The Impact of Physician Fee Schedule Introductions in Workers Compensation: An Event Study

Frank Schmid and Nathan Lord

Abstract

Motivation. Quantifying the impact of the introduction of physician fee schedules in workers compensation is an integral part of NCCI legislative pricing. Although the vast majority of U.S. states have physician fee schedules in place, a small number of jurisdictions operate without such a legal provision. Several studies have attempted to measure the impact of fee schedule introductions on the price and utilization of medical services provided by physicians. None of these analyses delivered evidence of an aggregate utilization increase in response to fee schedule introductions, although some point to changes in utilization for isolated procedures. Further, this prior research established overwhelming evidence that fee schedules contribute to lower price levels and lower rates of price level increases.

Method. This study analyzes the introduction of workers compensation physician fee schedules in two states: Tennessee (which adopted a fee schedule in July 2005) and Illinois (February 2006). Event study methodology is used to quantify the aggregate effect of these legislative actions. This aggregate effect is measured by a change in the severity index, which comprises both the price and utilization responses. Time series modeling is used to forecast the severity and utilization indexes that would have been observed absent the fee schedule introduction. The differences between observed (net of noise) and forecast severity and utilization indexes in the third month of fee schedule operation then serve as estimates for the impacts of the fee schedule implementation. The price response to this cost containment measure is backed out of the severity and utilization responses. In a sensitivity analysis, the price level response is obtained by comparing the price level of the third post-implementation month to the price level of the final pre-implementation month; the change in the price level thus measured is then combined with the estimated utilization effect to arrive at the severity response.

Results. In both jurisdictions, the fee schedule introductions contribute to a marked decline in the price level of medical services provided by physicians, as well as a permanent weakening in the rate at which this price level subsequently increases. In Tennessee, the price level declines in excess of 7 percent, and the annual rate of inflation lessens by 0.3 percentage points. By comparison, in Illinois, the price level drops by slightly more than 5 percent and the annual rate of inflation decreases by 0.6 percentage points. In Tennessee, there is a negative utilization response, which may be related to a restriction on physician choice that was implemented prior to the fee schedule introduction. For Illinois, the utilization response is essentially nil.

Availability. The statistical model was implemented in R (cran.r-project.org), using the R package *forecast* (cran.r-project.org/web/packages/forecast/index.html).

Keywords. Physician Fee Schedules, Utilization, Workers Compensation

1. INTRODUCTION

Quantifying the impact of the introduction of physician fee schedules in workers compensation is an integral part of NCCI legislative pricing. Although the vast majority of U.S. states have physician fee schedules in place, a small number of jurisdictions operate without such a legal provision. Several studies have attempted to measure the impact of fee schedule introductions on the price and utilization of medical services provided by physicians. None of these analyses delivered evidence of an aggregate utilization increase in response to fee schedule introductions, although some point to

changes in utilization for isolated procedures. Further, this prior research established overwhelming evidence that fee schedules contribute to lower price levels and lower rates of price level increases.

This study analyzes the introduction of workers compensation physician fee schedules in two states: Tennessee (which adopted a fee schedule in July 2005) and Illinois (February 2006). Event study methodology is used to quantify the aggregate effect of these legislative actions. This aggregate effect is measured by a change in the severity index, which comprises both the price and utilization responses. Time series modeling is used to forecast the severity and utilization indexes that would have been observed absent the fee schedule introduction. The differences between observed (net of noise) and forecast severity and utilization indexes in the third month of fee schedule operation then serve as estimates for the impacts of the fee schedule implementation. The price response to this cost containment measure is backed out of the severity and utilization responses. In a sensitivity analysis, the price level response is obtained by comparing the price level of the third post-implementation month to the price level of the final pre-implementation month; the change in the price level thus measured is then combined with the estimated utilization effect to arrive at the severity response.

1.1 Research Context

Studies on the impact of physician fee schedules fall into two categories. First, there are analyses that compare, for a given point in time, states with a physician fee schedule to states without such a legal provision. Second, there are single-state studies that focus on the time windows before and after the fee schedule introduction or, alternatively, compare workers compensation medical care to Group Health. Cross-state studies may be most suited for discerning the long-term effects of fee schedule introductions, although isolating the contribution of a physician fee schedule from other cost containment measures can be challenging. Paradoxically, now that the vast majority of states utilize physician fee schedules in workers compensation, gauging the degree to which these legal provisions succeed in containing the medical costs of workers compensation claims becomes an increasingly demanding task—this is because the counterfactual becomes progressively difficult to establish. Then again, single-state studies of the long-term effects of fee schedule introductions have their own challenges—the reason is that, over time, the analyzed jurisdictions may experience a host of changes to the legislative and economic environment that affect the provision of medical services by physicians in workers compensation. Examples of such changes include restrictions on physician choice and programs that provide incentives for returning to work.

Early cross-state studies of the effect of physician fee schedule introductions on the medical costs of workers compensation claims include a 1986 paper by Borba [2], research published in 1989 by the National Council on Compensation Insurance [14], an analysis by Boden and Fleischman [1] of

the same year, and a paper by Durbin and Appel [4] from 1991. Further studies were published by Pozzebon [15] in 1994 and by Robertson and Corro [21] in 2007.

In a preliminary analysis, Borba [2] compares the medical costs per claim of fee schedule states to non-fee schedule states. The author draws on workers compensation claims filed in 1980 and 1983, as recorded in the Detailed Claims Information (DCI) database of the National Council on Compensation Insurance (NCCI). The 1980 data set comprises three fee schedule jurisdictions (Florida, Massachusetts, and New York) and 10 non-fee schedule jurisdictions; the 1983 data set covers four fee schedule jurisdictions (Hawaii, Florida, Massachusetts, and Oregon) and 8 non-fee schedule jurisdictions. The author standardizes the medical care expenditures of the various states using information from the Health Care Financing Administration (HCFA). Borba finds that in the 1980 (1983) data set, the costs per claim are 9.0 (15.4) percent lower in fee schedule states than in non-fee schedule states.

The 1989 article by the National Council on Compensation Insurance [14] relates preliminary findings of a study undertaken by the NCCI Research Division. This study covers the time period 1965 through 1984 and an undisclosed number of jurisdictions; there are 512 annual observations. Based on an econometric time series–cross section approach, physician fee schedules are found to reduce the average medical costs per claim by 11.9 percent. Following this preliminary analysis, Durbin and Appel [4] published final results two years later, using a data set that spans the same time period (1965 through 1984) and comprises 33 jurisdictions. In this refined study, the authors arrive at a long-term effect of physician fee schedules on the medical costs per claim of a negative 3.5 percent; in a sensitivity analysis, a variation of the employed econometric model delivers a cost reduction of 5.4 percent.

The two multi-state studies, Boden and Fleischman [1] and Pozzebon [15], find no evidence for cost containment effects of physician fee schedules in workers compensation. The study by Boden and Fleischman provides an extensive analysis of the medical costs of workers compensation claims in 43 jurisdictions over the time period 1965 through 1985. The data were obtained from the National Council on Compensation Insurance, independent rating bureaus, and exclusive state funds. In a statistical analysis, the authors correlate for 41 jurisdictions the average annual rate of medical cost growth with the presence of a fee schedule. The measured correlation, although negative, is weak. Boden and Fleischman state that this lack of a statistical relation does not provide evidence for fee schedules having no effect and call for a more elaborate statistical analysis.

The approach pursued by Pozzebon [15] differs from the six discussed cross-state studies in that it makes use of individual claims data, as opposed to aggregates. The analyzed set of workers compensation claims consists of a random sample of 31,707 claims, which was drawn from a total

of 316,280 claims recorded in the NCCI DCI database. Only claims that could be considered closed 18 months after the date of injury were included in the sample. The observations range from injury years 1979 through 1987 and comprise 17 jurisdictions. The author reports eight versions of a time series–cross section model, all of which establish a statistically significant influence of physician fee schedules on the medical costs of workers compensation claims. In seven specifications, this influence is positive; the estimated percentage effect varies between 6.2 percent and 10.5 percent. Then again, in one specification, this influence is negative, measuring minus 6.8 percent. According to the author, the study suggests that physician fee schedules (among other measures of cost control) are not effective in containing the medical costs of workers compensation claims.

Robertson and Corro [21] use the least granular data of all cross-state studies when comparing individual medical transactions in workers compensation to Group Health. The data set of medical transactions related to workers compensation claims was provided by a set of insurance carriers. The Group Health data were obtained from MEDSTAT Group, Inc. (now known as Thomson Medstat) and comprise medical transactions related to PPOs, HMOs, and traditional health care plans. The analysis covers the time period 1997 through 2004 and encompasses 14 jurisdictions. Robertson and Corro show that in the jurisdictions without a fee schedule (Illinois, Indiana, and Tennessee), medical prices in workers compensation have the highest markup over Group Health.

An early single-state study on the effect of fee schedule introductions was sponsored by the Minnesota Department of Labor and Industry [13] and released in 1990. Further single-state studies were published in 1994 by Roberts and Zonia [20] on Michigan, and in 2010 by Radeva et al. [17] [18] on Illinois and Tennessee.

The 1990 study sponsored by the Minnesota Department of Labor and Industry [13] contrasts the costs of medical care associated with the workers compensation claims of a large insurance carrier to the costs of medical care experienced by Blue Cross/Blue Shield Minnesota for similar injuries. Further, this research investigates how medical costs per claim and charges for certain types of injury in the Minnesota workers compensation system compare to other states. The study concludes that there is no evidence that the physician fee schedule in Minnesota had a "significant direct impact on medical expenditures." The authors acknowledge that the "ineffectiveness is due in large part to faulty design of the medical fee schedule. Strategies that may increase effectiveness include limiting reimbursements to hospitals and mandating utilization review."

Roberts and Zonia [20] analyze the introduction of a physician fee schedule in Michigan. This fee schedule became effective in August 1989, along with a utilization review process. The authors compare the medical costs of workers compensation claims of the post-implementation time period October 1, 1989 through March 31, 1990 to the corresponding six-month time window in the prior

year. The data set was provided by an insurer that accounted for about 17 percent of premium dollars in the voluntary workers compensation market in this jurisdiction at the time. Only claims for which the medical treatment started in the stated time intervals were included. The sample size in the pre-implementation time window equaled 6,997, compared to 9,620 in the time interval following the implementation. Roberts and Zonia find that the median medical costs of workers compensation claims were 25.7 percent higher in the post-implementation time window; by comparison, from October 1988 to March 1990, the medical care component of the Consumer Price Index (CPI) increased by only 12.4 percent. The authors conclude that there is no evidence that the implementation of a physician fee schedule in Michigan decreased the medical costs of workers compensation claims.

In two studies, Radeva et al. [17] [18] analyze the impact of the introduction of physician fee schedules in Illinois and Tennessee. The Tennessee fee schedule took effect in July 2005; the Illinois fee schedule became operational in February 2006. In both jurisdictions, the physician fee schedule was part of a comprehensive set of policy actions concerning the reimbursement of medical care provided by physician and hospitals in the context of workers compensation. The authors quantify the impact of these legislative reform packages using workers compensation claims with more than seven days of lost time. For Tennessee, the authors are able to show that, following the fee schedule introduction, the medical costs per claim stabilized at the pre-implementation level. By comparison, during the three years prior to this legislative action taking effect, the medical costs per claim had increased at an annual rate of 7 percent, on average. Similarly, for Illinois, the authors find that the rate of growth of medical payments per claim slowed to 5 percent from the 12 percent annual average that was observed during the three years leading up to the fee schedule.

None of the discussed research publications provides persuasive findings of a systematic effect of fee schedule introductions on the utilization of medical care in workers compensation. Of the cross-state studies, only Borba [2] and Robertson and Corro [21] investigate the degree to which the impact of fee schedules on the cost of medical care may be due to differences in utilization. Borba reports that the number of office visits is higher in fee schedule states than in non-fee schedule states but cautions that this finding may be related to differences in compensability associated with waiting periods. Robertson and Corro, who study a dozen common workers compensation injuries for 14 jurisdictions, find no evidence of an impact of fee schedules on utilization.

Among the mentioned single-state studies, Roberts and Zonia [20] and Radeva et al. [18] address possible utilization effects of fee schedule introductions. Roberts and Zonia discover a decrease in the number of procedures to treat patients when comparing the post-implementation time window to the pre-implementation time interval surrounding the Michigan fee schedule implementation. Although this decrease in the supply of medical care is not statistically significant, in the context of a

statistically significant decrease in the duration of treatment, the finding points to a reduction in utilization. Then again, the authors document a "dramatic change … in the use of procedures for which there was no specific maximum fee in the fee schedule." Finally, Radeva et al. state that, following the Tennessee fee schedule introduction, "utilization by major nonhospital services … did not change significantly."

1.2 Objective

The objective of this study is to evaluate the impacts of fee schedule introductions on the medical costs of workers compensation claims. The medical costs of these claims are measured using a concept of contemporaneous severity. This concept of severity encompasses both the price and the quantity of medical services consumed within a given time window, where the consumption is normalized by the number of claims active during this time window. As a consequence of the contemporaneous nature of the severity measure, changes in the consumption of medical services associated with variations in claim duration are not accounted for.

This being an event study on a small set of jurisdictions, the impact of fee schedule introductions is measured on an unconditional basis. Specifically, the impact is not conditioned on the legislative environment of the jurisdiction, its demographic characteristics, or its economic conditions. Most important, the analysis does not attempt to isolate the contribution of the physician fee schedule to the efficacy of the whole body of cost containment measures; some of these measures may have been introduced alongside the fee schedule or may have been in place at the time this legal stipulation became effective. Among such cost containment initiatives may be mandatory utilization reviews, restrictions on physician choice, and hospital fee schedules.

1.3 Outline

What follows in Section 2 is a description of the data on fee schedules and medical transactions that are employed in this study. Section 3 outlines the severity, price, and utilization indexes used to gauge the responses to the fee schedule introductions; further, this section introduces the concept of price departure and offers a description of the time series model that establishes the counterfactual, defined as the situation that would have been observed absent the fee schedule introduction. Next, Section 4 presents the measured effects of the fee schedule introductions for the two analyzed states. Section 5 concludes.

2. THE DATA

The study uses data from two sources. First, physician fee schedules were obtained from Ingenix Inc. (now known as OptumInsight, Inc.) and employed in the analysis as stated by this data

provider. Second, the effects of fee schedule introductions were measured on a large set of medical transactions associated with workers compensation claims. These transaction records cover the time period January 1, 2000 through December 31, 2010 and were provided by a set of insurance carriers.

The jurisdictions analyzed in this study are Tennessee and Illinois. The jurisdiction state criterion and provider zip code information are used when linking medical transactions to a given state. Neither of the two states operates a state fund; both Tennessee and Illinois operate second injury funds, which are not associated with significant numbers of transactions and not included in the data set. As measured by written premium, for the year 2006, the market share of the carriers contributing to the medical transaction data set equals 30.7 percent for Tennessee and 32.8 percent for Illinois. In this market share computation, the self-insured are excluded.

The data set excludes transactions associated with medical services provided by hospitals and ambulatory surgical centers, but includes transactions related to services delivered by physicians (as the provider type) at these places of service. The medical transactions data were edited using expert knowledge on billing and reimbursement practices, and the data set was cleansed using statistical tools of outlier detection. For an overview on the employed data cleansing tools, see the appendix (Section 6).

The medical services associated with the obtained transaction records can be categorized into the American Medical Association (AMA) service categories Evaluation and Management Services, Anesthesia, Surgery, Radiology, Pathology and Laboratory, and Medicine. Transactions related to Anesthesia were excluded from the study due to difficulties in quantifying the units of service that are associated with the individual records. Pathology and Laboratory tends to be sparsely populated and, although included in All Categories, is consequently not studied as an independent service category. Physical Medicine, as a subcategory of Medicine, is defined by Current Procedural Terminology (CPT) codes ranging from 97001 through 97799.

For the purpose of this study, medical services are identified by a combination of CPT code and modifier; only modifiers that are recognized by fee schedules are considered. For transactions associated with a thus identified medical service, the maximum allowable reimbursement (MAR) may vary by geozip (geographic areas identified by arrays of zip codes; Illinois only) and place of service. Where such variation exists, the MAR of a given medical service cannot be read directly from the fee schedule but instead needs to be calculated for any given month as a weighted average across geozips and places of service, where the weights are the number of units of service provided.

For a given medical service, the study recognizes a MAR only if the fee schedule specifies a dollar amount (dubbed fixed-value MAR), as opposed to defining the MAR as usual and customary or in percent of billed charges, for instance. When a fee schedule change occurs mid-month, for the

purpose of calculating the average MAR of a given medical service for that month, the pertinent fee schedules are prorated based on the numbers of units of service provided under each regime.

Because the MAR that applies to a given medical transaction may differ with the place of service and (in Illinois) across geozips, the average monthly MAR of a given medical service may vary over time for a given fee schedule. This is because the distribution of transactions by place of service and geozip may change from month to month.

3. RESEARCH FRAMEWORK

The impact of fee schedule introductions is analyzed in a time window surrounding the fee schedule effective date. The counterfactual is established using a time series model that is calibrated to a multi-year pre-implementation time period. This way, possible changes in behavior associated with the anticipation of the fee schedule on the part of claimants, physicians, and insurers have only a dampened impact on the measured effect.

3.1 Price, Utilization, and Severity Indexes

The impact of fee schedule introductions is read from indexes. These indexes are on a monthly basis and calculated for the mentioned AMA categories and, these service categories taken together, for All Categories. Further, these indexes are computed for Physical Medicine, which constitutes a subset of the AMA category Medicine.

Price indexes are calculated for two sets of prices. First, there is a price index calculated from reimbursed amounts, encompassing all medical services. Second, there is a price index based on the fee schedule, comprising only medical services subject to a fixed-value MAR.

Both price indexes are Fisher indexes—prices and quantities are measured on the level of the medical service. Technically, the Fisher index is the geometric mean of the Laspeyres and Paasche indexes. The Laspeyres index compares the set of prices of the current month to the set of prices of the previous month, using as weights the quantities of medical services of the previous month. The Paasche index undertakes this comparison by using as weights the quantities of the current month.

The formula for the Laspeyres index reads

$$P_L = \frac{\sum_i p_i q_{i-1}}{\sum_i p_{i-1} q_{i-1}} \ . \qquad (1)$$

By comparison, the equation for the Paasche index is given by

$$P_P = \frac{\sum_i p_i q_i}{\sum_i p_{i-1} q_i} \ . \tag{2}$$

In the equations above, swapping prices for quantities and vice versa delivers the Laspeyres and Paasche quantity indexes. Analogous to the Fisher price index, the Fisher quantity index is obtained as the geometric mean of the Laspeyres and Paasche quantity indexes. For details on price and quantity indexes, see International Labour Office [10].

The Fisher index has a host of desirable properties. The most important property of the Fisher index in the context of this study is its ability to break down accurately the price and quantity responses to changes in relative prices. For instance, if the structure of consumed medical services changes in response to some services increasing in price less than others, then the Laspeyres (Paasche) price index overestimates (underestimates) the rate of inflation in the event that medical consumption shifts toward services that have increased in price comparatively less. This bias occurs because the Laspeyres index is based on the quantities of the previous month, which do not yet account for the shift in consumption toward the services that have become comparatively less expensive. Conversely, the Paasche index draws on the new quantities, thereby biasing the reading of the rate of inflation in the opposite direction.

The Fisher quantity index corresponds to the Fisher price index at reimbursed amounts—both concepts encompass medical services regardless of their fee schedule treatment. The product of these two Fisher indexes is related to the transaction volume. Specifically, the percentage change from the previous month of the product of the Fisher price and quantity indexes equals the percentage change in the transaction volume on which these indexes are calculated.

A utilization index is calculated by normalizing the Fisher quantity index by the number of active claims in the applicable month. This utilization index is again calculated for the mentioned service categories and for All Categories. Note that the number of active claims in a given month may vary across service categories. Specifically, a claim is considered active in a given service category (in All Categories) if there is a transaction associated with this claim in this service category (in any service category) that enters the price index for this service category (for All Categories) in that month.

A severity index is calculated as the product of the Fisher price index at reimbursed amounts and the utilization index. The following relation holds among the rates of severity growth (s), the rate of inflation (p), and the rate of utilization growth (u):

$$s = (1+p)\cdot(1+u) - 1 \ . \tag{3}$$

The utilization index represents a contemporaneous concept of utilization, since it builds only on transactions that have been observed in the month under consideration. To the degree to which the consumption of medical services provided by physicians is front-loaded in the lifetime of a claim, the utilization index (and, hence, the severity index) may increase in response to an influx of claims. This property of the utilization index may explain some of the seasonal variation that the utilization and the severity indexes display over the course of the calendar year. Seasonality in the utilization of medical services is to be expected, given the influence of climactic conditions on economic activity, in particular in the construction and leisure and hospitality industries. Finally, to the degree to which there is front-loading of medical services in the lifetime of a claim, the utilization index may decrease in response to a systematic increase in claim duration.

In Tennessee, in Physical Medicine, the MAR of a given medical service may be regressive with respect to the number of units of service provided to the claimant. Due to data limitations, this regression in MAR was not factored into the computation of the price index at fee schedule.

3.2 Price Departure

Typically, medical services provided by physicians are reimbursed at or below fee schedule, although jurisdictions vary by the degree to which the stipulated price ceilings are enforced. For instance, in Tennessee, the Commissioner may assess civil penalties for fee schedule violations at his discretion. By comparison, in Illinois, reimbursement above fee schedule is permitted when agreed to pursuant to a written contract.

Price departure measures the deviation of reimbursement from fee schedule. Specifically, price departure is defined as the ratio of transaction volume at reimbursed amounts to transaction volume at fee schedule, minus 1. In the denominator, for transactions associated with medical services that are not subject to a fixed-value MAR, reimbursed amounts substitute for the fee schedule. Medical services that are not subject to a fixed-value MAR are subject to price ceilings that are defined as a percentage of charges or are subject to usual and customary reimbursement (which may be defined as a function of charges). The transaction volume that contributes to the price departure calculation is slightly more comprehensive than the transaction volume that finds its way into the computation of the price and quantity indexes. This is because medical services enter the price (or quantity) index of a given month only if there is at least one transaction associated with these services in both the current month and the prior month.

Similar to the price, utilization, and severity indexes, price departure is calculated on a monthly basis for All Categories, the mentioned AMA categories, and Physical Medicine. To provide a numerical example, a price departure of minus 0.05 (or, equivalently, a negative 5 percent) states that the reimbursed amounts are 5 percent below fee schedule, on average.

Changes in the difference between the price indexes at reimbursed amounts and at fee schedule do not map exactly into changes in price departure. For instance, for a given array of prices, the price index does not respond to changes in quantities. By contrast, the price departure may increase for given reimbursement practices and a given fee schedule if the distribution of transactions shifts in favor of medical services that exhibit a comparatively large spread between MAR and reimbursed amount.

For Tennessee, in keeping with the computation of the price index at fee schedule, the regressive nature of the fee schedule in Physical Medicine was not factored into the computation of the price departure.

3.3 Time Series Model

The impact of a fee schedule introduction is measured by the difference between the observed severity index net of noise and the severity index that is estimated to have materialized absent the fee schedule. This aggregate impact is broken down into the price and utilization responses. The utilization response is again measured by the difference between the observed value net of noise and the counterfactual. After establishing the severity and utilization responses in this way, the price response is obtained as a residual. No prorating of the responses is necessary because, in both jurisdictions, the fee schedule introduction took effect on the first day of the month.

Visual inspection of the severity and price index charts indicates that the responses of these indexes to the fee schedule introductions have come to completion by the third post-implementation month; this holds for both analyzed jurisdictions and across all service categories. This short time lag in the response to fee schedule introductions agrees with the response to fee schedule changes documented in Schmid and Lord [23]. According to these authors, the bulk of the price and severity adjustments to fee schedule changes occur within the first two months of the new fee schedules having taken effect.

For the severity and utilization indexes, observed index values net of statistical noise and counterfactual index values are established using a univariate time series model. The statistical model is applied to the respective index through the final pre-implementation month for the purpose of generating forecasts for the post-implementation months. The third month of the forecast time period establishes the counterfactual of interest. Next, the statistical model is applied to the post-implementation observations, starting in the third month of the fee schedule operation. The first fitted value in this post-implementation time series delivers the observed value net of noise that is compared to the counterfactual.

The time series model employed in this analysis is a univariate exponential smoothing state-space model called TBATS. This model was developed by De Livera, Hyndman, and Snyder [5] and is available as part of the R package *forecast*. TBATS stands for Trigonometric, Box-Cox transform, ARMA errors, Trend, and Seasonal components, which summarizes the basic characteristics of this model. The seasonal components of the model are based on a trigonometric specification, which distinguishes this approach from the competing BATS model—the trigonometric specification limits the number of parameters in the seasonal components of the model. The number of seasonal periods was set to 12, thus acknowledging the monthly nature of the time series. Auto-regressive moving average (ARMA) errors were permitted, as well as the Box-Cox transform (which corrects for possible non-normality). For the purpose of forecasting, trend dampening was employed, although this may have little impact, given the short forecasting horizon of only three data points. Automatic model selection was employed using the Akaike information criterion (AIC).

4. IMPACT OF PHYSICIAN FEE SCHEDULE INTRODUCTIONS

This section presents the impacts of physician fee schedule introductions on the price, utilization, and severity indexes of medical care provided by physicians in the context of workers compensation. These impacts are discussed in their overall effect (All Categories) and, for illustration, in their effect on an individual service category or subcategory. For Tennessee, this category is Evaluation and Management Services and, for Illinois, it is Physical Medicine. The monthly price, utilization, and severity indexes run from January 2000 through December 2010. The fee schedule introductions in the two states occur approximately in the middle of the observed 11-year time period. Further, the events of interest occurred well ahead of the economic downturn that started in December 2007 (www.nber.org/cycles.html).

4.1 Tennessee

In 2004, the Tennessee Workers' Compensation Act underwent a sweeping reform. As a result of this legislative action, a physician fee schedule was introduced, effective July 1, 2005. This fee schedule became mandatory on January 1, 2006.

The Tennessee fee schedule was designed as a multiple of the applicable Medicare fee schedule, where the multiplicative factors vary by procedure. For repeat services in occupational and physical therapy, these multiples regress to unity, thereby gradually lowering the price ceiling to 100 percent of the amount reimbursable under Medicare. Reimbursement of procedures not explicitly covered by the fee schedule is limited to the lesser of usual and customary and 100 percent of Medicare. Prior to the fee schedule introduction, reimbursement was subject to usual and customary practices, as defined by the Medical Care and Cost Containment Committee.

As implemented, the Tennessee fee schedule updated annually based on the Medicare Economic Index, upon review by the Commissioner. Having been tied to Medicare in this way, the MAR for a given medical service could change without further legislative action. The first Medicare-related update of the Tennessee physician fee schedule took effect on January 1, 2006.

As part of the 2004 legislative reform, Tennessee limited provider choice. It is mandatory that the employer offer a panel of three physicians. From this list of providers, the employee has the privilege to choose one. The physician may be changed during ongoing treatment only with consent from both the employee and the employer. The employer has to give proof of the existence of the panel by signing a legal form, a copy of which has to be provided to the employee. This provision became effective for injuries on or after July 1, 2004.

The Tennessee data set contains 66 observations prior to the fee schedule implementation, and an equal number following it. All pre-implementation observations feed into the time series model that establishes the counterfactual for the third post-implementation month. All but the first two post-implementation observations are employed in the time series model that eliminates the statistical noise from the observed severity and utilization indexes in the third month of fee schedule operation.

4.1.1 All Categories

Chart 1, top panel, depicts the Fisher price indexes of medical services, at reimbursed amounts and at fee schedule. As mentioned, the price index at fee schedule is based on the fixed-value MAR. When no fixed-value MAR is available (for instance, because the medical service is subject to usual and customary reimbursement or the price ceiling is defined as a percentage of billed charges), this medical service is not involved in the computation of the price index at fee schedule.

In Chart 1, top panel, the first box (June 2005) associated with the price index at reimbursed amounts indicates the final month prior to the fee schedule implementation; the second box (September 2005) points to the third month of fee schedule operation. For this third post-implementation month, the impact of the fee schedule is measured by the difference between the counterfactual and the fitted value.

The displayed price index at fee schedule starts in the third post-implementation month and, for that month, this index is normalized to the price index at reimbursed amounts. If, subsequently, the price index at reimbursed amounts rises above the price index at fee schedule, this implies that since that first common month, on average, the inflation rate of the former has exceeded the inflation rate of the latter (as measured by the compound annual growth rate). As mentioned, the price index at fee schedule may change from month to month, even as the fee schedule does not. This is because the distribution of transactions by place of service may vary over time.

Chart 1: Tennessee, Price Indexes and Price Departure, All Categories

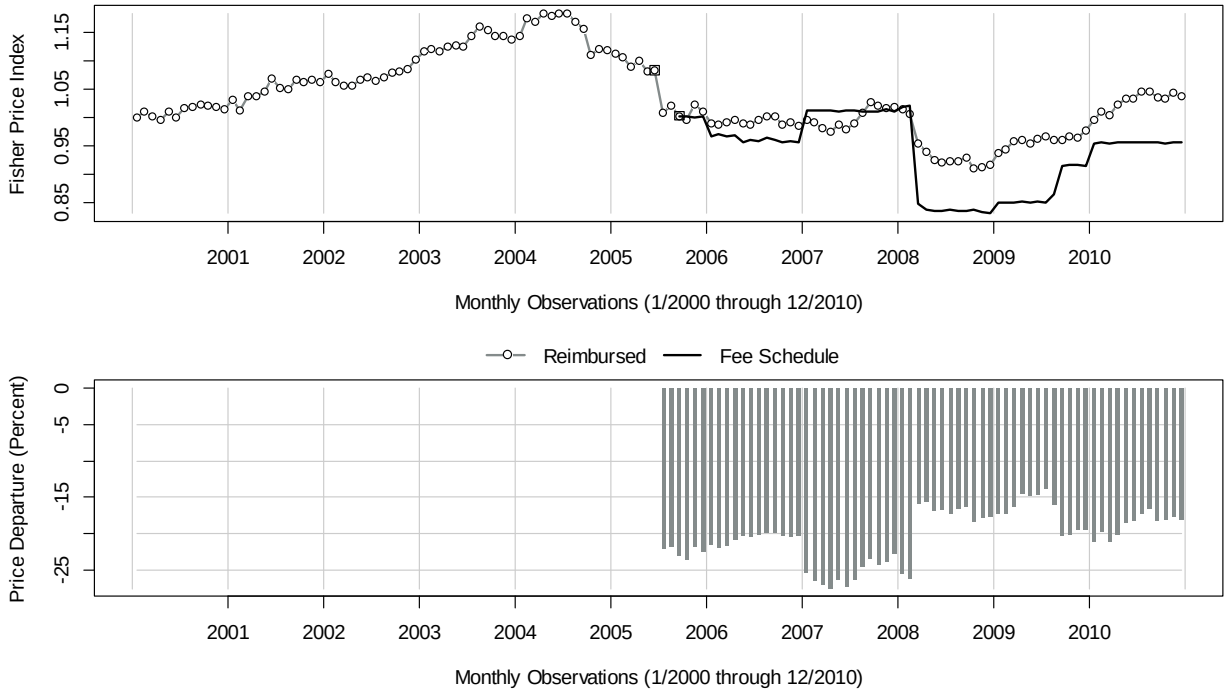


Chart 1, bottom panel, displays the price departure for All Categories, starting in the month the fee schedule took effect. As discussed, the price departure is calculated as the ratio of transaction volume at reimbursed amounts to transaction volume at fee schedule, minus 1. For a given fee schedule, an increase in the price index at reimbursed amounts tends to diminish the magnitude of the price departure, thereby shortening the depicted bars. Yet, as pointed out, changes in the price departure do not perfectly correlate with changes in the vertical distance between the price indexes.

The chart reveals that between the July 2005 fee schedule introduction and the end of 2006, the price departure averaged around minus 21 percent. Then, in January 2007, following a fee schedule increase, the price departure deepened to a value beyond a negative 25 percent. As the reimbursed amounts rose in mid-2007, the price departure retreated slightly. In early 2008, in the course of a major fee schedule decrease, only about half of the stipulated reduction in MAR manifested itself in a decline of the price level at reimbursed amounts. As a result of the limited adjustment, the price departure shrank to about a negative 16 percent.

The fee schedule reduction in early 2008 holds a lesson regarding the interaction between policy decisions and pricing behavior. Following a muted price level response to the 2008 fee schedule reduction, the fee schedule was raised in the second half of 2009. Clearly, during the time period

2008 through 2009, the price level at reimbursed amounts was more stable than the price ceilings imposed by policy actions. Further, the episode shows that the relation between fee schedules and reimbursed amounts is reciprocal.

Chart 2 depicts the severity and the utilization indexes in two panels. The panels, which are drawn on the same scale, display the observed, raw data (light gray) alongside the fitted values (black) generated by the time series model. The time window surrounding the fee schedule introduction is highlighted by a gray box. At the center of this box are the forecasts (dark gray), which are the estimated values in the first three post-implementation months for the hypothetical situation that no fee schedule was introduced. The fee schedule impact is measured by the vertical distance between the final value of these three forecasts and the first fitted value available for the post-implementation time period—both values are from the third month of fee schedule operation. This vertical distance between the observed value net of noise and the counterfactual indicates a 9.3 percent drop in severity (top panel) and a comparatively small 2.0 percent decrease in utilization (bottom panel). As implied by Equation (3), the decline in the price index at reimbursed amounts equals 7.4 percent.

The severity index displayed in Chart 2, top panel, displays a fair amount of statistical noise, which adds to the uncertainty associated with the estimated severity response. Thus, a sensitivity analysis is performed where the severity response is backed out of the observed change in the price level and the estimated utilization effect. The observed change in the price level is obtained by comparing the price level of the third post-implementation month to the price level of the final pre-implementation month; the price level response thus measured equals minus 7.4 percent, which (as a rounded number) equals the price level response established above. By way of Equation (3), based on unrounded numbers, the severity response amounts to a negative 9.2 percent, which is nearly identical to the previously established value.

Chart 2: Tennessee, Severity and Utilization Responses, All Categories

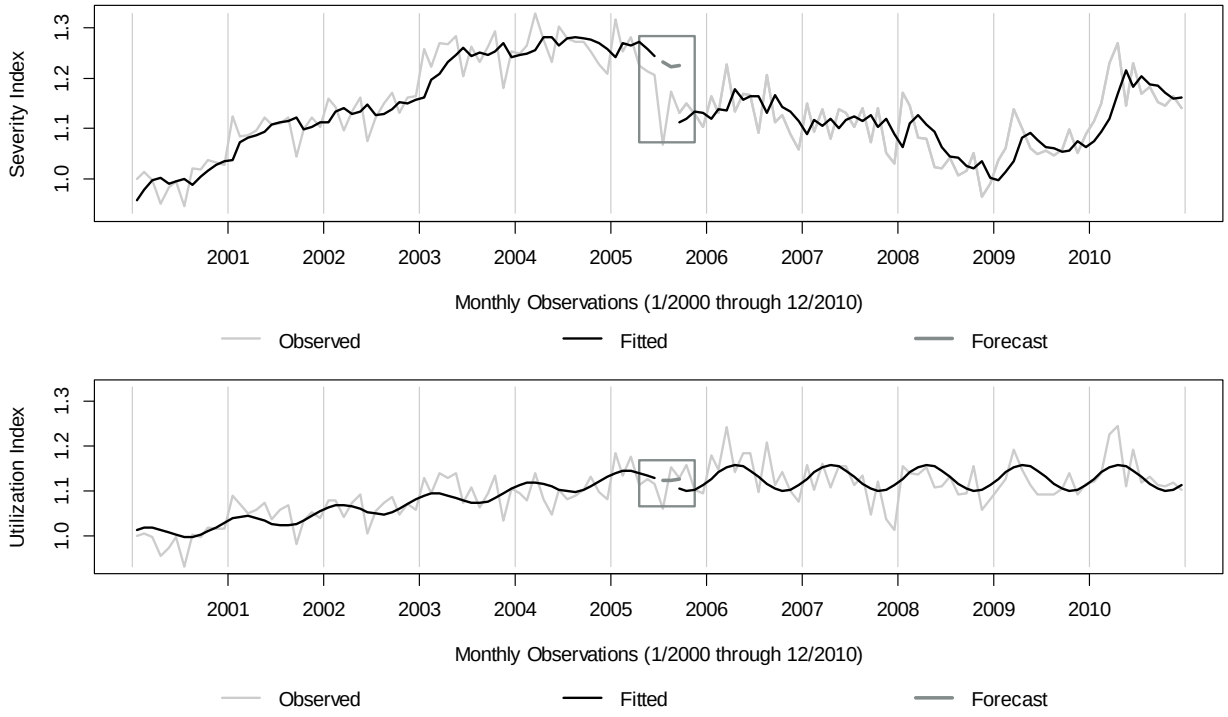


Chart 2, bottom panel, displays the utilization index, which exhibits a pronounced seasonality. Because the severity index is the product of the utilization index and the price index, the seasonality inherent in the utilization index carries over to the severity index (top panel).

Aside from this seasonal variation, the utilization index remains flat following the fee schedule introduction. This absence of a post-implementation utilization trend is in stark contrast to the steady utilization increase during the years leading up to the fee schedule. The estimated drop (compared to the counterfactual) and subsequent ebbing of the utilization index may be more related to the restriction on physician choice introduced in mid-2004 than to the fee schedule. Empirical studies by Durbin and Appel [4] and Neumark, Barth, and Victor [15] provide clear evidence of the cost containment effect of restrictions on provider choice. However, these studies focus on the overall cost impact and do not explicitly address the contribution of utilization changes.

For the purpose of comparing fee schedule prices to pre-implementation reimbursement at large, the price departure was calculated for the final pre-implementation month on an *as and if implemented* basis. This concept of *ex ante* price departure is analogous to the price departure displayed in the bottom panel of Chart 1 in that reimbursed amounts again substitute for the fee schedule where medical services have not been assigned a fixed-value MAR. With the *ex ante* price departure

calculated in this way, in the final pre-implementation month, the price level at reimbursed amounts was 15.7 percent below the price level at the impending fee schedule. By comparison, the price level at reimbursed amounts was 23.1 percent below the price level at fee schedule in the third month of fee schedule operation—the *ex post* price departure. The differential between *ex ante* and *ex post* price departures is attributable to the decline in the price level at reimbursed amounts.

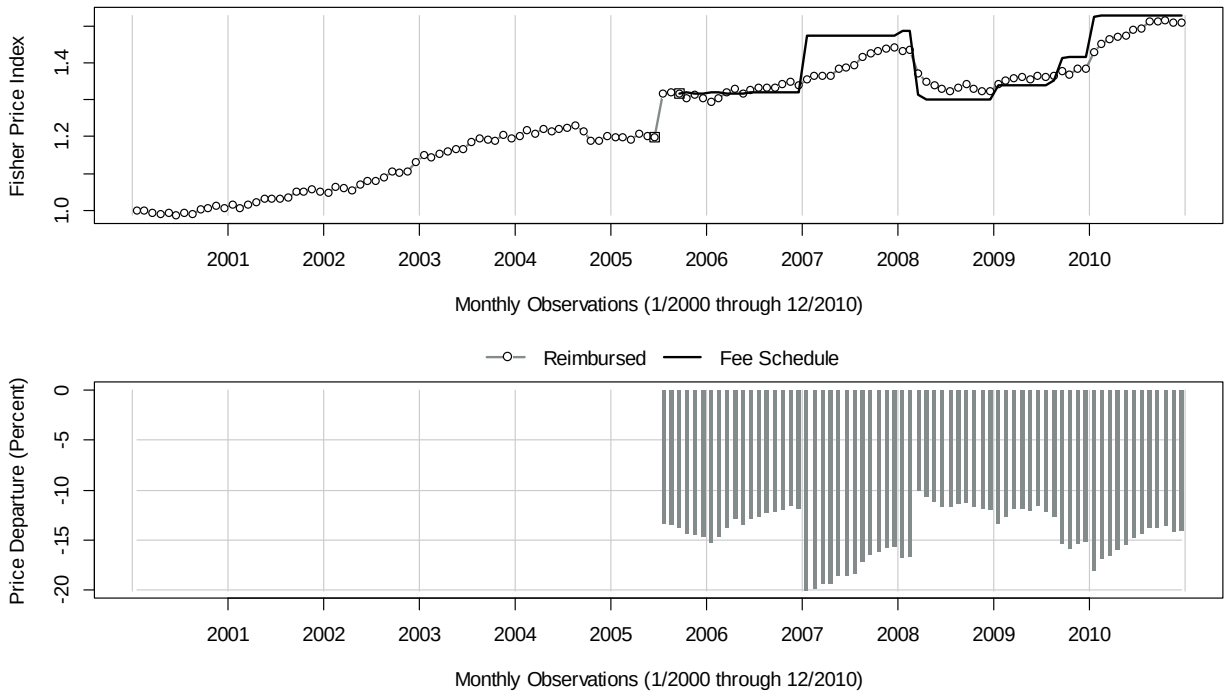
It is worth noting that the share of the transaction volume of the final pre-implementation month that was going to be subject to the fee schedule equaled 95.4 percent. In keeping with existing methodology, in this computation, only medical services that were to receive a fixed-value MAR were regarded as subject to the impending fee schedule.

4.1.2 Evaluation and Management Services

The impact of the fee schedule introduction on an individual service category is exemplified on Evaluation and Management Services. The analysis performed on this service category is analogous to the inquiry undertaken for All Categories. When it comes to normalizing the quantity index by the number of active claims for a given month, only claims for which there were transactions recorded in Evaluation and Management Services (in that month) were considered. In this service category, the share of the transaction volume of the final pre-implementation month that was going to be subject to the fee schedule amounted to 97.1 percent.

Chart 3 exhibits for Evaluation and Management Services the price index at reimbursed amounts and at fee schedule (top panel), along with the price departure (bottom panel). In this service category, contrary to the discussed All Categories (and all other service categories), the price level at reimbursed amounts increased following the fee schedule implementation. This price level increase measures 11.0 percent or, based on the discussed sensitivity analysis, 10.0 percent.

Chart 3: Tennessee, Price Indexes and Price Departure, Evaluation and Management Services



For a given medical service, in a given month, the reimbursed amounts are not necessarily uniform. Instead, these amounts describe a distribution, which frequently is multimodal. The price ceiling of a newly introduced fee schedule may pose a binding constraint for the top percentiles of the distribution or reimbursed amounts. By means of capping the top percentiles at the fixed-value MAR, the fee schedule lowers the average reimbursed amount, all else being equal. From this perspective, the introduction of a fee schedule is expected to depress the average reimbursement for a given medical service or, more broadly, the price index at reimbursed amounts of a given service category. But then, in Evaluation and Management Services, the price index at reimbursed amounts increased. Given that this service category accounts for 25.6 percent of the volume in the final pre-implementation month, this finding can hardly be treated as an anomaly in the data.

A possible explanation of the atypical response of the price level for Evaluation and Management Services may be found in the heuristic of anchoring discussed in psychology. In this cognitive process, an individual adjusts its numerical judgment or attitude toward a value that it considers as a candidate answer. As argued by Kahneman, Ritov, and Schkade [11], "anchoring effects are among the most robust observations in the psychological literature." These authors identify two "necessary and apparently sufficient conditions for the emergence of anchoring effects." One condition is "the

presence of some uncertainty about the correct or appropriate response." The other condition is "a procedure that causes the individual to consider a number as a candidate answer." In the context of physician fee schedules, the introduction of a MAR may serve as a candidate answer to the question of appropriate reimbursement.

Clearly, anchoring is not the only process that is capable of generating the observed price level response in Evaluation and Management Services. In industrial economics, it has been argued that price ceilings serve as focal points that solve the coordination problem inherent in tacit collusion. The concept of focal points has been introduced by Schelling [22], who showed how mutually recognized signs are able to facilitate solutions in coordination games. In the context of physician fee schedules, the MAR may serve as a focal point for the coordination of billing behavior among physicians. In a study of the credit card market in the 1980s, Knittel and Stango [12] argue that price ceilings solved the coordination problem that made tacit collusion possible. Then again, there are doubts that price ceilings can serve as focal points. For instance, Engelmann and Normann [6] analyze in an experimental setting whether price ceilings have a collusive effect. Based on results established in laboratory markets, the authors reject the focal-point hypothesis, according to which price ceilings solve the coordination problem associated with tacit collusion. The experiments show that markets with price ceilings have lower prices than markets without such constraints.

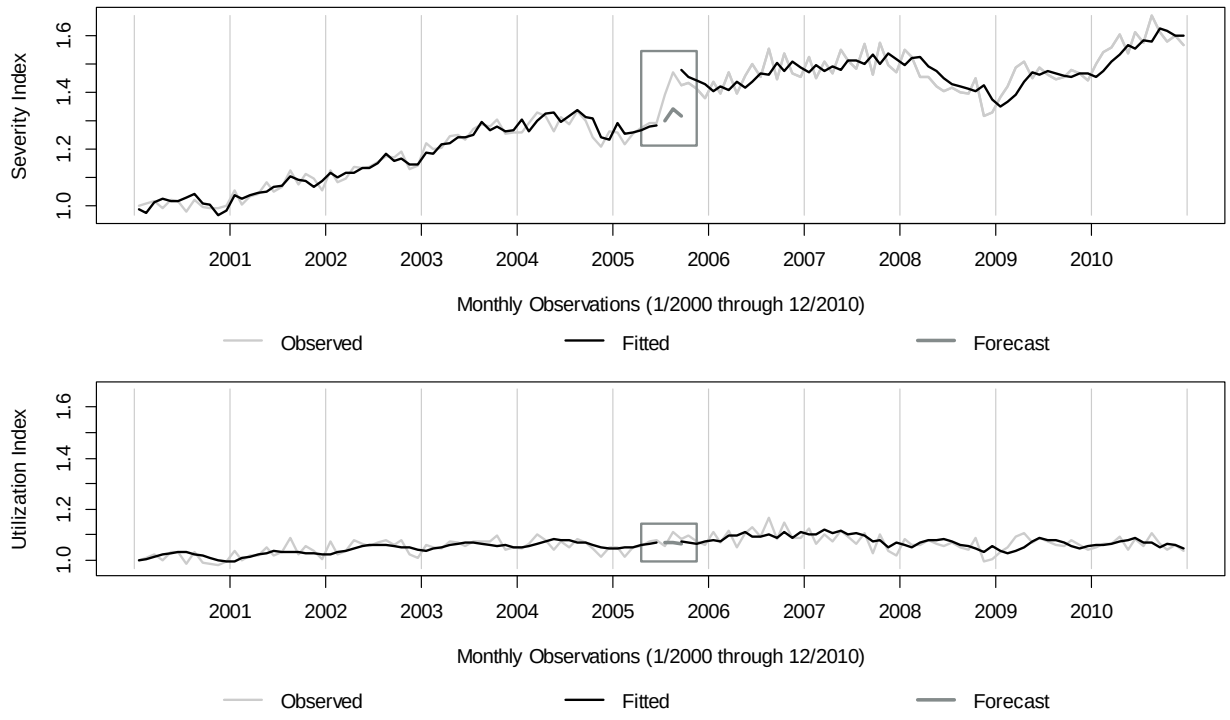
As argued, capping the upper percentiles of the distribution of reimbursed amounts reduces its mean, all else being equal. Conversely, to the extent that the MAR anchors the judgment regarding an appropriate reimbursement, the distribution of reimbursed amounts moves toward the MAR, thereby increasing the mean of this distribution. The net effect of these two opposing forces determines whether the average reimbursement for a given medical service or the overarching price index of the applicable service category increases in response to a fee schedule introduction.

When compared to All Categories, the *ex ante* price departure in Evaluation and Management Services was extensive, measuring a negative 21.1 percent. This large differential between the center of the pre-implementation distribution of reimbursed amounts and the newly introduced MAR may have afforded the anchoring effect an elevated degree of leverage. The price level increase that followed the fee schedule introduction reduced this differential to an *ex post* price departure of minus 13.7 percent (as measured in the third post-implementation month, according to its definition).

Chart 3 shows that in Evaluation and Management Services, the adjustment of the reimbursed amounts to the fee schedule implementation was swift. In spite of sluggish responses to subsequent fee schedule changes, by the end of the year 2010, the rate of inflation at reimbursed amounts that had materialized since the third post-implementation month was in close proximity to the rate of inflation implied by the stipulated price ceilings.

Chart 4 displays the fee schedule impacts on the severity and utilization indexes. The increase in severity reads 12.1 percent or, using the sensitivity analysis, 11.0 percent. The utilization response is positive but contained, measuring 1.0 percent. Remarkably, for Evaluation and Management Services, the utilization response agrees with classical economic theory, which posits that supply increases with price. Similarly, for Surgery (not shown) and Radiology (not shown), the utilization effect in response to a price level decrease is negative, albeit slender. Assuming that physicians have some discretion over the amount of medical care they provide to a claimant, it can be expected that the supply of these services will increase with the reimbursed amounts (and, correspondingly, decrease in response to a payment reduction). Then again, for the service category Medicine (not shown), the estimated utilization effect in response to a price level increase is positive and is thus at odds with classical economic theory. It is worth noting that at the level of the service category, there is a fair degree of statistical noise in the data, which poses a challenge to measuring an effect that, if it exists, is likely to be small in magnitude. As a result of the elevated level of randomness, the estimated utilization effects for the individual services categories have to be interpreted with caution.

Chart 4: Tennessee, Severity and Utilization Responses, Evaluation and Management Services



A negative utilization effect in response to a price increase agrees with the income targeting hypothesis put forward by Camerer at al. [3] in a study of New York City taxi drivers. Based on this

proposition, the supply of services decreases with price since a given income target can be reached with less input. But then, as argued by Schmid and Lord [23] in a study of workers compensation fee schedule changes, there is no indication of income targeting on the part of physicians. More important, Radeva et al. [19], in the context of the Tennessee fee schedule introduction, provide persuasive evidence that, in the category Evaluation and Management Services, physicians respond to changes in reimbursed amounts according to classical economic theory. The authors show that physicians substituted comparatively complex established patient office visits (CPT code 92214) for less complex ones (CPT code 92213). At the same time, the reimbursed amount for the more complex office visit increased by 29 percent, on average, compared to a mere 18 percent for the less complex of these services; the price increases were measured over the time period 2004 through 2006.

Aside from the two competing economic hypotheses, there is also the formative force of best medical practice. Although fee schedule introductions may alter economic incentives in the short term, it is difficult to argue that medical treatments do not revert to best practice in the longer term, especially as treatment patterns and medical technology evolve over time.

4.2 Illinois

The state of Illinois introduced a physician fee schedule in workers compensation effective February 1, 2006. Prior to this legislative provision taking effect, reimbursement was subject to being reasonable and necessary. When the employer did not agree to the expenses, the employee could file a petition asking the Workers' Compensation Commission to decide the disputed issue. For details, see Illinois Workers' Compensation Commission [8].

The Illinois fee schedule set the MAR of medical services to 90 percent of the 80th percentile of charges observed from August 1, 2002 through August 1, 2004. These charges were adjusted for the CPI for the period August 1, 2004 through September 30, 2005.

The MAR varies by geozip, which is defined by the zip codes that share the same first three digits, and by the site where the treatment occurred. Employers or insurance carriers may contract with providers at prices higher than fee schedule. Procedures for which the physician fee schedule does not stipulate a fixed-value MAR, the default reimbursement is set to 76 percent of actual charge.

Prior to the fee schedule introduction, amendments to the Illinois Workers' Compensation Act ended balance billing. As stated in the Fiscal Year 2005 Annual Report of the Illinois Workers' Compensation Commission [9], effective July 20, 2005, "[a] provider cannot hold an employee liable for costs related to non-disputed services for a compensable injury and shall not bill or attempt to

recover from the employee the difference between the provider's charge and the amount paid by the employer or insurer on a compensable injury."

In Illinois, an employee may choose any doctor or hospital. The employee is entitled to two choices of medical provider and their respective chains of referrals. These provisions were in place over the entire time window covered by this study; for details, see Illinois Workers' Compensation Commission [7] [8]. More recently, upon approval by the Department of Insurance, the employer may sponsor a Preferred Provider Program (PPP). Where implemented, the PPP is the employee's first provider choice, by default. By opting out of the PPP, the employee exercises his right on a second choice; the employee is then limited to one choice of doctor and subsequent referrals.

The Illinois data set contains 73 observations prior to the fee schedule introduction and 59 observations following it. As with Tennessee, all pre-implementation observations are employed in the time series model that establishes the counterfactual for the third post-implementation month, and all but the first two post-implementation observations enter the time series model that removes the statistical noise from the observed severity and utilization indexes.

4.2.1 All Categories

For All Categories, Chart 5, top panel, depicts the Fisher price indexes of medical services, at reimbursed amounts and at fee schedule. Again, the boxes (2006, January and April) indicate the final pre-implementation and the third post-implementation months. And, as before, the price index at fee schedule starts in the third month of the fee schedule operation and is normalized to the price index at reimbursed amounts observed in that month.

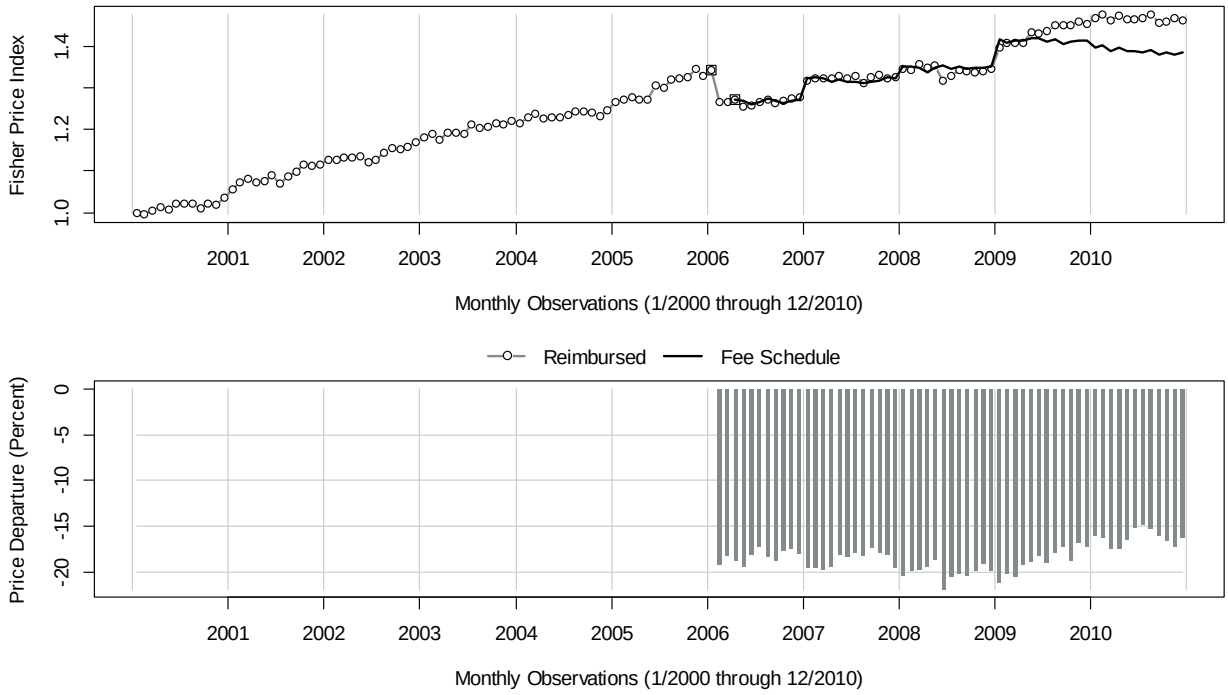
As the chart shows, the price index at reimbursed amounts closely tracks the price index at fee schedule during the first four years of the fee schedule operation. Then, several months into the year 2009, the price index at reimbursed amounts starts climbing as the price index at fee schedule begins to soften, thereby opening up a gap between the two indexes. As a result of the emerging difference in the rates of inflation, over the course of the year 2009, the price departure (displayed in the bottom panel) contracted from a value in the neighborhood of about minus 21 percent to approximately minus 17 percent.

Comparing Chart 5 to the corresponding chart for Tennessee (Chart 1) reveals that for a given fee schedule, the price index at fee schedule is less stable in Illinois than in Tennessee. This is because, in Illinois, the fee schedule varies by geozip. As the geographic distribution of transactions varies from month to month, the average MAR for a given medical service may change as a result.

Chart 6 depicts the severity and the utilization indexes in two panels. Again, the two panels are drawn on the same scale and display the observed data (light gray) alongside the fitted (black) and

forecast (dark gray) values generated by the time series model. For the third post-implementation month, the vertical distance between the observed value net of noise and the forecast indicates a 4.9 percent drop in severity (top panel). The change in utilization (bottom panel) is essentially nil (at 0.3 percent). By implication, the decline in the price index at reimbursed amounts equals 5.2 percent or, based on the sensitivity analysis, 5.3 percent.

Chart 5: Illinois, Price Indexes and Price Departure, All Categories



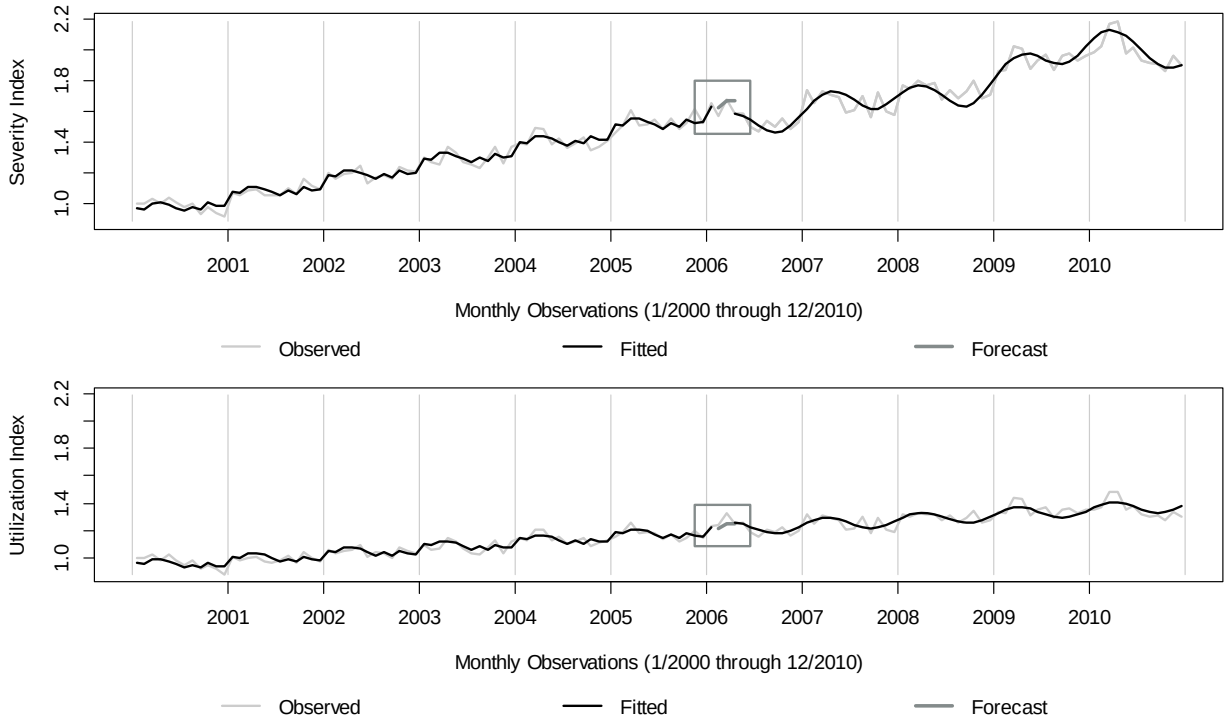
In the final pre-implementation month, the relative deviation of the reimbursed amounts from the MAR of the impending fee schedule—the *ex ante* price departure—ran at minus 14.7 percent. By comparison, the *ex post* price departure came to minus 18.8 percent (as shown in Chart 5, bottom panel). This differential of the *ex post* price departure to the *ex ante* price departure is due to the mentioned 5 percent drop in the price level at reimbursed amounts. Regarding the coverage of the fee schedule, 98.75 percent of the transaction volume in the pre-implementation month was going to be subject to fixed-value MAR.

The utilization index displayed in Chart 6 (bottom panel) exhibits a marked seasonality, similar to what was observed for Tennessee. It is evident from the chart that the seasonality in the severity index is more pronounced in the post-implementation time window. This increase in the amplitude of the seasonal variation is a statistical artifact that arises from the multiplication with increasing

price index values. For a higher level of the severity index, a given percentage of seasonal variation translates into a greater magnitude of absolute change. A closer look at the utilization index (bottom panel) reveals no apparent increase in seasonality.

Chart 6, bottom panel, demonstrates that, in Illinois, there is no leveling out of the consumption of medical services (per active claim) following the fee schedule introduction. This lends support to the hypothesis that the receding utilization growth observed in Tennessee is related to the restriction of provider choice, rather than the physician fee schedule.

Chart 6: Illinois, Severity and Utilization Responses, All Categories



4.2.2 Physical Medicine

The impact of the fee schedule introduction is exemplified for Physical Medicine. As mentioned, Physical Medicine is a subcategory of the AMA category Medicine, defined by the CPT code range 97001 through 97799. In this category, the share of the transaction volume of the final pre-implementation month that was going to be subject to the fee schedule equaled 99.5 percent.

Chart 7 exhibits for Physical Medicine the price index at reimbursed amounts and at fee schedule (top panel), along with the price departure (bottom panel). Following the initial price level decrease associated with the fee schedule introduction, the rate of inflation at reimbursed amounts fell short of the rate of inflation at fee schedule, thereby exposing a gap between the two indexes. Then, after

being largely flat for Calendar Years 2007 and 2008, the price index at reimbursed amounts rose noticeably in 2009 before softening in the second half of 2010. This surge in the price index in Physical Medicine contributed to the discussed rise in the price index for All Categories (Chart 5).

Chart 7, bottom panel, depicts the price departure for Physical Medicine. The run-up in the price level at reimbursed amounts from early 2009 to about mid-2010 manifested itself in a lessening of the price departure from a negative 15 percent to a mere negative 7.5 percent, approximately.

Chart 7: Illinois, Price Indexes and Price Departure, Physical Medicine

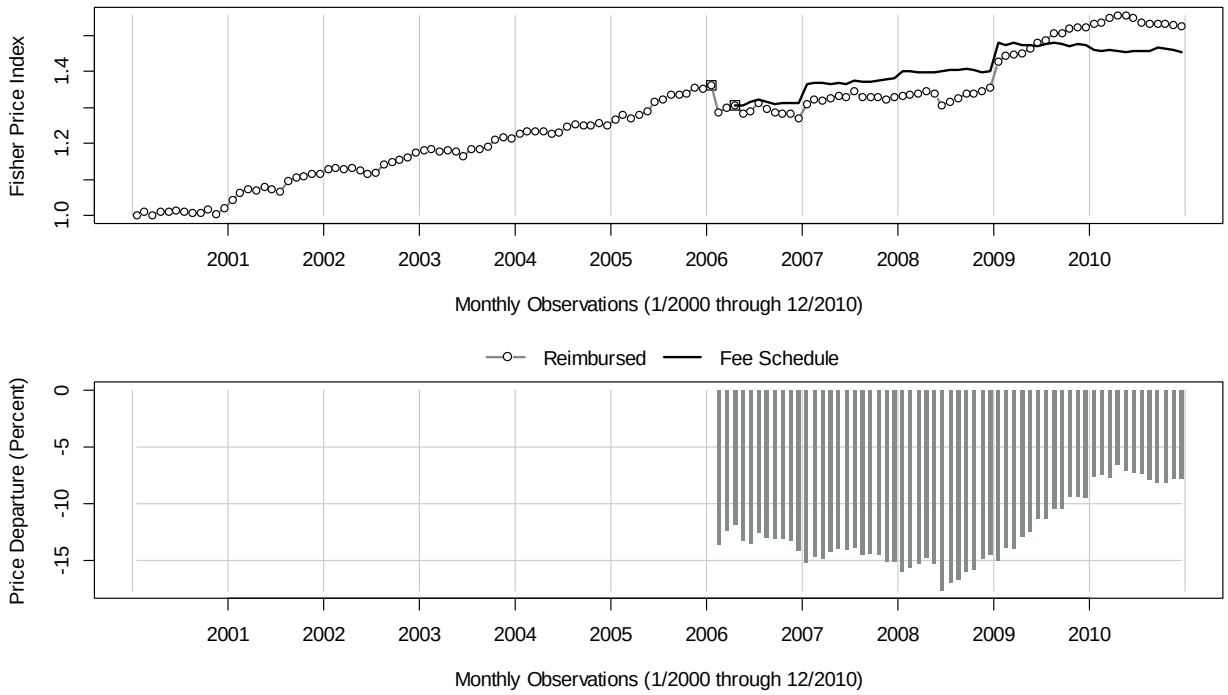
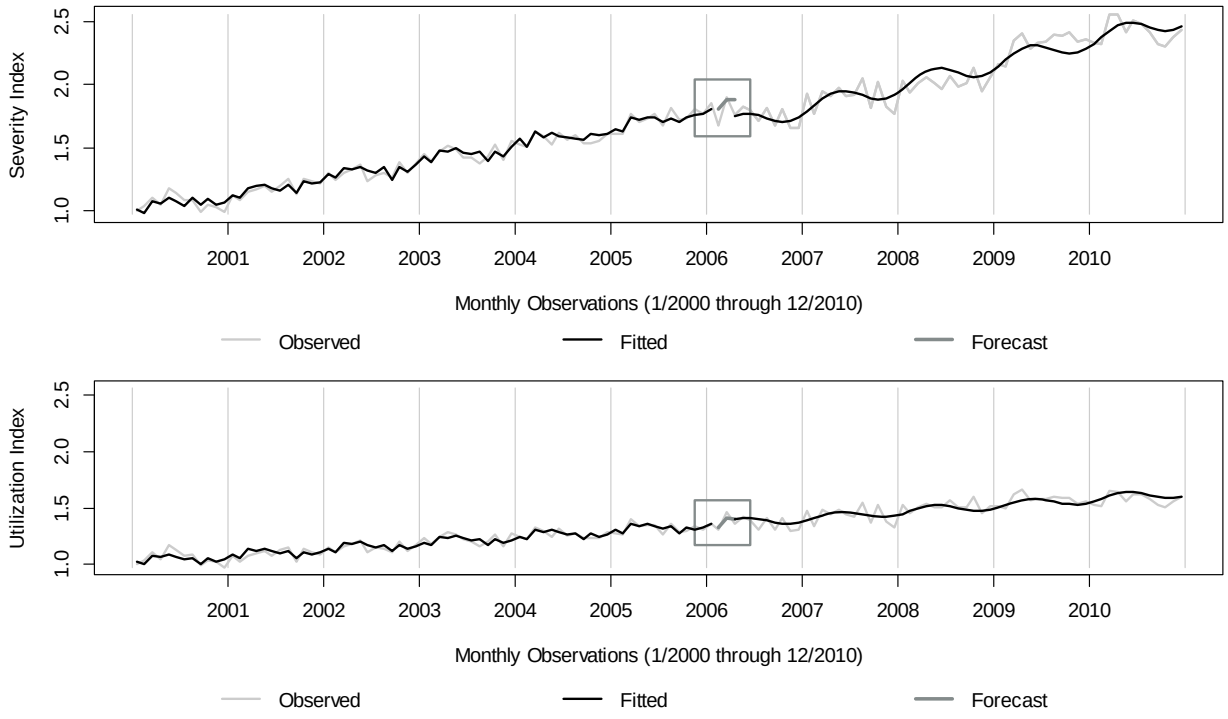


Chart 8 displays the severity (top panel) and utilization indexes. Again, the fee schedule impact is measured by the vertical distance between the final value of the three forecast data points and the first fitted value available for the post-implementation time period—both values are from the third month of fee schedule operation. This vertical distance between the observed value net of noise and the counterfactual indicates a 7.1 percent drop in severity (top panel) and a negligible 0.3 percent increase in utilization (bottom panel). By implication, the decline in the price index at reimbursed amounts equals 7.3 percent. Based on the sensitivity analysis, the price level decrease measures 4.1 percent; the implied severity decline amounts to 3.9 percent.

The insignificant utilization responses in All Categories and Physical Medicine are in accord with similarly immaterial utilization effects (not shown) in Medicine overall, Evaluation and Management Services, and Radiology. Only Surgery displays a material utilization increase, at 8.5 percent; this is in response to a 13.9 percent (sensitivity analysis: 8.6 percent) decline in the price level. It is worth noting that Surgery is a comparatively sparsely populated service category (as measured by number of transactions, not dollars) and thus liable to a fair amount of statistical noise.

Chart 8: Illinois, Severity and Utilization Responses, Physical Medicine



4.3 Summary of Effects

Table 1 summarizes the findings of the event study for All Categories. The table exhibits the responses to the fee schedule introductions of severity, price level, and utilization. Further, the table informs on the *ex post* price departure (defined as relative deviation of reimbursed amounts from fee schedule in the third month of fee schedule operation) as well as the *ex ante* price departure (which, by definition, is computed for the final pre-implementation month).

Although Table 1 does not capture any potential impact of the fee schedule introduction that may have materialized following the third post-implementation, such residual effect may be gauged by studying Charts 2 (Tennessee) and 6 (Illinois).

Both fee schedule introductions elicit negative price level responses—these responses amount to minus 7.4 (7.4) percent for Tennessee and minus 5.2 (5.3) percent for Illinois, where the values in parentheses were obtained in a sensitivity analysis. In Tennessee, the negative utilization effect may be associated with restrictions on provider choice that were implemented a year before the fee schedule introduction. In Illinois, the utilization response is immaterial. As a consequence, the severity responses that can be attributed with confidence to the fee schedule introductions are those associated with the price level.

Table 1: Impact of Fee Schedule Introduction, All Categories

Jurisdiction	Effects (Percent Change)			Price Departure (Percent)		Price Departure (Percentage Points)
	Severity	Price Level	Utilization	*Ex Ante*	*Ex Post*	Difference
Tennessee	–9.3 (–9.2)	–7.4 (–7.4)	–2.0	–15.7	–23.1	–7.4
Illinois	–4.9 (–5.0)	–5.2 (–5.3)	0.3	–14.7	–18.7	–4.0

Note: Values in parentheses pertain to the sensitivity analysis. Calculations are based on unrounded numbers; consequently, the displayed values may differ from those obtained when performing the calculations on the displayed, rounded values. The negative utilization effect in Tennessee may be related to restrictions on physician choice introduced in mid-2004.

The negative price level responses indicate that the hypothesized anchoring effect does not dominate the opposing effect that originates in the price ceilings becoming binding constraints. Then again, as discussed for Evaluation and Management Services in the context of the Tennessee fee schedule introduction, a pronounced *ex ante* price departure may prompt an increase in the price index at reimbursed amounts.

The *ex ante* price departures of the two jurisdictions are remarkably similar, measuring about minus 15 percent. Yet, there is a considerable difference in the *ex post* price departures. Whereas for Tennessee, the difference between the *ex ante* to *ex post* price departures measures 7.4 percentage points, for Illinois, it is 4.0 percentage points.

The absence of a significant utilization response allows for a straightforward evaluation of fee schedule introductions, because it enables the decision-maker to focus on the price level impact. For an *ex ante* price departure in the neighborhood of minus 15 percent, the effect of the fee schedule introduction can be summarized by a price decline of between 5 and 7.5 percent. As an alternative, the effect of the fee schedule introduction can be summarized in a drop in the price departure (from the *ex ante* value to the *ex post* value) by between 4 and 7.5 percentage points.

The discussed reduction in the price level informs on the initial, short-term effect of the fee schedule introduction. The long-term, permanent effect is more difficult to establish, if only because there is more than one way of measuring it. The long-term effect of the fee schedule introduction may be related to the permanence of the initial effect on the price level. Alternatively, the long-term effect may be tied to a lasting reduction in the rate of inflation (compared to the rate that would be observed otherwise). According to this latter definition, the long-term effect includes and extends beyond the permanence of the initial price level decrease. It is important to note that a permanent non-increase in the rate of inflation (compared to what would be observed otherwise) is a sufficient condition for the initial effect on the price level to be permanent.

It could be argued that the permanence of the initial price level effect can be read from the behavior of the post-implementation price departure. Yet, even if the price departure remained at the *ex post* level (apart from short-term fluctuations), this would not constitute evidence of the initial effect being permanent. This is because of the possibility of regulatory capture, as put forward by Stigler [24]. According to this theory of public choice, the regulated (here, the physicians) find ways of employing the regulators to their own economic benefit. Specifically, as a result of regulatory capture, the fee schedule might become so accommodating over time that, despite a stable or even deepening price departure, the price index at reimbursed amounts grows as fast as it would absent the fee schedule. Additionally, the price departure may remain stable as the fee schedule allows for a rate of inflation that, over time, erases the initial effect and restores the price level to what would be observed absent the cost containment measure. Due to the possibility of a fee schedule being diluted as a result of regulatory capture, the magnitude of the price departure cannot serve as a measure of the permanence of the initial price level decrease.

Research findings that point to the permanence of the effect of fee schedules on the price level of medical services provided by physicians have been published by Robertson and Corro [21] and, most recently, by Yang and Fomenko [26]. (The research report by Yang and Fomenko follows earlier editions, which offer similar findings.) As discussed, Robertson and Corro compare workers compensation to Group Health and show that in jurisdictions without a fee schedule, medical prices in workers compensation tend to have a higher markup over Group Health. Yang and Fomenko, in comparing 25 jurisdictions for the first half of 2011, demonstrate that the six non-fee schedule jurisdictions are among the seven states with the highest price level for nonhospital, nonfacility medical services delivered in the context of workers compensation. Illinois is the only fee schedule jurisdiction that ranks with the set of non-fee schedule states.

As mentioned, if the post-implementation rate of inflation is no greater than what would be observed absent the fee schedule, then this can be read as an indication of the permanence of the initial price level decrease. Marked differences in the rates of price inflation for medical services

between fee schedule states and non-fee schedule states have been observed by Yang and Fomenko [26]. (Here again, the findings reported by Yang and Fomenko have been published in earlier editions of that research report.) Yang and Fomenko present an annual price index for workers compensation-related nonhospital, nonfacility services for the time period 2002 through (the first half of) 2011. The authors show that, among the 25 studied jurisdictions, the six non-fee schedule states are among the jurisdictions with a higher than average rate of inflation. Similar evidence has been established by Schmid and Lord [23], who study medical services provided by physicians in the context of workers compensation for 32 states in the time period 2000 through 2010. These authors show that states without fee schedules (or with charge-based fee schedules, where reimbursement is determined as a percentage of the charged amount) are liable to experience above-average rates of inflation.

As pertains to the two jurisdictions studied here, the rates of inflation during the years following the fee schedule introduction are considerably below their pre-implementation values. This also holds for the rates of inflation of the medical care components of the applicable regional CPI (regional M-CPI, for short). For Tennessee, the pertinent Bureau of Labor Statistics region is the South; for Illinois, it is the Midwest.

Table 2 exhibits the rates of inflation for the Fisher index at reimbursed amounts and for the applicable regional M-CPI. The pre-implementation values of the price indexes run from January 2000 through the pertinent final pre-implementation month, which is June 2005 for Tennessee and January 2006 for Illinois. By comparison, the post-implementation price index series starts in the third post-implementation month and ends in December 2010. The price indexes are not seasonally adjusted. Technically, the rates of inflation are calculated as compound annual growth rates. In a first step, the difference in the natural logarithms of the final and first monthly values of the applicable time window was divided by the fractional number of years that separates these two observations. In the next step, this ratio was exponentiated and diminished by one.

The impact of the fee schedule introduction on the rate of inflation is determined by means of a difference-in-differences approach. First, for each inflation series, the pre-implementation values are subtracted from the corresponding post-implementation numbers. Second, for every jurisdiction, the resulting difference for the Fisher price index is diminished by the difference obtained for the regional M-CPI.

Table 2: Annual Rates of Inflation: Post-Implementation Compared to Pre-Implementation

Jurisdiction	Fisher Price Index at Reimbursed Amounts (Percent Increase)		Regional M-CPI (Percent Increase)		Difference in Differences (Percentage Points)
	Before	After	Before	After	
Tennessee	1.5	0.6	4.0	3.5	–0.3
Illinois	5.0	3.0	4.8	3.4	–0.6

Note: The values for the difference in differences were computed from unrounded rates of inflation and, as a result, may disagree with the corresponding values obtained from the displayed rounded rates of inflation.

As shown in Table 2, for both jurisdictions, the fee schedule introduction has contributed to a lasting reduction in the rate of inflation for medical services delivered by physicians in the context of workers compensation. This reduction goes beyond what has been observed for medical care in general. For Tennessee, the annual rate of increase in the price index of medical services provided by physicians is 0.3 percentage points lower than what would be observed without the fee schedule. For Illinois, the reduction in the annual rate of inflation amounts to 0.6 percentage points. Although Illinois sustains the smaller decline in the price level, it does experience the larger decrease in the rate of inflation.

5. CONCLUSION

Event study methodology was employed to quantify the impact of physician fee schedule introductions on the price and quantity levels of medical services provided by physicians to workers compensation claimants.

In accordance with previous studies of fee schedule introductions, no material and systematic increase in utilization related to this cost containment measure has been discovered. The decrease in utilization that was estimated for Tennessee may be related to restrictions on provider choice that were introduced a year before the fee schedule was implemented. By implication, the impact of a fee schedule introduction is largely confined to the price level response.

In both jurisdictions, the short-term impact on the price level is substantial; more important, there is a weakening of the rate at which this price level subsequently increases. In Tennessee, the price level declines by 7.4 percent and the annual rate of inflation lessens by 0.3 percentage points. By comparison, in Illinois, the price level dips by 5.2 percent and the annual rate of inflation slows by 0.6 percentage points. Alternative to the change in the price level, the short-term effect of the fee

schedule introduction can be gauged by a change in price departure (from the *ex ante* value to the *ex post* value). For Tennessee, the price departure expands by 7.4 percentage points and, for Illinois, it grows by 4.0 percentage points.

For Evaluation and Management Services in Tennessee, the price level increases in the wake of the fee schedule introduction. Possibly, this price level response may be due to an anchoring effect. Yet, no direct evidence in favor of this hypothesis was produced and, hence, competing hypotheses cannot be dismissed without further research.

The analysis was unconditional in that there was no attempt to isolate the fee schedule impact from other cost containment measures that may have been implemented alongside. Further, no economic or demographic differences across the two studied jurisdictions were accounted for. This operational constraint originated in the small number of events available for the analysis. But then, such dissimilarities in the legislative and economic environment between the two jurisdictions may account for the difference in the price level and inflation responses in the presence of nearly identical *ex ante* price departures.

6. APPENDIX

6.1 Recoding Units of Service

For some medical services, the supplied quantity of service is measured in number of minutes. Yet, the units of service, as laid down in the fee schedule, refer to the number time intervals, where a time interval is defined as a multiple of minutes. Medical services where the units of service are defined in such a way are common in Anesthesia (not covered in this study) and Physical Medicine.

In the employed data set, there were transaction records that appeared to report the number of minutes instead of the units of service. Before subjecting these transactions to the data cleansing tools discussed below, an algorithm was applied for the purpose of recoding the reported units of service, if necessary. First, if the reported units equaled 9 or less, the reported value was left in place. Second, if the number of units reported was a multiple of 15, it was assumed that this reported value refers to the number of minutes. Third, if the number of units reported was not a multiple of 15 but was a multiple of 10, it was again assumed that the reported value reflects the number of minutes. Finally, if the reported value was greater than 9 but was not a multiple of 15 or 10, the units of service were treated as unknown—this way, the transaction is excluded from the computation of the price fences detailed below, yet is submitted to the associated outlier detection and management.

6.2 Outlier Detection

Outlier detection is undertaken independently for each jurisdiction and calendar year. At the center of the outlier detection approach is the schematic plot developed by Tukey [25]. The algorithm associated with this plot applies to reimbursement per unit of service on the natural log scale. Percentiles are indicated by the letter p; upper case format indicates a percentile on the raw scale, whereas the lower case points to the logarithmic scale. Outlier detection is performed on the level of the medical service and on the level of the service category. Price fences are defined for the purpose of restating prices and quantities.

For a given medical service, if $P_{75} \neq P_{25}$, then the price fences are set to $p_{75}+0.6$ and $p_{25}-0.6$. Exceptions are transactions for which the paid-to-submit ratio is greater than 0.5; in these cases, the lower fence is set to $p_{25}-0.7$. Conversely, if $P_{75}=P_{25}$, then the price fences are set to $p_{85}+0.2$ and $p_{15}-0.2$. Transactions that fall inside the price fences of a given medical service make it into the calculation of the price fences at the level of the service category. The upper fence at the level of the service category is defined as the maximum of $p_{90}+0.5$ (where the percentile is based on the service category) and the maximum of the upper fences across all medical services (in that service category) that register at least 20 transactions in the applicable calendar year. Similarly, the lower fence at the

level of the service category is defined as the minimum of p_{10}–0.5 and the minimum of the lower fences across all medical services that account for at least 20 transactions.

Transactions that are located inside the fences, both at the level of the medical service and the level of the service category, remain unedited. These transactions enter the computation of the average price per unit of service and the median units of service per transaction for the applicable medical service in a given month.

Medical services that register less than 12 records (in a given year and jurisdiction) are excluded from the analysis.

6.3 Outlier Management

Outlier management is undertaken on a calendar year basis, in keeping with the price fences, which were computed from data for the calendar year.

Transactions that come with prices per unit of service above the upper fences of the applicable medical service or the overarching service category are reset to the mean price of this medical service; the units of service associated with these transactions remain unaltered.

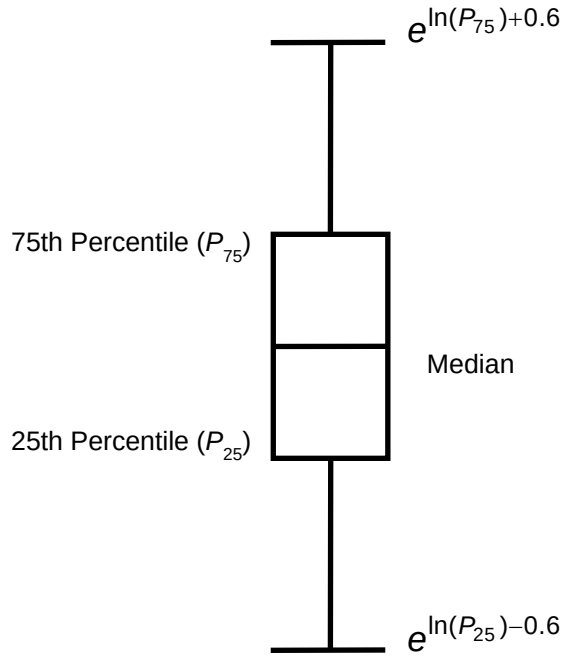
Transactions with prices per unit of service below the lower fences of the respective medical service or the applicable service category have their units of service restated based on the following process—that process also applies to transactions with unknown units. First, the number of units is set to the median number of units per transaction for this medical service; this median number of units is typically unity. Then, the price is recalculated based on the units of service thus restated. If this recalculated price falls below the lower fences of the medical service or the service category, then the units of service associated with this transactions is set to unity. Then again, the price is recalculated. If this price still falls below any of the two applicable lower price fences, then the record is discarded as a nuisance transaction. Conversely, if, during this iterative process, the recalculated price exceeds any of the two upper fences, then this price is reset to the mean of the applicable medical service and no further restatement is done.

6.4 Tukey's Schematic Plot (Boxplot)

Chart A.1 depicts Tukey's schematic plot, also known as box-and-whiskers plot or boxplot. The objective of the boxplot is to report major location parameters (such as the median and the 25th and 75th percentiles) and to identify outliers. In this graph, the hinges that define the upper and lower limits of the box identify the inter-quartile range (IQR), which comprises 50 percent of the data. For the purpose of this study, the fences are defined on the logarithmic scale. The upper fence signifies the sum of the 75th percentile and 0.6 on the natural log scale (which corresponds to multiplying the 75th percentile on the raw scale by 1.8, approximately). The lower fence equals the

difference between the 25th percentile and 0.6 on the log scale (which amounts to dividing the 25th percentile on the raw scale by 1.8, approximately). Values beyond the fences are considered outliers.

Chart 9: Tukey's Schematic Plot (Box Plot)



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Abbreviations and Notations

AIC, Akaike information criterion
AMA, American Medical Association
ARMA, Auto-regressive moving average
BATS, Box-Cox transform, ARMA errors, trend, and seasonal components
CPI, Consumer Price Index
CPT, Current Procedural Terminology
DCI, Detailed Claims Information
HCFA, Health Care Financing Administration
HMO, Health Maintenance Organization
IQR, Inter-Quartile Range
MAR, Maximum Allowable Reimbursement
M-CPI, Medical care component of the CPI
NCCI, National Council on Compensation Insurance
PPO, Preferred Provider Organization
PPP, Preferred Provider Program
TBATS, Trigonometric, Box-Cox transform, ARMA errors, trend, and seasonal components

Biographies of the Authors

Frank Schmid, Dr. habil., was, at the time of writing, a Director and Senior Economist at the National Council on Compensation Insurance, Inc.
Nathan Lord is a Senior Actuarial Analyst at the National Council on Compensation Insurance, Inc.