moves that identify leads and lags of any interstate moves and the state fixed effects.

The key issue in interpreting the parameters is that Finkelstein *et al.* (2016) have shown that differences in health care utilization across local areas affects health care utilization even conditional on individual fixed effects. As a result, if on the state level, SOP laws and spending were correlated for reasons other than the passage of the law and δ_s does not adequately control for the level of the outcome in each state, the correlation between SOP laws and spending would bias our results. Fortunately, because δ_s is identified off of movers, differences in the fixed effect for movers and non-movers is not a problem. Since δ_s is identified from the changing health care utilization patterns of movers, it could be biased if there is some persistence or habit formation of past place on current consumption, but Finkelstein *et al.* (2016) suggests that is not likely the case. Thus, our movers estimates should account for the shifts in supply and demand due to this policy.

A related concern is if people move to states with narrow scope of practice laws they

disproportionately choose places with low utilization relative to the rest of the state and when they move to states with broad SOP laws they choose places with high utilization relative to the rest of the state (or vice versa). Although, this is possible, it is not obvious why this would be the case.

5 Cross-Sectional Comparisons

We start by reviewing some descriptive patterns of health care utilization by state policy. Table 1 reports the average spending, prescribing, and health outcomes for Medicare beneficiaries by the extent to which NPs are able to practice independently. The equivalent table for commercially-insured beneficiaries in the MarketScan data is in Table 2. These conditional summary statistics indicate the sample means for these outcomes, which will help guide interpretation of the results. Medicare beneficiaries in our sample have, on average, one half ER visit per year, have 3.5 evaluation and management visits (i.e., standard PCP visit) a year, and 17 prescribing events (filled prescriptions, including refills) per year. The mortality rate for Medicare beneficiaries is around five percent. These sample means are typically lower for the (younger) beneficiaries in the MarketScan sample. The one exception here is checkups (well-visits), which are common and frequent for young children.

These are also the static patterns that the fixed effects of the difference-in-differences research design will difference out. For example, inpatient spending is lower in states with independent practice versus no independence. The same is true for imaging and testing spending. A direct, uncontrolled comparison between patients in any of the policy regime would be confounded by the geographic variation in medical spending and practice between states.

6 Main Results

6.1 Health

Opponents of expanding NP scope of practice argue that allowing NPs to practice without state-mandated supervision or collaboration with physicians is unsafe for patients (Iglehart, 2013), while proponents argue expanding NP scope of practice is unlikely to harm patients (Adams & Markowitz, 2018; Gilman & Koslov, 2014; Xue & Intrator, 2016). In Table 3 we test whether expanded NP scope of practice leads to worse health by estimating the effect of full independence on measures of intensive health care utilization that we expect to be correlated with health and a direct measures of health, death. The table summarizes the results of both the difference-in-differences (equation 1) and patient mover (equation 3) models, and the Medicare and commercial claims data sets.

We expect that if allowing independent practice compromised patient safety, we would see significant increases in inpatient admissions, inpatient spending, readmissions, ER visits, and potentially deaths after states expanded NP scope of practice. In the Medicare difference-in-differences analysis reported in the top panel of Table 3, we see decreases in these outcomes that are sometimes marginally significant, although never statistically significant at the $p = 0.05$ level. The magnitudes of the point estimates are are relatively large, e.g., the decrease in inpatient spending is about 8 percent. Results are similar for specifications that drop movers (Online Appendix Table A.1).

Figure 1 shows event study plots of the same outcomes. There is little evidence of trends that would bias the main difference-in-differences results. The figure shows that inpatient admissions, inpatient expenditures, and readmissions fall for several years after the law change and all three decreases are consistently statistically significant by three years after the event. This is not true of ER visits and deaths, where we never see statistically significant decreases. The longer term, statistically significant, decreases in inpatient admissions, spending, and readmissions without a corresponding increase in deaths is consistent with expanded NP

scope of practice causing improved health.

The second panel of Table 3 shows the effect of expanded NP scope of practice on commercial inpatient admissions, inpatient spending, and ER visits.[9] The point estimates are small in magnitude and never statistically significant. We find no statistically significant pre-trends or longer term effects in the post-period (Table 3 and Online Appendix Figure A.1). The third panel of Table 3 shows the effect of moving to a state with a broader scope of practice on the same set of outcomes as the Medicare difference-in-differences. Again the results are statistically insignificant at the $p = 0.05$ level with no evidence of statistically significant pre-trends or longer term effects in the post-period (Online Appendix Figure A.2). However, in this specification the point estimates are positive, in some cases not small, and for both log inpatient spending and mortality, marginally significant.

The null effect of the two difference-in-differences specifications reported in Table 3 is not simply due to a lack of power. For example, we can reject, at the 95 percent level, almost any positive increase in Medicare inpatient spending. We can can reject an increase in commercial inpatient spending of about 0.7 percent for a population that spends an average of $864 on inpatient care per year. These results suggest that expanding NP scope of practice does not harm either Medicare or commercial patients for several years after the event. This contrasts with the Medicare mover results. The coefficients are roughly as precisely estimated as the difference-in-differences results, but because the coefficients are positive we can only reject an increase in inpatient spending of about 16 percent or an increase in inpatient admissions of about 8 percent.

Hamilton III (2017) estimates that allowing NP's to prescribe controlled substances reduces hospital admissions by a statistically insignificant 1.7 percent using the Medical Expenditures Panel Survey, which is between our findings of 7 percent decrease in the Medicare data and a 1 percent decrease in the commercial data. Our estimates for Medicare ER visits,

[9]Unlike the Medicare data, the MarketScan data does not include a readmission variable so we do not report readmission results. We expect that death is not likely to be a useful health measure for this population in this data set so we also do not include it.

a statistically insignificant decrease of 0.016 visits, is roughly in line with the estimates of Traczynski & Udalova (2018) using the MEPS data, −0.013 visits, while our estimates for commercial visits a statistically insignificant increase of about 0.011 visits.

Together these results suggest that at least for several years after the law change, it is unlikely that expanding NP scope of practice causes significant harm to patients. There is also some evidence of health benefits for Medicare patients in particular. Our estimates are also consistent with the literature, which also finds little evidence of harm and some evidence of benefits from expanding NP scope of practice.

6.2 Outpatient Care

A possible benefit of increasing NP scope of practice is that it will lead to greater access to care and thus increased utilization of outpatient care. Increased outpatient care is also a plausible mechanism for the improvements in health detected for Medicare patients. We estimate the effect of expanding NP scope of practice on measures of outpatient care in Tables 4-6.

Table 4 summarizes outpatient utilization results of both the difference-in-differences (equation 1) and patient mover (equation 3) models, and the Medicare and commercial claims data sets on measures of the quantity of outpatient care. The top two panels shows that expanding NP scope of practice does not increase the amount of outpatient care received by Medicare and commercial beneficiaries as measured by primary care Evaluation and Management visits, which we call "office visits", well visits ("checkups"), prescriptions, or prescription spending.[10] Figure 2 shows event study plots of these outcomes using Medicare data and Online Appendix Figure A.3 shows the analogous results using commercial data. There is little evidence of trends that would bias the main difference-in-differences results and no evidence of an effect of the law changes on each outcome. These results suggest that the law changes do not increase access to care to an extent that the amount of outpatient

[10]Results are similar for specifications that drop movers (Online Appendix Table A.2).

care increased, and that the improvements in the health of Medicare patients are not driven by increased outpatient health care utilization.

The results for movers in the bottom panel of Table 4 show significant decreases in office visits and increases in prescription spending, and no effect on well visits. Prescriptions also increase but the effect is not statistically significant. Online Appendix Figure A.4 shows no evidence of pre-trends for these outcomes. This pattern of results is consistent with substituting office visits for prescriptions, and does not clearly suggest an increase or decrease in access to care.

One concern with expanding scope of practice is that it could lead to over-testing because NPs have less training than physicians and may lean on testing to make diagnoses. Alternatively, increased testing could be beneficial if it is a result of increased access to needed care. The last two columns of Table 4 and the analogous event study plots in Figure 2 and Online Appendix Figures A.3-A.4 show no evidence that increasing scope of practice leads to increased spending on imaging or testing. Although, imaging spending falls significantly for commercial patients, Online Appendix Figure A.3 suggests it is driven by a pre-trend.

Although we do not see effects on aggregate outpatient utilization, its possible there could be important compositional effects that are hidden by the aggregate results. We first look for evidence of substitution between different types of practitioners and then check if there are differential effects of expanded NP scope of practice on controlled substances prescriptions.

The data present inherent limitations in measuring substitution between different types of providers. Each claim lists the provider by the provider's National Provider Identifier (NPI). Per Medicare's billing rules, when an NP provides service under the supervision of a physician, the care can be billed as if the physician provided the care. Further, Medicare pays allied professionals eighty-five cents on the dollar for care reported (billed) as provided an allied professional, vis-a-vis that provided by (billed as) an physician. This provides a strong financial incentive for supervised allied professionals to bill as their supervising physician when they are supervised (DesRoches *et al.*, 2013). Thus, the effects we measure reflect

the differences across care billed as, but not necessarily provided by, these two distinct sets of providers. This can be informative, insofar as this reflects differentiation between the billed-as allied providers, which may be more distinct from allied providers that bill as their supervising physicians.

There is little evidence of substitution between different types of practitioners in either the Medicare or commercial difference-in-differences results (Online Appendix Tables A.3 and A.4). However, in the mover analysis we do see significant increases in office visits to NPs as well as increases in checkups and prescriptions that are not significant at the 5% level. There are also significant decreases in office visits and checkups to PCPs (Online Appendix Table A.5). The significant decreases for PCPs are much larger than the increase for NPs, which is why visits fall on net. This suggests that in the longer term, full independence affects how health care provision is organized. However, as noted above, this analysis must be interpreted with some caution because NPs starting to bill independently rather than under a physician's NPI number could lead to an estimated increase in visits without NPs actually seeing additional patients.

Controlled substances are drugs whose consumption has the potential for abuse and dependence. The DEA regulates the prescribing of these drugs and classifies them into five schedules depending on the likelihood they will cause dependence and be abused. Only drugs in schedules II-V can be prescribed. We hypothesize that NPs may prescribe controlled substances differently than physicians because of their different experience and training, that expanding NP scope of practice could affect how they prescribe scheduled drugs, and that these potential differences could have meaningful effects on patient health.

Table 5 breaks down the effect on prescriptions by the schedule the drug belongs to which is a proxy for its potential for abuse using the difference-in-differences (equation 1) and patient mover (equation 3) models, and the Medicare and commercial claims data sets. The first column of the top panel shows the effect of expanded scope of practice on narcotic schedule II drugs prescribed to Medicare beneficiaries. The drugs include powerful opioids

like Dilaudid, OxyContin, and fentanyl.[11] We see significant decreases in prescriptions of about 0.06 prescriptions per person, which is about a 10 percent decrease in narcotic schedule II prescriptions. This result implies that expanding NPs scope of practice substantially reduces prescriptions of the opioids most prone to abuse. There are also significant increases in non-narcotic schedule II drugs which are largely stimulants, but its effect is over an order of magnitude smaller than the effect on schedule II narcotic drugs. Event study plots support the finding that schedule II prescriptions fall, although part of the decrease happens in the year before the event (Figure 3). Decreased opioid prescriptions could contribute to reduced hospitalizations but is unlikely to fully explain the reduction because there are approximately 0.44 fewer inpatient admissions for each less opioid prescription.

There are no significant effects in the remaining categories including narcotic schedule III drugs that include opioids with less than 90 mg of codeine; non-narcotic schedule III drugs which includes drugs such as ketamine, anabolic steroids, testosterone; schedule IV drugs which includes some narcotic drugs like Darvocet as well as anti-anxiety drugs like Valium and sleep aids like Ambien; and schedule V drugs that may include small amounts of narcotics like some cough suppressants and antidiarrheal drugs.[12] Event study plots provide little evidence of effects in other categories (Figure 3). The mover analysis shows no evidence of reduced prescriptions of any of the categories of controlled substances and the event study plots generally support these results (Online Appendix Figure A.5).

We have somewhat less detailed prescription data in the commercial sample because of how the drugs are coded. In particular, we cannot separate narcotic from non-narcotic drugs for both schedules II and III. We find no significant effects on schedule II, IV, or IV drugs (Table 5). There is a negative and statistically significant estimate for Schedule III prescriptions. This category includes some opioids in lower doses than schedule II opioids as well as non-opioids with potential for abuse like ketamine and anabolic steroids. The decrease in Schedule III prescriptions is 8 percent (0.022 against a sample average of about

[11] https://www.deadiversion.usdoj.gov/schedules/

[12] See, https://www.dea.gov/drug-scheduling.

0.27). However, the event study plots from Schedule III prescriptions show evidence of a pre-trend so this result may not be causal (Online Appendix Figure A.6).[13]

We find little evidence that expanding scope of practice increases outpatient healthcare utilization, but it may decrease the prescribing of opioids. Traczynski & Udalova (2018) found that increased NP scope of practice increased checkups while Hamilton III (2017) shows decreases in total office-based visits. The null effect on outpatient visits that we estimate is precise and can reject effects of the magnitude of Hamilton III (2017).

Hamilton III (2017) finds a larger decreases in opioid prescriptions following increases in NP scope of practice that allow NPs to prescribe controlled substance than we do, while the McMichael (2018) effects are smaller. The standard caveats apply—our estimates correspond to a later time period with later policy variation and the effect of these policies may have varied over time. Second, we focus on the Medicare FFS population, whereas Hamilton III (2017) uses the MEPS, which surveys the US civilian, non-institutionalized population. Finally, our results are difficult to compare to Hamilton III (2017), since we construct annual measures of health and utilization to map into the state-by-year nature of exposure to the policy change in the standard difference-in-differences research design. Hamilton III (2017) constructs biannual measures due to the instrument design of the MEPS.

6.3 Prices

A significant benefit of the MarketScan data is that it allows us to measure the effect of expanding NP scope of practice on prices for office visits. It is plausible that a broader scope of practice will lead to lower prices either through increased competition among primary care providers or increased use of independently practicing NPs, who tend to be paid less per visit, providing a larger share of services. To measure the effect of expanding NP scope of practice on prices, we compute average prices per visit across all office visit (evaluation and management) codes and for each office visit code.

[13]Consistent with our results for Medicare patients, we find no effect of expanding NP scope of practice on visits by type of provider: NP, PCP, or PA (Appendix Table A.4)

The log average price of office visits reflects the average price of the average visit. Because the provider has some ability to determine the visit duration and corresponding billing code, changes in NP prescription authority could both change the price per code, but also the distribution of the codes billed. That is to say, the average price could change for two reasons: conditional on the billing code, the price changes; or the average billing code changes. The estimates of equation (2) on the prices of evaluation and management codes can be found in Figure 4.

There is some evidence that expanding NP scope of practice reduces costs in the short-term, but that effect does not persist. Figure 4 shows the average price per visit fall significantly in the year of the law change, but that effect does not persist and is no longer significant by the following year. The short-term price decrease appears to be drive by decreases in the price of 15 and 25 minute existing patient visits, which are the most frequently billed evaluation and management codes (15 or 25 minute visits for established patients; a 3 or 4 in the fifth digit, and a 1 in the fourth)

The long-term results in Table 6 estimated using equation (1) are consistent with the event study plots. The first column in the first row reports the average price paid for all evaluation and management visits. The difference-in-differences estimate is less than one-tenth of one percent. The balance of the first row reports the estimates for new patients, separately by visit intensity level. The second row reports the estimates for the established patient visits, also separately by intensity level. In no case do we see a statistically significant effect on price. The codes that do exhibit larger price changes with the law change (e.g., the new patient codes) are less frequently observed and have correspondingly noisier difference-in-differences estimates. The average price and the most frequently observed prices are relatively precisely estimated, with confidence intervals that typically reject effects of around 3 percent.

7 Heterogeneous effects

7.1 Populations where effects are more likely

Despite the fact that we found no effect on outpatient care in the sample as a whole, it is possible there are effects on outpatient care in places where nurse practitioners play a larger role in primary care and places where physicians are less available. In particular we check if there are differential effects of independent practice in areas where NPs make up a larger share of primary care providers, in rural areas, and in PCP shortage areas. We focus on the Medicare difference-in-differences analysis because we do not observe county or zipcode of residence in the MarketScan data. We also test whether the evidence of health effects we see in the Medicare difference-in-differences analysis are concentrated in places where we expect effects to be more likely, and find that in general they are.

We might expect to see a greater response to law changes in areas where NPs are a larger share of primary care providers, in rural areas, and in PCP shortage area. There is little evidence that there are larger increases in total visits or prescriptions for patients in rural areas, shortage areas than non-rural and non-shortage areas relative to other areas (Online Appendix Tables A.6-A.8). We actually see relative decreases in prescriptions in places where a large share of providers are NPs.[14] The reduced utilization of schedule II drugs seems to be driven by non-rural areas and places where a high share of providers are NPs (Online Appendix Tables A.6 and A.8). However, we see significantly larger reductions in imaging and testing spending in rural areas relative to non-rural areas and marginally significant decreases in shortage areas relative to non-shortage areas. Taken together these results suggest there are not differentially larger increases in access to care in places where we expect access to increase the most.

We also check if the effects on our proxies for health are higher in places where we expect NP independence to be more important (Online Appendix Tables A.9-A.11). We find that

[14]We focus on areas where NPs make up a larger share of primary care providers by dividing the NP share into terciles and coding counties with the highest share of NPs as omitted category.

the reductions in utilization of multiple types of high intensity health care is significantly larger in PCP shortage areas (Online Appendix Table A.10). We also see the significant reductions in ER visits and mortality, but not other proxies for health, are driven by places with a high share of NPs (Online Appendix Table A.11).[15] These results are suggestive that the health effects are concentrated in places where we expect them to be larger, which is consistent with them being caused by independent practice rather than something else, although they do not appear in all such places and they are not connected to increased use of outpatient care.

7.2 Reconciling the estimates for commercial and Medicare patients

We hypothesize that one reason why we may detect effects on our proxies for health for the Medicare patients but not the commercial patients is that the Medicare patients are closer to the margin of going to the hospital than the commercial patients. Medicare patients have about 3.9 times as many admissions per capita as commercial patients. Consequently, improvements in health that are measured with hospital admissions may be more likely to be detectable in Medicare than commercial patients.

We investigate this hypothesis by using the Medicare chronic conditions data to split the Medicare sample by their predicted health and then we check how the effect of the law change varies with prior patient health. We measure patient health using predictions of the probability the beneficiary will die in a particular year using lags of their chronic conditions. We then divide patients into terciles of their predicted probability of dying and ask if the effects are larger for patients with higher probabilities of dying.

Admissions and inpatient spending decline slightly for the healthiest two-thirds of Medicare patients, but the magnitude is much smaller than the pooled estimate and it is not close

[15] Inpatient admissions and inpatient spending also decrease significantly in such places, but the estimates are fairly similar to places where the NP share is relatively low.

to being statistically significant. However, admissions and inpatient spending decline by over twice as much for the sickest third of patients, and the decrease relative to the healthiest third is statistically significant for admissions and marginally significant for log inpatient spending. However, the sickest Medicare patients also die at higher rates than the healthiest patients after the scope of practice expansion (online appendix table A.12). The fact that the effects are larger for the sickest patients provides some evidence that the difference in the commercial and Medicare results is due to the relative health of those to populations.[16]

8 Conclusion

Expanding nurse practitioner scope of practice could benefit patients by increasing competition for primary care services and access to health care or harm patients by removing necessary supervision from providers with less training than medical doctors. We can reject that law changes cause moderate amounts of harm for several years after following NP scope of practice expansions in the commercially insured and Medicare samples. We also find some evidence of benefits in that Medicare beneficiary inpatient admissions and spending fall significantly a few years after the event with no increase in mortality. It is less clear why this happens. Although, there is some evidence that prescriptions of the most powerful opioids fall, there is little evidence that the increase in scope of practice translates into increased primary care visits or prescriptions. The benefits appear to be tied to places where we expect broader NP scope of practice to have an impact.

There is no evidence that moving to a state with a broader scope of practice is beneficial, but there are no statistically significant increases in harm. Although for some outcomes the increases are marginally significant and we can only reject relatively large amounts of harm, so we cannot reject the possibility of material harm in the very long run.

[16]We find no increase in visits or prescriptions for the patients with the highest probability of dying. There is an increase in visits, imaging, and testing for the middle tercile relative to the healthiest tercile. The reduction in schedule II prescriptions is entirely driven by the healthiest two-thirds of patients. There is no evidence of a reduction for the least healthy tercile of patients (online appendix table A.13).

Our results as well as the broader literature on the effects of expanding NP scope of practice (Alexander & Schnell, 2019; Hamilton III, 2017; Kleiner *et al.*, 2016; Traczynski & Udalova, 2018) and other allied professionals like certified nurse midwives (Markowitz *et al.*, 2017) suggest that patients do not benefit from restricted scope of practice, and provide suggestive evidence that a broader scope of practice is beneficial. These results along with the existence of a number of other potential benefits of broader scope of practice (Gilman & Koslov, 2014) suggest that increasing NP scope of practice is unlikely to harm patients and may be beneficial at least for several years after the law change.

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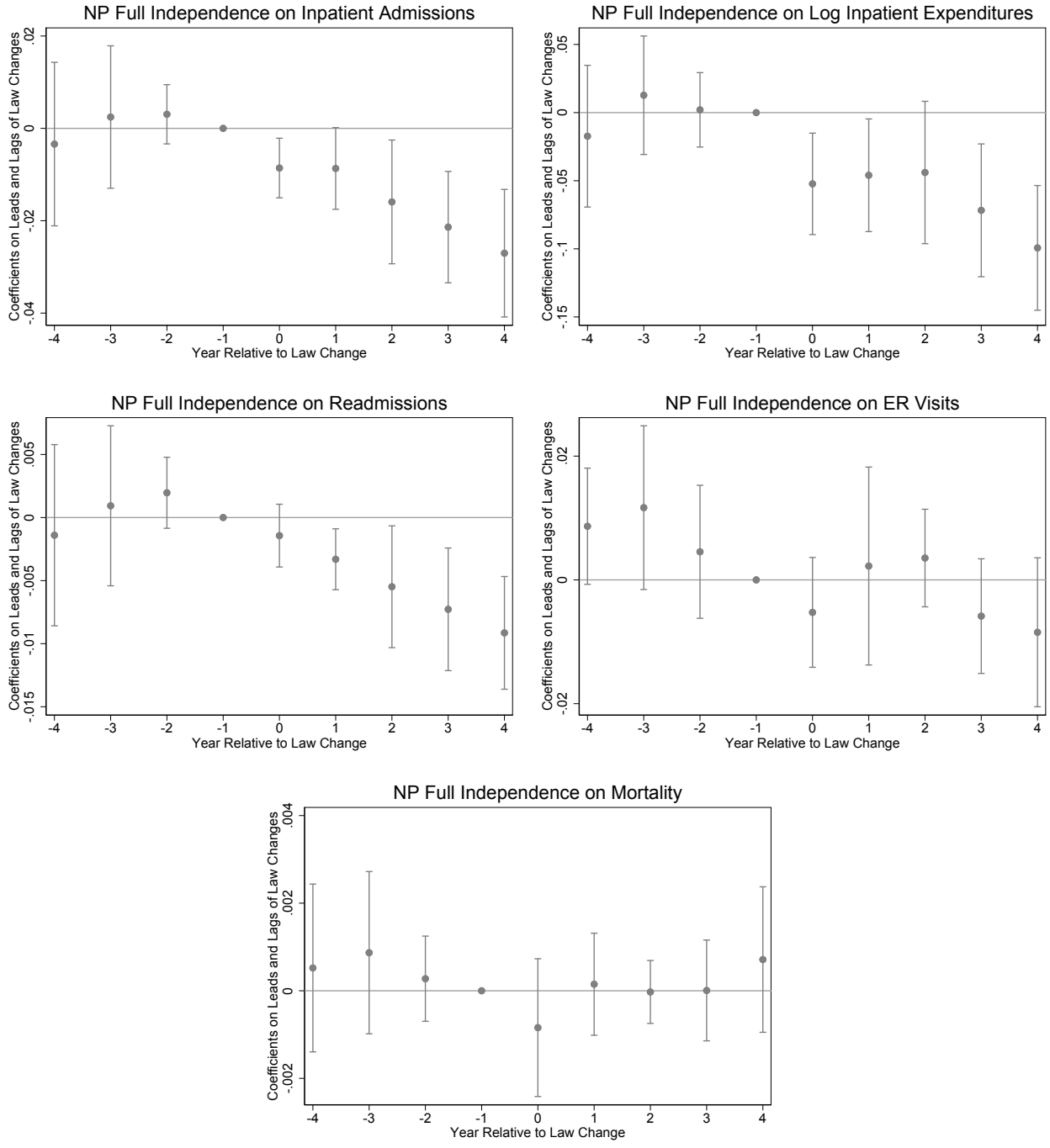
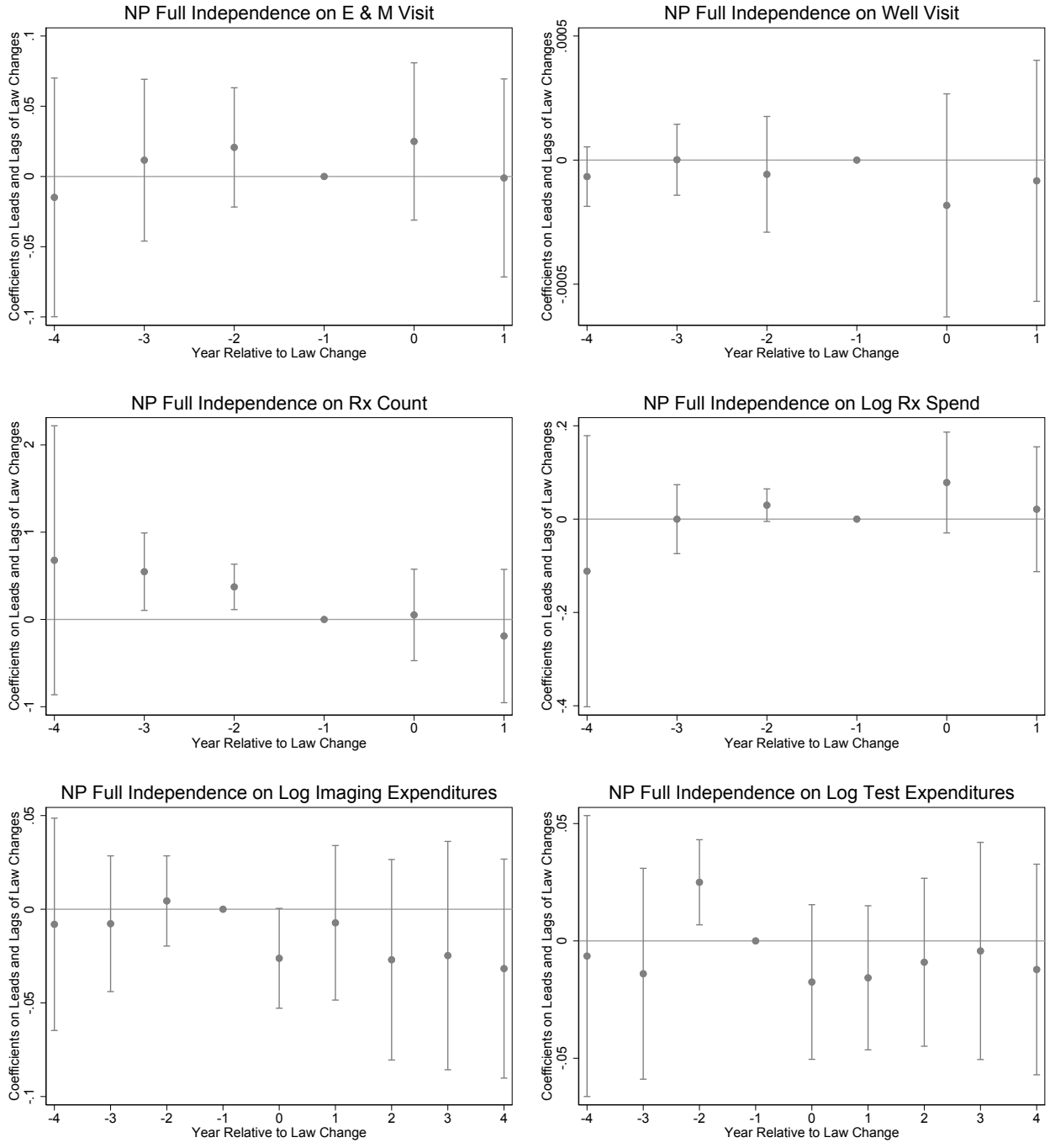
Figure 1: Effect of Expanding NP Scope of Practice on Proxies for Health for Medicare Beneficiaries



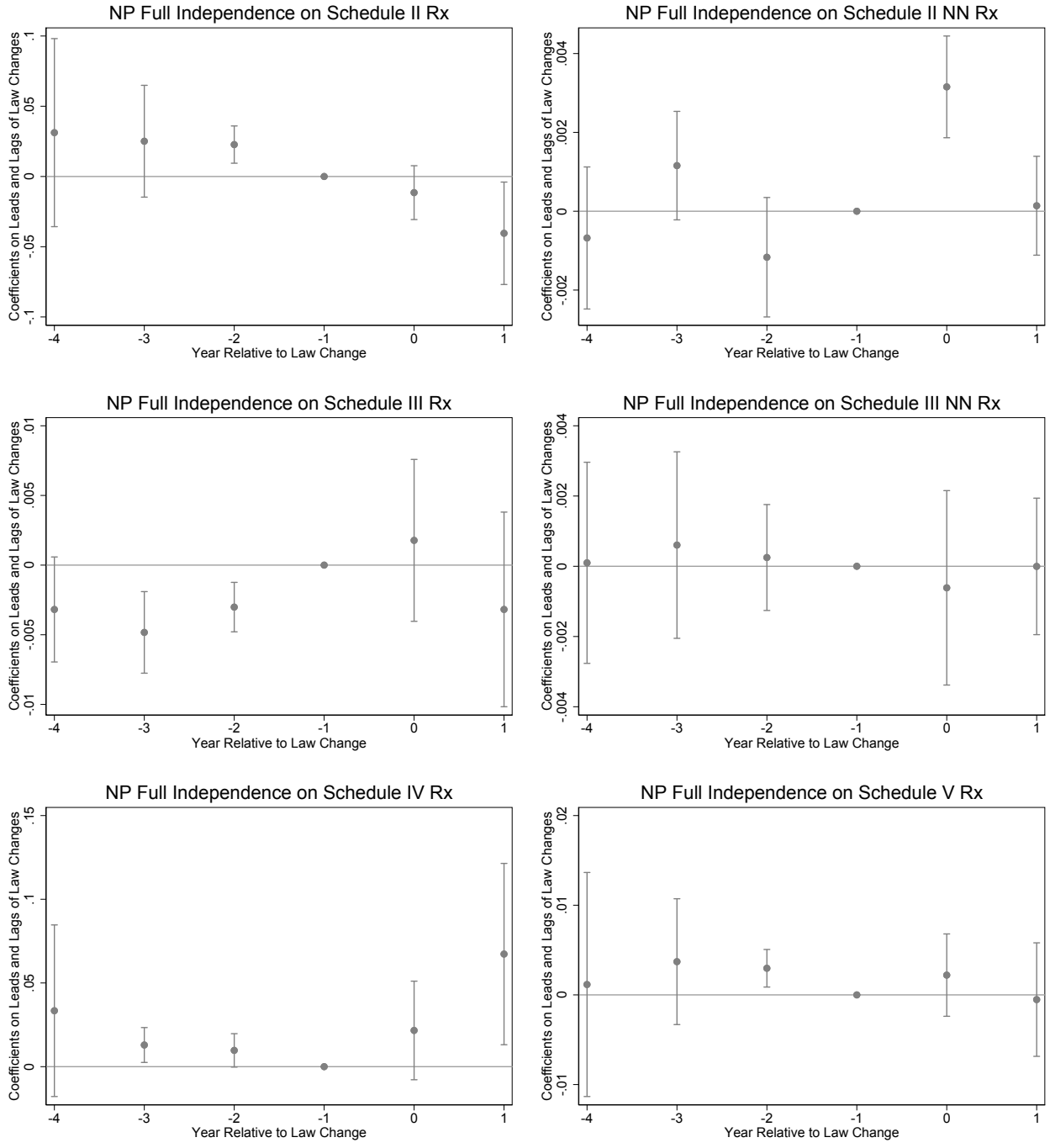
Notes: Data cover the 1999-2015 period. The unit of analysis is the beneficiary-year. Plots are of coefficients on leads and lags of the change in scope of practice laws with the one-year lead normalized to zero. The figures plot estimates from regressions of the level of the outcome variable on leads and lags of the law changes; beneficiary, age, state, and year fixed effects; an indicator for rural counties; and controls for PA scope of practice law changes. Error bars show the 95-percent confidence interval. Standard errors are clustered by state.

Figure 2: Effect of Expanding NP Scope of Practice on Outpatient Care and Tests for Medicare Beneficiaries



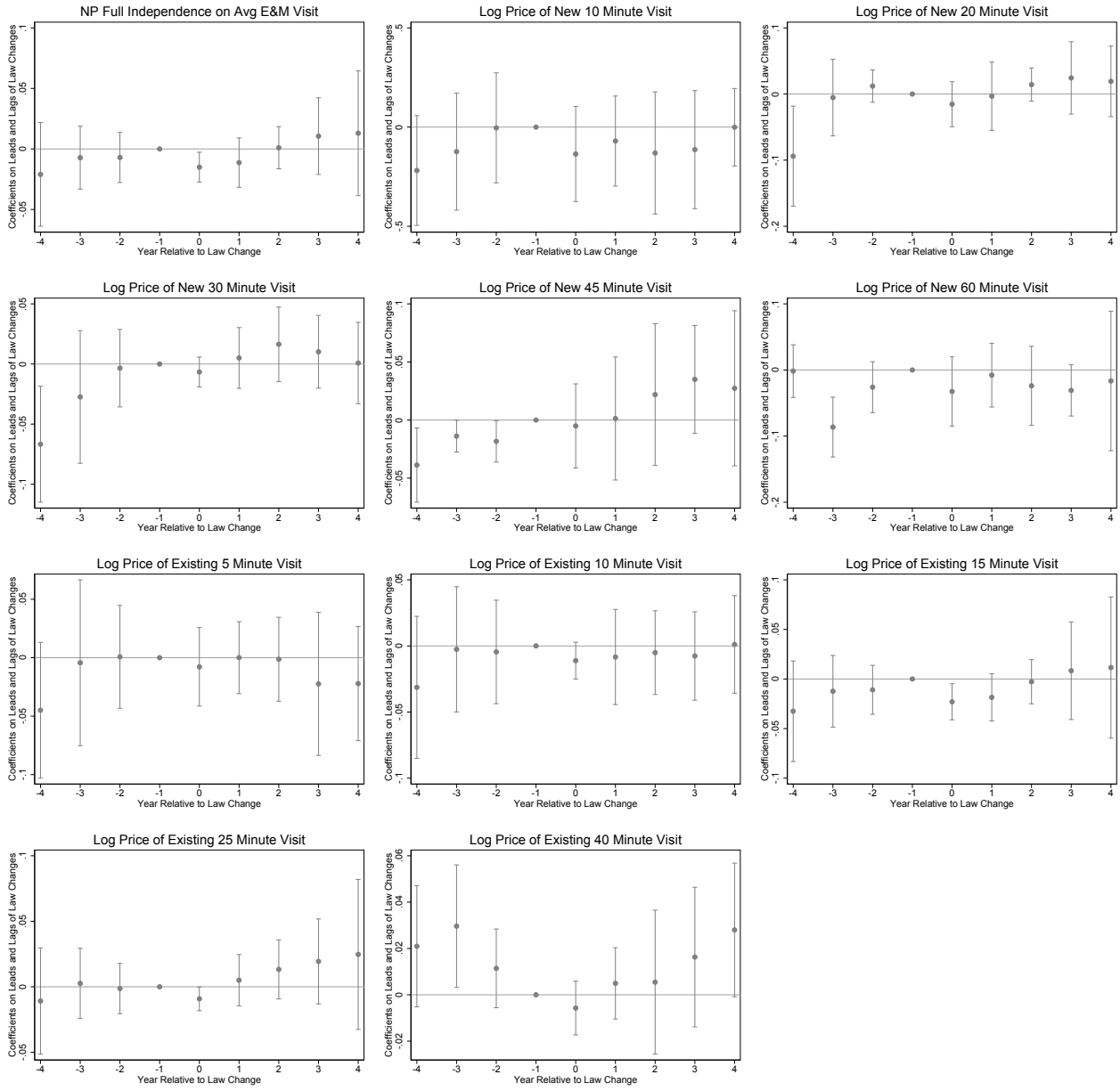
Notes: Data cover the 2005-2012 period except for the prescription data which is from 2006-2012 and imaging and testing which is from 1999-2015. The unit of analysis is the beneficiary-year. Plots are of coefficients on leads and lags of the change in scope of practice laws with the one-year lead normalized to zero. The figures plot estimates from regressions of the level of the outcome variable on leads and lags of the law changes; beneficiary, age, state, and year fixed effects; an indicator for rural counties; and controls for PA scope of practice law changes. Error bars show the 95-percent confidence interval. Standard errors are clustered by state.

Figure 3: Effect of Expanding NP Scope of Practice on Prescriptions for Medicare Beneficiaries



Notes: Data cover the 2006-2012 period. The unit of analysis is the beneficiary-year. Plots are of coefficients on leads and lags of the change in scope of practice laws with the one-year lead normalized to zero. The figures plot estimates from regressions of the level of the outcome variable on leads and lags of the law changes; beneficiary, age, state, and year fixed effects; an indicator for rural counties; and controls for PA scope of practice law changes. Error bars show the 95-percent confidence interval. Standard errors are clustered by state.

Figure 4: Effect of Expanding NP Scope of Practice on Office Visit Prices of Commercially Insured Patients



Notes: Data cover the 2007-2015 period. The unit of analysis is the beneficiary-year. Plots are of coefficients on leads and lags of the change in scope of practice laws with the one-year lead normalized to zero. The figures plot estimates from regressions of the level of the outcome variable on leads and lags of the law changes; beneficiary, age, state, and year fixed effects; and controls for PA scope of practice law changes. Error bars show the 95-percent confidence interval. Standard errors are clustered by state.

Table 1: State Summary Statistics for Medicare Beneficiaries

Average # Per Person	Fully Independent (1)	Not Independent (2)
Inpatient Admissions	0.285	0.354
Log Inpatient Spending	1.715	1.982
Readmissions	0.042	0.059
ER Visits	0.519	0.540
Office Visits (E & M Visits)	3.472	3.639
Checkups (Well Visits)	0.001	0.001
Log Physician Spending	4.924	5.130
Log Prescription Spending	3.186	3.365
Prescriptions	16.925	19.422
Schedule II Narcotic Prescriptions	0.632	0.579
Schedule II Non-narcotic Prescriptions	0.011	0.008
Schedule III Narcotic Prescriptions	0.040	0.044
Schedule III Non-narcotic Prescriptions	0.009	0.009
Schedule IV Prescriptions	0.340	0.468
Schedule V Prescriptions	0.043	0.058
Imaging Spending	3.465	3.751
Testing Spending	3.671	4.078
Log Total Spending	7.465	7.626
Deaths	0.051	0.055

Note: Data cover the 2005-2012 period except for the prescription data which is from 2006-2012 and admissions, readmissions, ER visits, deaths and all spending data except prescription spending which are available from 1999-2015. Each cell displays mean values per person per year of each variable in states with different NP scope of practice laws.

Table 2: State Summary Statistics for Commercially Insured Patients

Average # Per Person	Fully Independent (1)	Not Independent (2)
Inpatient Admissions	0.076	0.090
Inpatient Spending	839	864
ER Visits	0.193	0.221
Office Visits (E & M Visits)	1.639	1.643
Checkups (Well Visits)	0.300	0.259
Log Physician Spending	0.221	0.242
Log Inpatient Spending	0.333	0.361
Log Prescription Spending	3.161	3.181
Prescriptions	8.020	8.138
Unscheduled Prescriptions	6.852	7.023
Schedule II Prescriptions	0.368	0.273
Schedule III Prescriptions	0.255	0.268
Schedule IV Prescriptions	0.384	0.377
Schedule V Prescriptions	0.060	0.059
Imaging Spending	2.176	2.291
Testing Spending	2.750	2.923
Log Total Spending	5.904	5.897
Log Average Price	4.600	4.411

Note: Data cover the 2007-2015 period. Each cell displays mean values per person per year of each variable in states with different NP scope of practice laws.

Table 3: Effect of Expanding NP Scope of Practice on Higher Intensity Care and Health

Medicare Difference-in-Differences

Dependent Variable:	Inpatient Admissions	Log Inpatient Spending	Readmissions	ER Visits	Mortality
Fully Independent	-0.026	-0.08	-0.0080	-0.0155	-0.0019
	(0.013)	(0.04)	(0.0055)	(0.0091)	(0.0010)
# Observations	24,586,939	24,586,939	24,586,939	24,586,939	24,586,939

Commercial Difference-in-Differences

Dependent Variable:	Inpatient Admissions	Log Inpatient Spending	ER Visits
Fully Independent	-0.001	-0.004	0.0114
	(0.004)	(0.005)	(0.0098)
# Observations	131,042,891	131,042,158	131,042,891

Medicare Movers

Dependent Variable:	Inpatient Admissions	Log Inpatient Spending	Readmissions	ER Visits	Mortality
Fully Independent	0.009	0.07	0.001	0.005	0.0060
	(0.009)	(0.04)	(0.003)	(0.013)	(0.0035)
	24,076,445	24,076,445	24,076,445	24,076,445	24,076,445

Note: Medicare data cover the 1999-2015 period and commercial data are from 2007-2015. The unit of observation is beneficiary-year. Numbers reported in the Fully Independent rows are coefficients and standard errors (in parenthesis, clustered by state) from regressions of the level of each of the dependent variables on an indicator for states allowing NPs full independence, beneficiary age fixed effects, PA scope of practice indicators, beneficiary fixed effects, year fixed effects, and state fixed effects. The Medicare DiD specification also includes county characteristics and the Medicare mover specification additionally includes indicators for leads and lags of interstate moves.

Table 4: Effect of Expanding NP Scope of Practice on Outpatient Care and Tests

Medicare Difference-in-Differences

Dependent Variable:	Office Visits (Evaluation & Management)	Checkups (Well Visits)	Prescriptions	Log Rx Spending	Log Imaging Spending	Log Testing Spending
Fully Independent	0.016	-0.00024	-0.755	0.028	-0.044	-0.057
	(0.030)	(0.00019)	(0.466)	(0.078)	(0.048)	(0.037)
# Observations	11,268,572	11,268,572	9,740,318	9,740,318	24,586,939	24,586,939

Commercial Difference-in-Differences

Dependent Variable:	Office Visits (Evaluation & Management)	Checkups (Well Visits)	Prescriptions	Log Rx Spending	Log Imaging Spending	Log Testing Spending
Fully Independent	-0.0099	0.00088	-0.052	0.027	-0.060	-0.029
	(0.0473)	(0.01005)	(0.356)	(0.115)	(0.019)	(0.050)
# Observations	131,042,891	131,042,891	131,042,891	131,034,874	131,035,136	131,031,881

Medicare Movers

Dependent Variable:	Office Visits (Evaluation & Management)	Checkups (Well Visits)	Prescriptions	Log Rx Spending	Log Imaging Spending	Log Testing Spending
Fully Independent	-0.207	-0.000231	1.055	0.128	0.0025	-0.035
	(0.097)	(0.000688)	(0.772)	(0.057)	(0.0220)	(0.025)
	11,010,875	11,010,875	9,517,782	9,517,782	24,076,445	24,076,445

Note: Medicare data cover the 1999-2015 period except the visits (2005-2012) and prescriptions (2006-2012). Commercial data are from 2007-2015. The unit of observation is beneficiary-year. Numbers reported in the Fully Independent rows are coefficients and standard errors (in parenthesis, clustered by state) from regressions of the level of each of the dependent variables on an indicator for states allowing NPs full independence, beneficiary age fixed effects, PA scope of practice indicators, beneficiary fixed effects, year fixed effects, and state fixed effects. The Medicare DiD specification also includes county characteristics and the Medicare mover specification additionally includes indicators for leads and lags of interstate moves.

Table 5: Effect of Expanding NP Scope of Practice on Controlled Substances

Medicare Difference-in-Differences

Dependent Variable:	Schedule II Narcotics	Schedule II Non-narcotics	Schedule III Narcotics	Schedule III Non-narcotics	Schedule IV	Schedule V
Fully Independent	-0.0583	0.0015	0.0019	-0.0012	0.0372	-0.0018
	(0.0283)	(0.0005)	(0.0039)	(0.0015)	(0.0194)	(0.0022)
# Observations	9,740,318	9,740,318	9,740,318	9,740,318	9,740,318	9,740,318

Commercial Difference-in-Differences

Dependent Variable:	Not Scheduled	Schedule II	Schedule III	Schedule IV	Schedule V
Fully Independent	-0.1026	0.0150	-0.0223	0.0139	-0.0011
	(0.3153)	(0.0161)	(0.0068)	(0.0215)	(0.0033)
# Observations	131,042,891	131,042,891	131,042,891	131,042,891	131,042,891

Medicare Movers

Dependent Variable:	Schedule II Narcotics	Schedule II Non-narcotics	Schedule III Narcotics	Schedule III Non-narcotics	Schedule IV	Schedule V
Fully Independent	0.0387	0.0004	-0.0136	-0.0040	0.0114	-0.0116
	(0.0544)	(0.0116)	(0.0090)	(0.0029)	(0.0345)	(0.0197)
	9,517,782	9,517,782	9,517,782	9,517,782	9,517,782	9,517,782

Note: Medicare data cover the 2006-2012 period and commercial data are from 2007-2015. The unit of observation is beneficiary-year. Numbers reported in the Fully Independent rows are coefficients and standard errors (in parenthesis, clustered by state) from regressions of the level of each of the dependent variables on an indicator for states allowing NPs full independence, beneficiary age fixed effects, PA scope of practice indicators, beneficiary fixed effects, year fixed effects, and state fixed effects. The Medicare DiD specification also includes county characteristics and the Medicare mover specification additionally includes indicators for leads and lags of interstate moves.

Table 6: Effect of Expanding NP Scope of Practice on Office Visit Prices for Commercially Insured Patients

Dependent Variable:	Log Avg. Price	Log Price of New Outpatient E&M Office Visit				
	E&M Office Visit	10 Minutes	20 Minutes	30 Minutes	45 Minutes	60 Minutes
Fully Independent	-0.0003	-0.103	0.002	0.030	0.032	0.001
	(0.0134)	(0.063)	(0.022)	(0.027)	(0.028)	(0.020)
R^2	0.71	0.80	0.72	0.68	0.75	0.75
# States	44	44	44	44	44	44
# Observations	71,690,930	14,549	637,474	2,355,500	729,623	98,319

Dependent Variable:	Log Price of Existing Outpatient E&M Office Visit				
	5 Minutes	10 Minutes	15 Minutes	25 Minutes	40 Minutes
Fully Independent	-0.002	-0.001	0.001	0.010	-0.003
	(0.012)	(0.014)	(0.015)	(0.013)	(0.015)
R^2	0.92	0.84	0.81	0.85	0.87
# States	44	44	44	44	44
# Observations	920,573	4,417,664	50,875,451	27,290,641	2,125,106

Note: Data cover the 2007-2015 period. The unit of observation is beneficiary-year. Numbers reported in the Fully Independent rows are coefficients and standard errors (in parenthesis, clustered by state) from regressions of the level of each of the dependent variables on an indicator for states allowing NPs full independence, beneficiary age fixed effects, PA scope of practice indicators, beneficiary fixed effects, year fixed effects, and state fixed effects.

Online Appendix

A Data Appendix

A.1 Scope of Practice Laws

There are a number of cases cases where our sources disagree on the timing of the expansion of NP practice authority and NP prescriptive authority. However, the difference in timing is typically only a year or two, and there is often some ambiguity that implies both codings could be reasonable depending on the interpretation of independent practice and prescriptive authority.[17] We attempt to determine which coding is correct, and if there is any remaining uncertainty choose the earliest year the law change was recorded as occurring.

A.2 Claims data

Evaluation and management visits (CPT codes 99201-5 and 99211-5) are the most frequently billed codes in Medicare and reflect the charges for providers' time and effort in figuring out how to treat the patient. The fifth digit of the code reflects the resource intensity of the service, typically characterized by the duration of the visit. The fourth digit reflects whether or not the patient is new to the provider or practice.

The controlled substance status is included in the MarketScan data. We add it to the Medicare data by merging it with supplemented the FDA's National Drug File, which characterizes each drug (a National Drug Code) by its strength, class, generic status and controlled substance schedule status, among other things. There appear to be inconsistencies in the National Drug Codes in the MarketScan data, so we cannot merge it with the FDA's National Drug File.

[17] See, Traczynski & Udalova (2018); Hamilton III (2017); Kleiner *et al.* (2016); Kuo *et al.* (2013); McMichael (2017); Tu (2017).

B Appendix Figures

Online appendix figures A.1-A.2 show event study representations of the difference-in-differences analysis for commercial patients and the mover analysis for Medicare patients for the health outcomes.

Online appendix figures A.3-A.4 show event study representations of the difference-in-differences analysis for commercial patients and the mover analysis for Medicare patients for the outpatient care outcomes.

Online appendix figures A.5-A.6 show event study representations of the difference-in-differences analysis for commercial patients and the mover analysis for Medicare patients for the prescriptions of scheduled drugs outcomes.

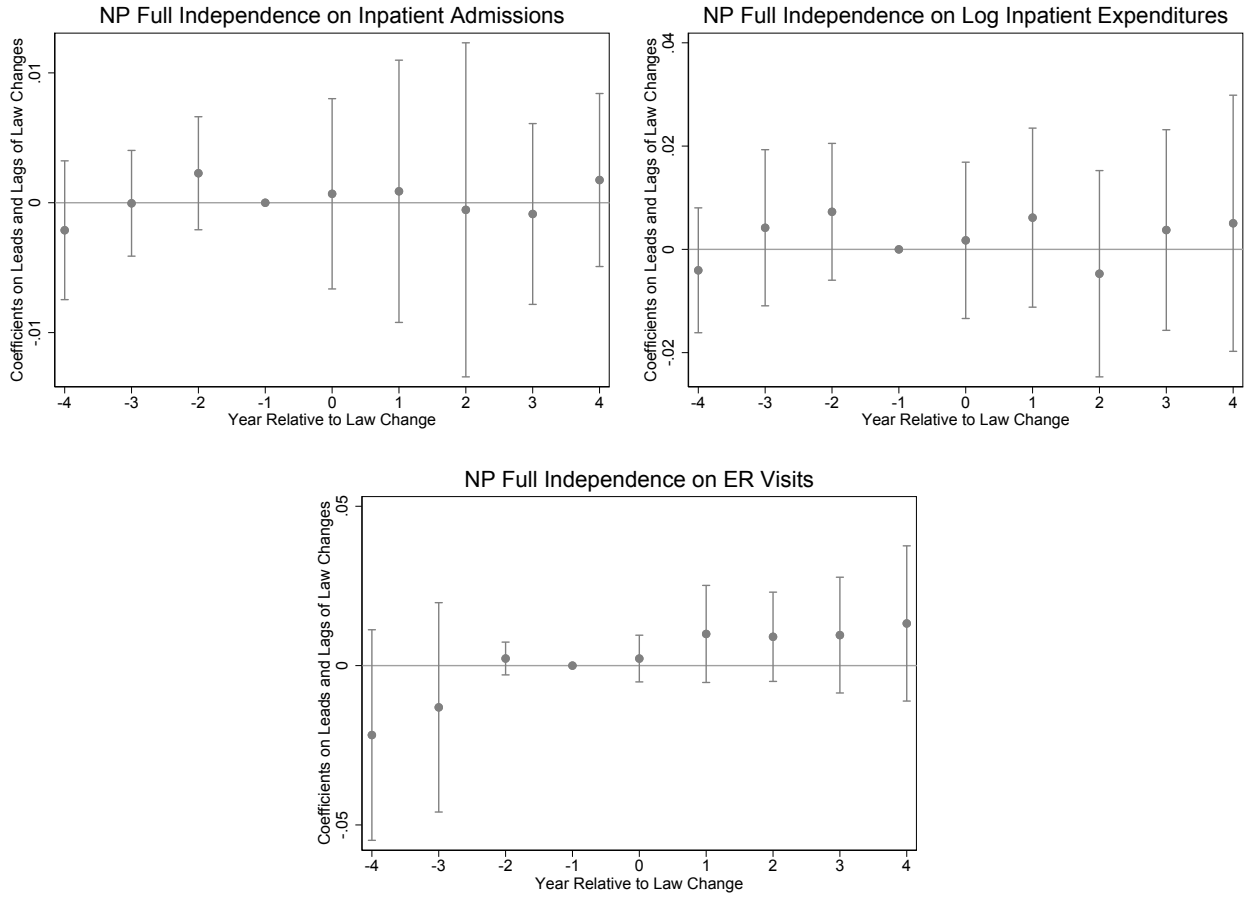
C Appendix Tables

Online appendix tables A.1-A.2 show the main difference-in-differences results identified using only law changes, i.e., excluding interstate movers.

Online appendix table A.3-A.5 shows the effect of expanding SOP or moving to a state with a broader SOP on visits and prescriptions billed by NPs, PCPs, and PAs.

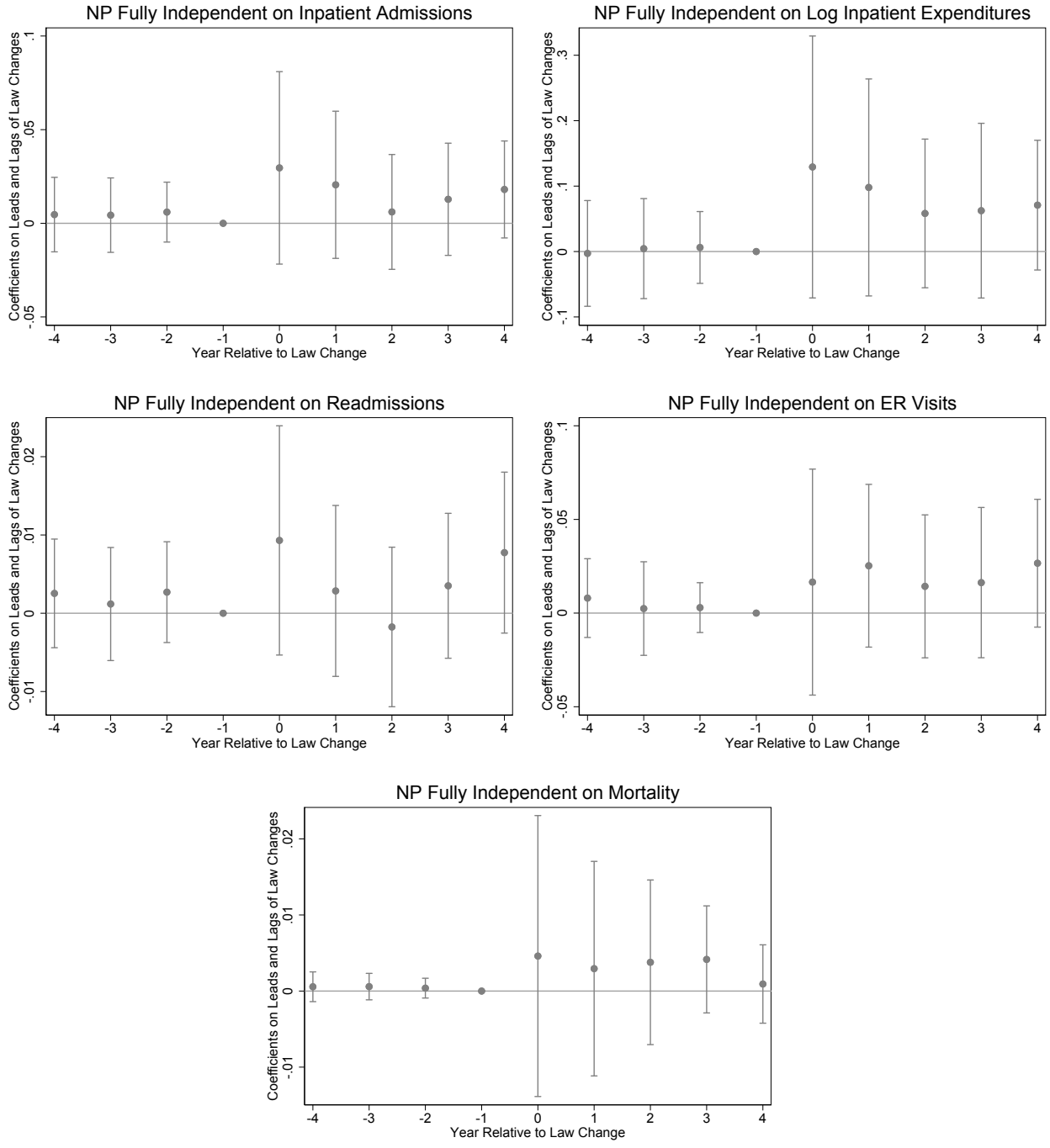
Online appendix tables A.6-A.13 show the main difference-in-differences results interacted with rural status, physician shortage areas, the NP share of providers, and beneficiary health.

Figure A.1: Effect of Expanding NP Scope of Practice on Proxies for Health for Commercially Insured Patients



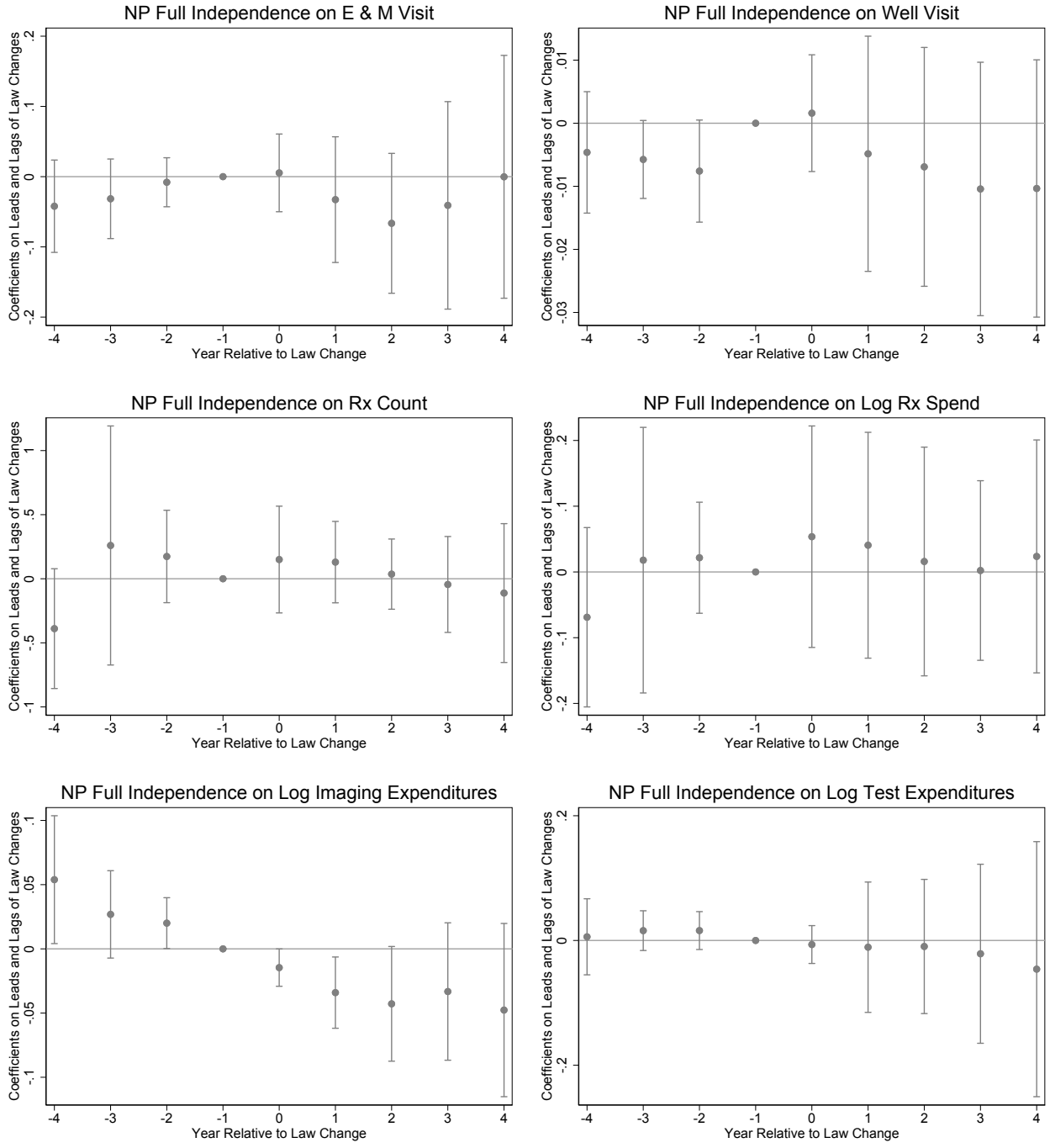
Notes: Data cover the 2007-2015 period. The unit of analysis is the beneficiary-year. Plots are of coefficients on leads and lags of the change in scope of practice laws with the one-year lead normalized to zero. The figures plot estimates from regressions of the level of the outcome variable on leads and lags of the law changes; beneficiary, age, state, and year fixed effects; and controls for PA scope of practice law changes. Error bars show the 95-percent confidence interval. Standard errors are clustered by state.

Figure A.2: Effect of Moving to a State with Broader NP Scope of Practice on Proxies for Health for Medicare Beneficiaries



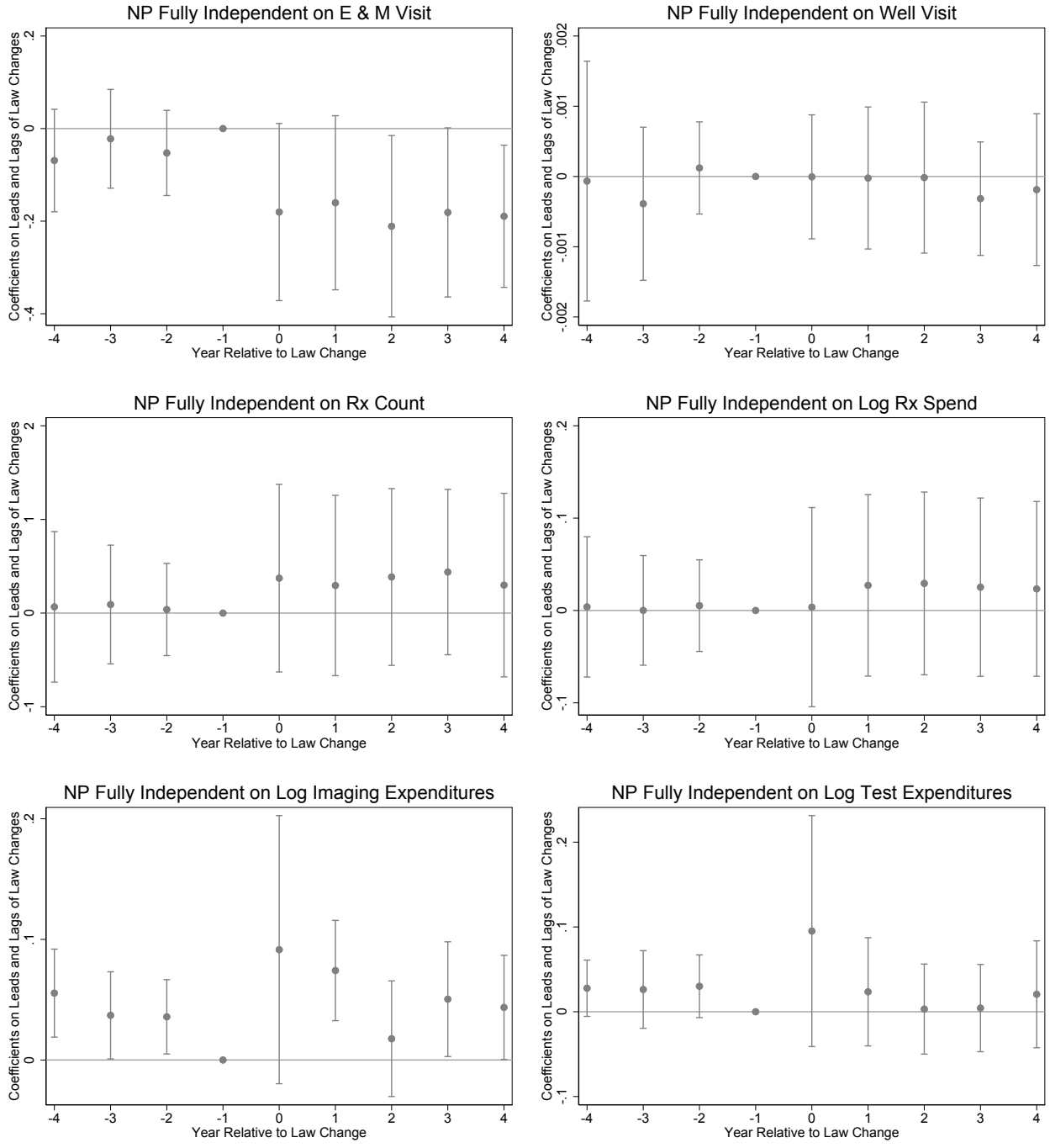
Data cover the 1999-2015 period. The unit of analysis is the beneficiary-year. Plots are of coefficients on leads and lags of indicators for scope of practice laws with the one-year lead normalized to zero. The figures plot estimates from regressions of the level of the outcome variable on leads and lags of the laws; beneficiary, age, state, and year fixed effects; leads and lags for of an indicator for an interstate move; an indicator for rural counties; and controls for PA scope of practice law changes. Error bars show the 95-percent confidence interval. Standard errors are clustered by state.

Figure A.3: Effect of Expanding NP Scope of Practice on Outpatient Care and Tests for Commercially Insured Patients



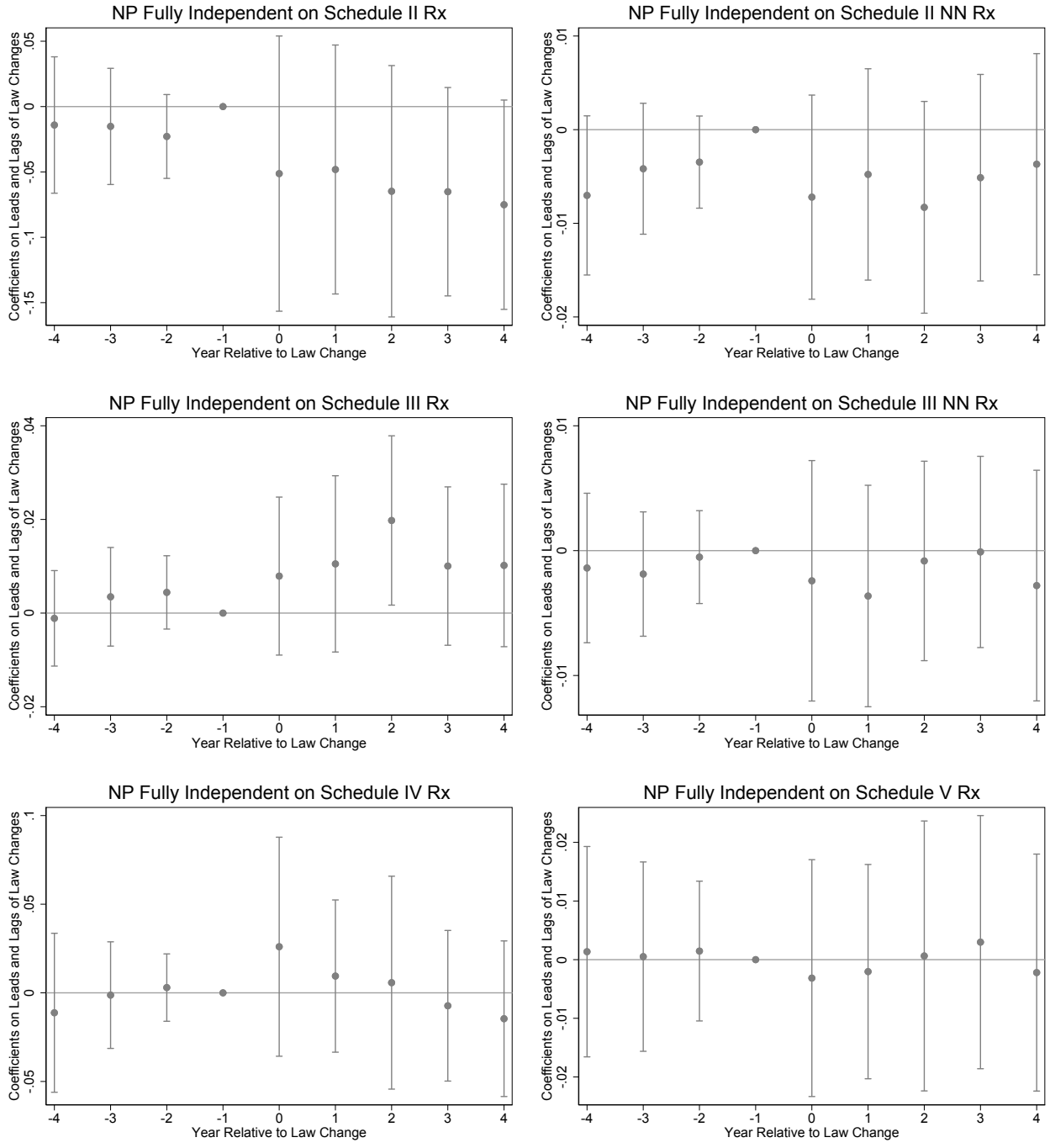
Notes: Data cover the 2007-2015 period. The unit of analysis is the beneficiary-year. Plots are of coefficients on leads and lags of the change in scope of practice laws with the one-year lead normalized to zero. The figures plot estimates from regressions of the level of the outcome variable on leads and lags of the law changes; beneficiary, age, state, and year fixed effects; and controls for PA scope of practice law changes. Error bars show the 95-percent confidence interval. Standard errors are clustered by state.

Figure A.4: Effect of Moving to a State with Broader NP Scope of Practice on Outpatient Care and Tests for Medicare Beneficiaries



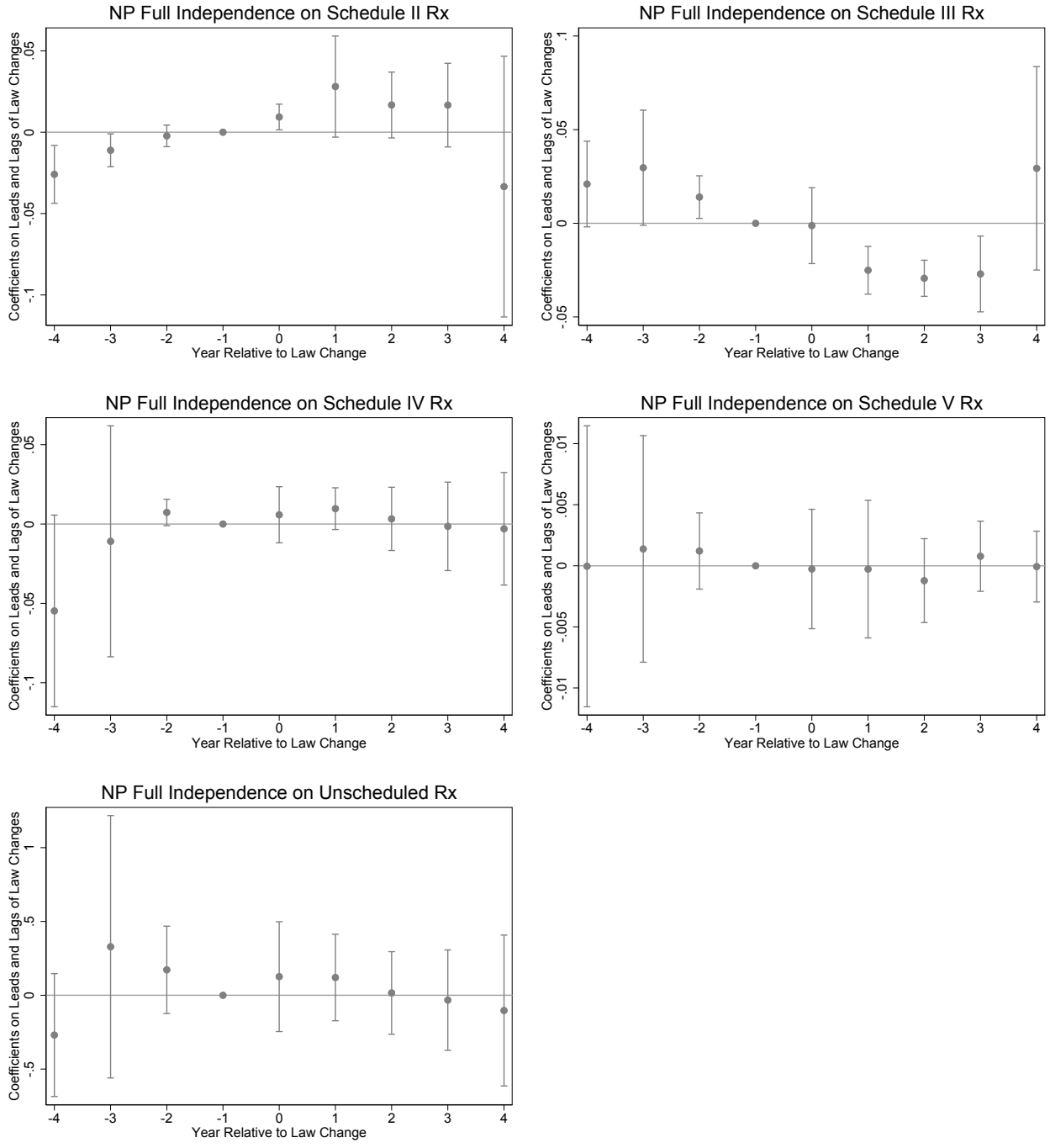
Notes: Data cover the 2005-2012 period except for the prescription data which is from 2006-2012 and imaging and testing which is from 1999-2015. The unit of analysis is the beneficiary-year. Plots are of coefficients on leads and lags of indicators for scope of practice laws with the one-year lead normalized to zero. The figures plot estimates from regressions of the level of the outcome variable on leads and lags of the laws; beneficiary, age, state, and year fixed effects; leads and lags for of an indicator for an interstate move; an indicator for rural counties; and controls for PA scope of practice law changes. Error bars show the 95-percent confidence interval. Standard errors are clustered by state.

Figure A.5: Effect of Moving to a State with Broader NP Scope of Practice on Prescriptions for Medicare Beneficiaries



Notes: Data cover the 2006-2012 period. The unit of analysis is the beneficiary-year. Plots are of coefficients on leads and lags of indicators for scope of practice laws with the one-year lead normalized to zero. The figures plot estimates from regressions of the level of the outcome variable on leads and lags of the laws; beneficiary, age, state, and year fixed effects; leads and lags for of an indicator for an interstate move; an indicator for rural counties; and controls for PA scope of practice law changes. Error bars show the 95-percent confidence interval. Standard errors are clustered by state.

Figure A.6: Effect of Expanding NP Scope of Practice on Prescriptions for Commercially Insured Patients



Notes: Data cover the 2007-2015 period. The unit of analysis is the beneficiary-year. Plots are of coefficients on leads and lags of the change in scope of practice laws with the one-year lead normalized to zero. The figures plot estimates from regressions of the level of the outcome variable on leads and lags of the law changes; beneficiary, age, state, and year fixed effects; and controls for PA scope of practice law changes. Error bars show the 95-percent confidence interval. Standard errors are clustered by state.

Table A.1: Effect of Expanding NP Scope of Practice on Higher Intensity Care and Health for Medicare Beneficiaries - Excluding Interstate Movers

Dependent Variable:	Inpatient Admissions	Log Inpatient Spending	Readmissions	ER Visits	Mortality
Fully Independent	-0.025	-0.08	-0.0078	-0.0139	-0.0021
	(0.014)	(0.05)	(0.0061)	(0.0098)	(0.0010)
R^2	0.35	0.30	0.26	0.40	0.59
# States	51	51	51	51	51
# Observations	22,215,495	22,215,495	22,215,495	22,215,495	22,215,495

Note: Data cover the 1999-2015 period. The unit of observation is beneficiary-year. The sample excludes interstate movers. Numbers reported in the Fully Independent row are coefficients and standard errors (in parenthesis, clustered by state) from regressions of the level of each of the dependent variables on an indicator for states allowing NPs full independence, beneficiary age fixed effects, county characteristics, PA scope of practice indicators, beneficiary fixed effects, year fixed effects, and state fixed effects.

Table A.2: Effect of Expanding NP Scope of Practice on Outpatient Care and Tests for Medicare Beneficiaries - Excluding Interstate Movers

Dependent Variable:	Office Visits (E&M Visits)	Checkups (Well Visits)	Prescriptions	Log Rx Spending	Log Imaging Spending	Log Testing Spending
Fully Independent	0.014	-0.00028	-0.764	0.039	-0.040	-0.055
	(0.029)	(0.00022)	(0.463)	(0.083)	(0.051)	(0.039)
R^2	0.62	0.19	0.84	0.88	0.44	0.55
# States	51	51	51	51	51	51
# Observations	10,120,074	10,120,074	8,752,139	8,752,139	22,215,495	22,215,495

Dependent Variable:	Schedule II Narcotics	Schedule II Non-narcotics	Schedule III Narcotics	Schedule III Non-narcotics	Schedule IV	Schedule V
Fully Independent	-0.0604	0.0014	0.0017	-0.0014	0.0373	-0.0018
	(0.0295)	(0.0007)	(0.0044)	(0.0013)	(0.0198)	(0.0026)
R^2	0.71	0.67	0.64	0.55	0.66	0.61
# States	51	51	51	51	51	51
# Observations	8,752,139	8,752,139	8,752,139	8,752,139	8,752,139	8,752,139

Note: Data cover the 2005-2012 period except for the prescription data which is from 2006-2012 and imaging and testing which is from 1999-2015. The unit of observation is beneficiary-year. The sample excludes interstate movers. Numbers reported in the Fully Independent rows are coefficients and standard errors (in parenthesis, clustered by state) from regressions of the level of each of the dependent variables on an indicator for states allowing NPs full independence, beneficiary age fixed effects, county characteristics, PA scope of practice indicators, beneficiary fixed effects, and state fixed effects.

Table A.3: Effect of Expanding NP Scope of Practice on Outpatient Care by Provider Type for Medicare Beneficiaries

Dependent Variable:	Office Visits (E&M Visits)	Checkups (Well Visits)	Prescriptions
NPs	-0.0079	-0.000019	0.0024
	(0.0181)	(0.000016)	(0.1155)
# Observations	11,268,572	11,268,572	9,740,318
PAs	-0.0007	-0.000004	-0.0368
	(0.0144)	(0.000014)	(0.0511)
# Observations	11,268,572	11,268,572	9,740,318
PCPs	0.0241	-0.000221	-0.7205
	(0.0364)	(0.000188)	(0.4360)
# Observations	11,268,572	11,268,572	9,740,318

Note: Data cover the 2005-2012 period except for the prescription data which is from 2006-2012. The unit of observation is beneficiary-year. Numbers reported rows are coefficients and standard errors (in parenthesis, clustered by state) on the Fully Independent variable from regressions of the level of each of the dependent variables for visits to/prescriptions by the provider listed in the row on an indicator for states allowing NPs full independence, beneficiary age fixed effects, county characteristics, PA scope of practice indicators, beneficiary fixed effects, year fixed effects, and state fixed effects.

Table A.4: Effect of Expanding NP Scope of Practice on Outpatient Care by Provider Type for Commercially Insured Patients

Dependent Variable:	Office Visits (E&M Visits)	Checkups (Well Visits)
NPs	0.0031	0.0016
	(0.0095)	(0.0015)
# Observations	131,042,891	131,042,891
PAs	0.0165	0.0005
	(0.0107)	(0.0004)
# Observations	131,042,891	131,042,891
PCPs	-0.0300	-0.0012
	(0.0467)	(0.0103)
# Observations	131,042,891	131,042,891

Note: Data cover the 2007-2015 period. The unit of observation is beneficiary-year. Numbers reported rows are coefficients and standard errors (in parenthesis, clustered by state) on the Fully Independent variable from regressions of the level of each of the dependent variables for visits to/prescriptions by the provider listed in the row on an indicator for states allowing NPs full independence, beneficiary age fixed effects, PA scope of practice indicators, beneficiary fixed effects, year fixed effects, and state fixed effects.

Table A.5: Effect of Moving to State with Broader Scope of Practice on Outpatient Care for Medicare Beneficiaries by Provider Type

Dependent Variable:	Office Visits (E&M Visits)	Checkups (Well Visits)	Prescriptions
NPs	0.066	0.00018	0.213
	(0.033)	(0.00009)	(0.175)
# Observations	11,010,875	11,010,875	9,517,782
PAs	-0.006	0.00057	0.081
	(0.018)	(0.00054)	(0.091)
# Observations	11,010,875	11,010,875	9,517,782
PCPs	-0.266	-0.00099	0.591
	(0.094)	(0.00044)	(0.895)
# Observations	11,010,875	11,010,875	9,517,782

Note: Data cover the 2005-2012 period except for the prescription data which is from 2006-2012. The unit of observation is beneficiary-year. Numbers reported in the rows are coefficients and standard errors (in parenthesis, clustered by state) on indicators for NP scope of practice within a state for visits limited to the type of practitioner listed in each panel of the table from regressions of the level of each of the dependent variables on an indicator for full independence, beneficiary age fixed effects, county characteristics, PA scope of practice indicators, beneficiary fixed effects, year fixed effects, state fixed effects, and indicators for leads and lags of interstate moves.

Table A.6: Effect of Expanding NP Scope of Practice on Outpatient Care and Tests for Medicare Beneficiaries - Rural Areas

Dependent Variable:	Office Visits (E&M Visits)	Checkups (Well Visits)	Prescriptions	Log Rx Spending	Log Imaging Spending	Log Testing Spending
Fully Independent	0.027	-0.00032	-0.750	0.045	-0.024	-0.041
	(0.025)	(0.00023)	(0.473)	(0.078)	(0.041)	(0.029)
Fully Independent×	-0.067	0.00044	-0.029	-0.099	-0.120	-0.098
Rural	(0.074)	(0.00026)	(0.503)	(0.052)	(0.040)	(0.045)
Rural	-0.068	-0.00019	-1.067	-0.014	-0.095	-0.191
	(0.039)	(0.00013)	(0.226)	(0.019)	(0.014)	(0.021)
R^2	0.62	0.19	0.83	0.88	0.44	0.54
# States	51	51	51	51	51	51
# Observations	11,268,572	11,268,572	9,740,318	9,740,318	24,586,939	24,586,939

Dependent Variable:	Schedule II Narcotics	Schedule II Non-narcotics	Schedule III Narcotics	Schedule III Non-narcotics	Schedule IV	Schedule V
Fully Independent	-0.0707	0.0011	0.0021	-0.0013	0.0427	-0.0034
	(0.0209)	(0.0004)	(0.0039)	(0.0014)	(0.0183)	(0.0022)
Fully Independent×	0.0738	0.0027	-0.0012	0.0009	-0.0326	0.0091
Rural	(0.0420)	(0.0014)	(0.0037)	(0.0013)	(0.0135)	(0.0038)
Rural	-0.0710	-0.0013	-0.0003	0.0034	-0.0051	-0.0022
	(0.0185)	(0.0013)	(0.0023)	(0.0010)	(0.0109)	(0.0041)
R^2	0.71	0.67	0.63	0.55	0.66	0.60
# States	51	51	51	51	51	51
# Observations	9,740,318	9,740,318	9,740,318	9,740,318	9,740,318	9,740,318

Note: Data cover the 2005-2012 period except for the prescription data which is from 2006-2012 and imaging and testing which is from 1999-2015. The unit of observation is beneficiary-year. Numbers reported in the rows are coefficients and standard errors (in parenthesis, clustered by state) on the Prescribe Independently variable fully interacted with an indicator for rural counties from regressions of the level of each of the dependent variables on an indicator for states allowing NPs to prescribe independently fully interacted with an indicator for a rural county, beneficiary age fixed effects, PA scope of practice indicators, beneficiary fixed effects, year fixed effects, and state fixed effects.

Table A.7: Effect of Expanding NP Scope of Practice on Outpatient Care and Tests for Medicare Beneficiaries - PCP Shortage Areas

Dependent Variable:	Office Visits (E&M Visits)	Checkups (Well Visits)	Prescriptions	Log Rx Spending	Log Imaging Spending	Log Testing Spending
Fully Independent	0.029	-0.00021	-0.557	0.061	-0.027	-0.032
	(0.031)	(0.00022)	(0.596)	(0.104)	(0.045)	(0.033)
Fully Independent×	-0.030	-0.00008	-0.444	-0.074	-0.037	-0.052
PCP Shortage Area	(0.050)	(0.00018)	(0.396)	(0.092)	(0.019)	(0.028)
PCP Shortage Area	-0.038	0.00006	0.153	0.001	0.002	0.010
	(0.018)	(0.00008)	(0.126)	(0.015)	(0.006)	(0.010)
R^2	0.62	0.19	0.83	0.88	0.44	0.54
# States	51	51	51	51	51	51
# Observations	11,268,572	11,268,572	9,740,318	9,740,318	24,586,939	24,586,939

Dependent Variable:	Schedule II Narcotics	Schedule II Non-narcotics	Schedule III Narcotics	Schedule III Non-narcotics	Schedule IV	Schedule V
Fully Independent	-0.0551	0.0018	0.0036	0.0000	0.0508	-0.0009
	(0.0287)	(0.0006)	(0.0043)	(0.0014)	(0.0221)	(0.0023)
Fully Independent×	-0.0070	-0.0006	-0.0039	-0.0026	-0.0305	-0.0021
PCP Shortage Area	(0.0175)	(0.0016)	(0.0023)	(0.0015)	(0.0118)	(0.0023)
PCP Shortage Area	0.0079	0.0018	0.0020	-0.0007	0.0077	0.0018
	(0.0112)	(0.0013)	(0.0022)	(0.0012)	(0.0074)	(0.0035)
R^2	0.71	0.67	0.63	0.55	0.66	0.60
# States	51	51	51	51	51	51
# Observations	9,740,318	9,740,318	9,740,318	9,740,318	9,740,318	9,740,318

Note: Data cover the 2005-2012 period except for the prescription data which is from 2006-2012 and imaging and testing which is from 1999-2015. The unit of observation is beneficiary-year. Numbers reported in the rows are coefficients and standard errors (in parenthesis, clustered by state) on the Fully Independent variable fully interacted with an indicator for counties that are PCP shortage areas from regressions of the level of each of the dependent variables on an indicator for states allowing NPs full independence fully interacted with an indicator for PCP shortage counties, beneficiary age fixed effects, PA scope of practice indicators, beneficiary fixed effects, year fixed effects, and state fixed effects.

Table A.8: Effect of Expanding NP Scope of Practice on Outpatient Care and Tests for Medicare Beneficiaries - By NP Share of PCPs

Dependent Variable:	Office Visits (E&M Visits)	Checkups (Well Visits)	Prescriptions	Log Rx Spending	Log Imaging Spending	Log Testing Spending
Fully Independent	-0.004	-0.00047	-1.155	-0.003	-0.036	-0.036
	(0.041)	(0.00027)	(0.420)	(0.089)	(0.044)	(0.045)
Fully Independent×	0.028	0.00039	0.508	0.047	-0.017	-0.044
Middle Tercile	(0.030)	(0.00017)	(0.479)	(0.109)	(0.013)	(0.032)
Fully Independent×	0.030	0.00027	0.890	0.057	0.003	0.012
Bottom Tercile	(0.086)	(0.00036)	(0.821)	(0.152)	(0.027)	(0.044)
Middle Tercile	-0.024	-0.00018	-0.062	-0.018	-0.009	-0.024
	(0.020)	(0.00009)	(0.150)	(0.014)	(0.012)	(0.016)
Top Tercile	-0.025	-0.00026	-0.431	-0.041	-0.027	-0.055
	(0.027)	(0.00015)	(0.197)	(0.025)	(0.015)	(0.019)
R^2	0.62	0.19	0.83	0.88	0.44	0.54
# States	51	51	51	51	51	51
# Observations	11,254,582	11,254,582	9,728,314	9,728,314	24,555,757	24,555,757

Dependent Variable:	Schedule II Narcotics	Schedule II Non-narcotics	Schedule III Narcotics	Schedule III Non-narcotics	Schedule IV	Schedule V
Fully Independent	-0.101	0.00120	0.0014	0.0003	0.0196	-0.0080
	(0.030)	(0.00098)	(0.0027)	(0.0018)	(0.0089)	(0.0022)
Fully Independent×	0.072	0.00095	0.0013	-0.0020	0.0259	0.0090
Middle Tercile	(0.030)	(0.00149)	(0.0040)	(0.0016)	(0.0172)	(0.0022)
Fully Independent×	0.054	-0.00027	-0.0001	-0.0032	0.0318	0.0117
Bottom Tercile	(0.023)	(0.00171)	(0.0051)	(0.0015)	(0.0343)	(0.0037)
Middle Tercile	-0.016	0.00010	-0.0039	-0.0005	0.0046	-0.0073
	(0.012)	(0.00146)	(0.0024)	(0.0012)	(0.0073)	(0.0035)
Bottom Tercile	-0.000	-0.00001	-0.0043	-0.0011	-0.0182	-0.0021
	(0.014)	(0.00231)	(0.0027)	(0.0012)	(0.0107)	(0.0049)
R^2	0.71	0.67	0.63	0.55	0.66	0.60
# States	51	51	51	51	51	51
# Observations	9,728,314	9,728,314	9,728,314	9,728,314	9,728,314	9,728,314

Note: Data cover the 2005-2012 period except for the prescription data which is from 2006-2012 and imaging and testing which is from 1999-2015. The unit of observation is beneficiary-year. Numbers reported in the rows are coefficients and standard errors (in parenthesis, clustered by state) on the Fully Independent variable fully interacted with indicators for terciles of the NP share of PCPs from regressions of the level of each of the dependent variables on an indicator for states allowing NPs full independence fully interacted with indicators for terciles of the NP share of PCPs, beneficiary age fixed effects, PA scope of practice indicators, county characteristics, beneficiary fixed effects, year fixed effects, and state fixed effects. Lower terciles are associated with a lower share of NPs.

Table A.9: Effect of Expanding NP Scope of Practice on Higher Intensity Care and Health for Medicare Beneficiaries - Rural Areas

Dependent Variable:	Inpatient Admissions	Log Inpatient Spending	Readmissions	ER Visits	Mortality
Fully Independent	-0.025	-0.08	-0.0079	-0.0162	-0.0018
	(0.013)	(0.04)	(0.0055)	(0.0089)	(0.0012)
Fully Independent×	-0.004	-0.01	-0.0006	0.0042	-0.0005
Rural	(0.007)	(0.03)	(0.0021)	(0.0127)	(0.0012)
Rural	-0.010	-0.05	-0.0023	-0.0006	-0.0046
	(0.003)	(0.01)	(0.0011)	(0.0050)	(0.0008)
R^2	0.35	0.29	0.26	0.39	0.59
# States	51	51	51	51	51
# Observations	24,586,939	24,586,939	24,586,939	24,586,939	24,586,939

Note: Data cover the 1999-2015 period. The unit of observation is beneficiary-year. Numbers reported in the rows are coefficients and standard errors (in parenthesis, clustered by state) on the Fully Independent variable fully interacted with an indicator for rural counties from regressions of the level of each of the dependent variables on an indicator for states allowing NPs full independence fully interacted with an indicator for a rural county, beneficiary age fixed effects, PA scope of practice indicators, beneficiary fixed effects, year fixed effects, and state fixed effects.

Table A.10: Effect of Expanding NP Scope of Practice on Higher Intensity Care and Health for Medicare Beneficiaries - PCP Shortage Areas

Dependent Variable:	Inpatient Admissions	Log Inpatient Spending	Readmissions	ER Visits	Mortality
Fully Independent	-0.017	-0.05	-0.0052	-0.0116	-0.0013
	(0.013)	(0.04)	(0.0058)	(0.0101)	(0.0011)
Fully Independent×	-0.018	-0.05	-0.0061	-0.0084	-0.0012
PCP Shortage Area	(0.007)	(0.02)	(0.0027)	(0.0085)	(0.0006)
PCP Shortage Area	0.003	0.00	0.0015	0.0062	0.0000
	(0.002)	(0.01)	(0.0007)	(0.0028)	(0.0004)
R^2	0.35	0.29	0.26	0.39	0.59
# States	51	51	51	51	51
# Observations	24,586,939	24,586,939	24,586,939	24,586,939	24,586,939

Note: Data cover the 1999-2015 period. The unit of observation is beneficiary-year. Numbers reported in the rows are coefficients and standard errors (in parenthesis, clustered by state) on the Fully Independent variable fully interacted with an indicator for counties that are PCP shortage areas from regressions of the level of each of the dependent variables on an indicator for states allowing NPs full independence fully interacted with an indicator for a PCP shortage counties, beneficiary age fixed effects, PA scope of practice indicators, beneficiary fixed effects, year fixed effects, and state fixed effects.

Table A.11: Effect of Expanding NP Scope of Practice on Higher Intensity Care and Health for Medicare Beneficiaries - By NP Share of PCPs

Dependent Variable:	Inpatient Admissions	Log Inpatient Spending	Readmissions	ER Visits	Mortality
Fully Independent	-0.026	-0.085	-0.0078	-0.0265	-0.0040
	(0.011)	(0.038)	(0.0040)	(0.0119)	(0.0016)
Fully Independent×	0.001	0.009	-0.0010	0.0151	0.0032
Middle Tercile	(0.008)	(0.024)	(0.0034)	(0.0123)	(0.0013)
Fully Independent×	0.003	0.000	0.0018	0.0215	0.0027
Bottom Tercile	(0.011)	(0.036)	(0.0057)	(0.0176)	(0.0013)
Middle Tercile	-0.005	-0.019	-0.0012	-0.0010	-0.0010
	(0.004)	(0.013)	(0.0013)	(0.0039)	(0.0006)
Top Tercile	-0.007	-0.031	-0.0012	-0.0085	-0.0016
	(0.004)	(0.016)	(0.0015)	(0.0061)	(0.0008)
	0.35	0.29	0.26	0.39	0.59
# States	51	51	51	51	51
# Observations	24,555,757	24,555,757	24,555,757	24,555,757	24,555,757

Note: Data cover the 1999-2015 period. The unit of observation is beneficiary-year. Numbers reported in the rows are coefficients and standard errors (in parenthesis, clustered by state) on the Fully Independent variable fully interacted with indicators for terciles of the NP share of PCPs from regressions of the level of each of the dependent variables on an indicator for states allowing NPs full independence fully interacted with indicators for terciles of of the the NP share of PCPs, beneficiary age fixed effects, PA scope of practice indicators, county characteristics, beneficiary fixed effects, year fixed effects, and state fixed effects. Lower terciles are associated with a lower share of NPs.

Table A.12: Effect of Expanding NP Scope of Practice on Higher Intensity Care and Health for Medicare Beneficiaries - By Patient Health

Dependent Variable:	Inpatient Admissions	Log Inpatient Spending	Readmissions	ER Visits	Mortality
Fully Independent	-0.012	-0.035	-0.0030	-0.0210	-0.0065
	(0.011)	(0.040)	(0.0042)	(0.0110)	(0.0017)
Fully Independent×	0.000	0.002	0.0001	0.0083	0.0028
Middle Tercile	(0.002)	(0.010)	(0.0007)	(0.0036)	(0.0006)
Fully Independent×	-0.030	-0.101	-0.0109	0.0053	0.0103
Bottom Tercile	(0.014)	(0.052)	(0.0048)	(0.0188)	(0.0026)
Middle Tercile	0.001	-0.041	0.0021	0.0263	0.0014
	(0.001)	(0.004)	(0.0003)	(0.0019)	(0.0003)
Bottom Tercile	0.033	-0.028	0.0138	0.1172	0.0272
	(0.002)	(0.010)	(0.0008)	(0.0041)	(0.0008)
	0.35	0.30	0.26	0.40	0.60
# States	51	51	51	51	51
# Observations	21,261,218	21,261,218	21,261,218	21,261,218	21,261,218

Note: Data cover the 1999-2015 period. The unit of observation is beneficiary-year. Numbers reported in the rows are coefficients and standard errors (in parenthesis, clustered by state) on the Fully Independent variable fully interacted with indicators for terciles of beneficiary health from regressions of the level of each of the dependent variables on an indicator for states allowing NPs full independence fully interacted with indicators for terciles of beneficiary health, beneficiary age fixed effects, PA scope of practice indicators, county characteristics, beneficiary fixed effects, year fixed effects, and state fixed effects. Lower terciles are associated with worse health.

Table A.13: Effect of Expanding NP Scope of Practice on Outpatient Care and Tests for Medicare Beneficiaries - By Patient Health

Dependent Variable:	Office Visits (E&M Visits)	Checkups (Well Visits)	Prescriptions	Log Rx Spending	Log Imaging Spending	Log Testing Spending
Fully Independent	-0.004	-0.00027	-0.755	0.022	-0.013	-0.016
	(0.035)	(0.00017)	(0.459)	(0.075)	(0.044)	(0.036)
Fully Independent×	0.029	0.00009	0.040	0.007	0.026	0.039
Middle Tercile	(0.014)	(0.00012)	(0.136)	(0.012)	(0.009)	(0.007)
Fully Independent×	0.033	0.00001	0.066	0.004	-0.092	-0.099
Bottom Tercile	(0.073)	(0.00012)	(0.595)	(0.033)	(0.020)	(0.027)
Middle Tercile	-0.043	0.00012	0.298	-0.029	-0.093	-0.126
	(0.007)	(0.00003)	(0.049)	(0.005)	(0.004)	(0.005)
Bottom Tercile	-0.164	0.00014	3.397	0.170	-0.084	-0.049
	(0.017)	(0.00004)	(0.197)	(0.010)	(0.005)	(0.008)
R^2	0.62	0.19	0.83	0.88	0.44	0.55
# States	51	51	51	51	51	51
# Observations	10,396,507	10,396,507	8,963,964	8,963,964	21,261,218	21,261,218

Dependent Variable:	Schedule II Narcotics	Schedule II Non-narcotics	Schedule III Narcotics	Schedule III Non-narcotics	Schedule IV	Schedule V
Fully Independent	-0.083	0.00163	0.0039	-0.0016	0.0371	0.0004
	(0.029)	(0.00061)	(0.0040)	(0.0017)	(0.0168)	(0.0025)
Fully Independent×	0.009	0.00039	-0.0004	0.0009	-0.0004	-0.0033
Middle Tercile	(0.007)	(0.00042)	(0.0018)	(0.0004)	(0.0040)	(0.0017)
Fully Independent×	0.067	0.00096	-0.0060	0.0002	0.0040	-0.0037
Bottom Tercile	(0.032)	(0.00142)	(0.0025)	(0.0009)	(0.0110)	(0.0031)
Middle Tercile	0.012	0.00041	0.0002	0.0000	0.0058	0.0027
	(0.003)	(0.00020)	(0.0004)	(0.0002)	(0.0018)	(0.0007)
Bottom Tercile	0.109	0.00259	0.0017	0.0012	0.0389	0.0117
	(0.009)	(0.00048)	(0.0008)	(0.0003)	(0.0042)	(0.0013)
R^2	0.70	0.66	0.64	0.55	0.66	0.60
# States	51	51	51	51	51	51
# Observations	8,963,964	8,963,964	8,963,964	8,963,964	8,963,964	8,963,964

Note: Data cover the 2005-2012 period except for the prescription data which is from 2006-2012 and imaging and testing which is from 1999-2015. The unit of observation is beneficiary-year. Numbers reported in the rows are coefficients and standard errors (in parenthesis, clustered by state) on the Fully Independent variable fully interacted with indicators for terciles of beneficiary health from regressions of the level of each of the dependent variables on an indicator for states allowing NPs full independence fully interacted with indicators for terciles of beneficiary health, beneficiary age fixed effects, PA scope of practice indicators, county characteristics, beneficiary fixed effects, year fixed effects, and state fixed effects. Lower terciles are associated with worse health.