



Impact of Changes to Physician Fee Schedules in Workers Compensation

Evidence From 31 States

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Impact of Physician Fee Schedules in Workers Compensation

- Context of our research
- Questions & findings
- Tools of the trade
- Implementation
- The Model
- Findings



Context

Physician Fee Schedules

In Workers Compensation medical inflation is outpacing indemnity inflation

Many states have physician fee schedules to control costs

- These define a Maximum Allowable Reimbursement (MAR) for most medical services
- Prices⁽¹⁾ for other services may be capped as a percentage of charges or “usual and customary”
 - These are not considered to be subject to the physician fee schedule

(1) For the purposes of this presentation, unless otherwise stated, “price” will refer to the price of a service at reimbursement



Context

Physician Fee Schedules

Actual reimbursement often differs from the applicable MAR

- On aggregate, prices fall below MAR⁽¹⁾
 - The amount that prices deviate from MAR is referred to as departure⁽²⁾
- Prices follow a distribution
 - The immediate impact of the MAR is to truncate the right tail of the distribution of prices

Prior Medicare studies have shown a “utilization offset” when maximum reimbursements were decreased

- Savings from lower prices were offset by increased utilization

(1) Individual services may be reimbursed above MAR. States regulate payment above MAR differently. In Tennessee both the insurer and the physician are subject to a fine if reimbursement is greater than the legislated MAR. In Illinois contracts between an insurer and a provider supersede the physician fee schedule.

(2) Departure is measured as the difference between the reimbursed price and the MAR. That is, a departure of negative 10% implies that a service was reimbursed 10% below the MAR.

The Research Questions

What is the impact of changes to physician fee schedules in workers compensation on...

- The actual reimbursement for physician services?
- The level of consumption of physician services?

How can the combined impact on price and quantity levels be measured as a function of state characteristics, such as...

- The price departure?
- The price level at fee schedule relative to neighboring states?



The Findings

In response to a fee schedule increase, severity rises by about 80 percent of the legislated price level change, on average

- This response varies with the level of prices at fee schedule

In response to a fee schedule decrease, severity declines by about 50 percent of the legislated change

No discernible change in utilization was found

The Tools

Laspeyres and Paasche and Lowe Price Indexes

The Laspeyres Price Index^(1,2) answers the following question

- If an American household spent \$1,000 last month on the bundle of goods and services that it then consumed, how much money would this household have to spend this month on the same bundle of goods and services?

The Paasche Price Index⁽¹⁾ answers the following question

- If an American household spends \$1,000 on a bundle of goods and services this month, how much money would this household have had to spend last month on that same bundle of goods and services?

The Star index is a Laspeyres index across states instead of time

- If an average American household spends \$1,000 on a bundle of goods and services, how much would an average Florida household spend on the same bundle of goods and services?

(1) The formula of the Laspeyres (Paasche) Quantity Index is identical to the formula of Laspeyres (Paasche) Price Index with prices and quantities trading places

(2) The CPI is modeled after the Laspeyres Price Index

The Tools

Fisher Price Index

Since they fix their basket of goods (and don't account for changes in consumption)

- The Laspeyres Price Index overestimates price changes⁽¹⁾
- The Paasche Price Index underestimates price changes⁽¹⁾

The Fisher⁽²⁾ Index is obtained as the geometric mean of the Laspeyres and Paasche Indexes

- The Fisher index estimates price changes with accuracy and symmetry
- Fisher price and quantity index accurately decompose price and quantity changes
- Often referred to as the Fisher Ideal index for these and other desirable properties⁽³⁾

(1) This applies under classical economic theory where it is assumed consumption will shift towards goods that increase (decrease) in price relatively less (more).

(2) The GDP Deflator is a Fisher Ideal Index

(3) International Labor Office (2004) *Consumer Price Index Manual: Theory and Practice*, Geneva, p. 296.



The Tools

Utilization and Severity Indexes

- The utilization index is a Fisher quantity index normalized by the number of active claims^(1,2)
- The severity index is the product of the Fisher price index and the utilization index
 - In approximation, the CAGR (compound annual growth rate) of the severity index equals the sum of the CAGRs of the price and utilization indexes
 - The severity index reflects a concept of contemporaneous severity, as losses are not developed
 - Claims tend to consume more physician services early in their lifetime
 - The severity index may decline in response to an increase in claim duration

(1) A claim is considered active for a given series in a given month if that claim has a service that is present in that series for that month

(2) The number of active claims was calculated using the "month (t) to month (t-1) ratio," as underlies the price index concept



Implementation

The Data Set

- The data set comprises transactions of workers compensation physician services⁽¹⁾ of 31 states⁽²⁾ for the time period 2000 through 2010
 - Services provided by hospitals and ambulatory surgical centers are excluded⁽³⁾
 - The jurisdiction state criterion and provider zip code information is used when linking transactions to states
- We have information on the medical fee schedules in place at the time
- We edited the data set by drawing on expert knowledge, and we cleansed the data using statistical tools of outlier detection⁽⁴⁾

(1) A service is defined by the CPT (Current Procedural Terminology) code and, where the modifier is part of the fee schedule, by the combination of CPT code and modifier

(2) The states are AK, AL, AR, AZ, CO, CT, DC, FL, GA, HI, ID, IL, KS, KY, MD, ME, MS, MT, NC, NE, NM, NV, OK, OR, RI, SC, SD, TN, TX, UT, and VT

(3) Exclusion is by provider type, not place of service

(4) See the appendix



Implementation

The Tools

For each state, build monthly indexes and series measuring physician services⁽¹⁾

- Fisher Price index⁽²⁾
- Laspeyres MAR index⁽³⁾
- Star MAR index^(3,4)
- Utilization index⁽²⁾
- Severity index⁽²⁾
- Departure⁽⁵⁾

Define the impulse as the change in the price index at fee schedule, weighted by the transaction volume subject to the fee schedule

Estimate the effect on the price, utilization, and severity indexes using a statistical impulse-response model

(1) The indexes comprise all American Medical Association (AMA) categories (except Anesthesia) and state-specific codes (where not included in AMA categories). Separate indexes were built for each AMA category (except Anesthesia) for testing and observation, but they were not used in the model

(2) Price, utilization, and severity indexes were built using all services, both subject to fee schedule and not subject to fee schedule

(3) The MAR indexes were calculated using only those services subject to a fee schedule

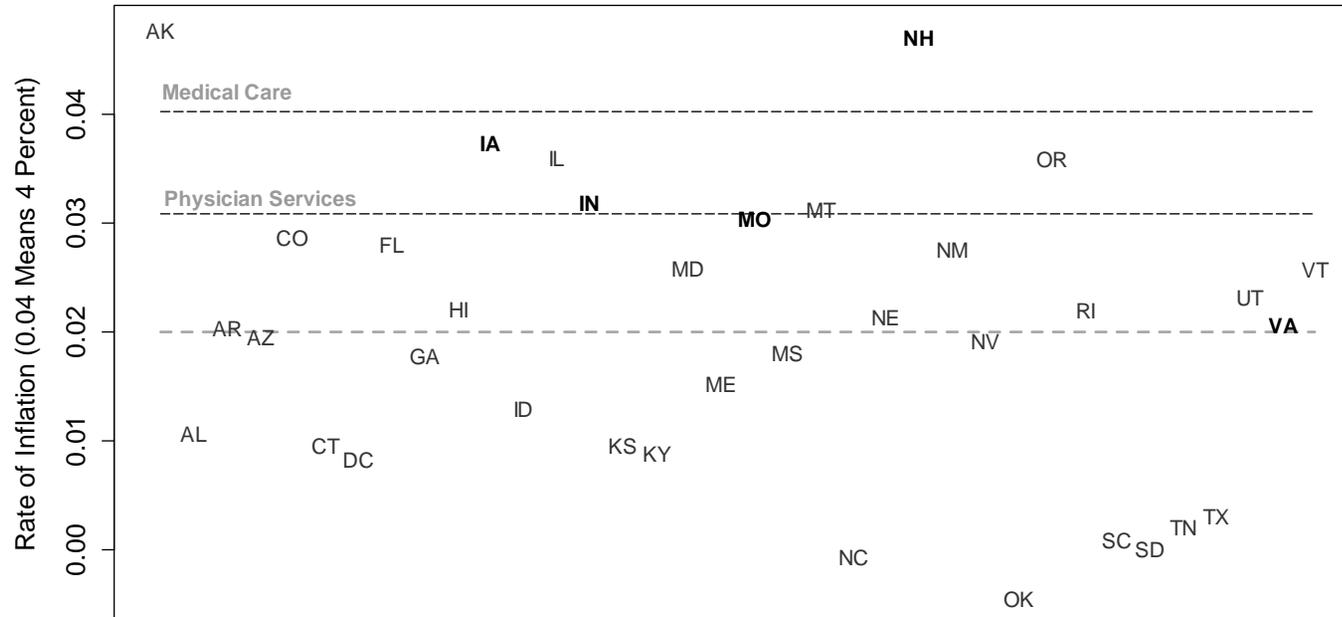
(4) The Star MAR index is uses all states with a fee schedule in our dataset as the base of the index. It captures the relative level of the fee schedule

(5) The price departure was calculated using all services, both subject to fee schedule and not subject to fee schedule. For services not subject to fee schedule and for services where the applicable MAR could not be found, reimbursed prices were substituted for the MAR



Price Inflation

Physician Services, 36 States, 2000–2010



All five states without a fee schedule experienced above average inflation

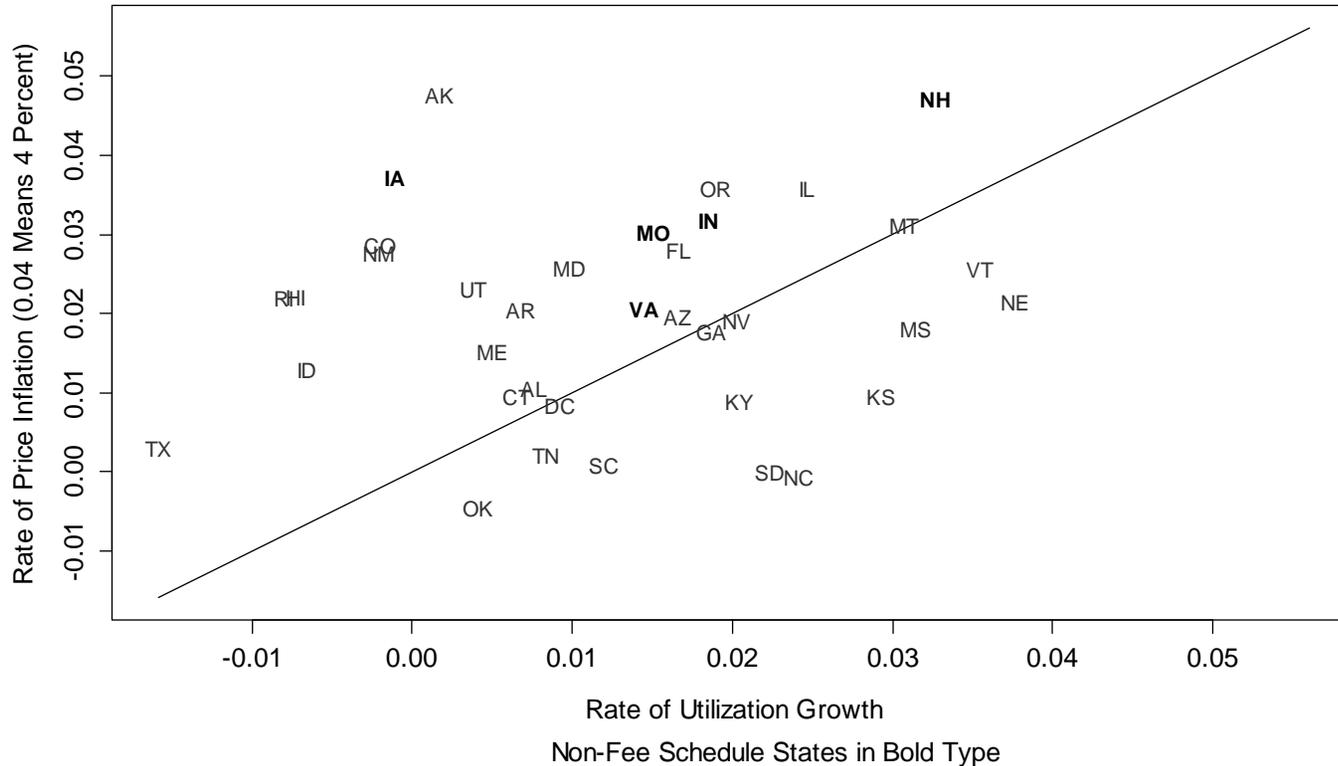
Non-Fee Schedule States in Bold Type
 - - - Equally Weighted Mean Across States

Both the “Medical Care” and “Physician Services” rates of inflation were calculated with data from the Bureau of Labor Statistics (www.bls.gov/cpi/cpifact4.htm)
 The price index of physician services is a Fisher price index, which is computed at actual prices, and comprises all CPT codes
 Non-fee schedule states are states that do not use a fixed-value MAR (Maximum Allowable Reimbursement) for the relevant physician services at any point during the time period covered by the analysis. Non-fee schedule states may have fee schedules for hospital or other non-physician entities. Likewise, they may regulate physician reimbursement based on the charged amount or on what is considered usual and customary
 All growth rates shown are CAGRs; the first observed price indexes are as of February 2000



Utilization Increases Versus Inflation

Physician Services, 36 States, 2000–2010



No obvious relationship between rate of inflation and rate of utilization growth

Rate of inflation tends to exceed rate of utilization growth

The price and utilization indexes are Fisher indexes, which are computed at actual prices, and comprises all CPT codes; the severity index is the product of the Fisher price index and the utilization index

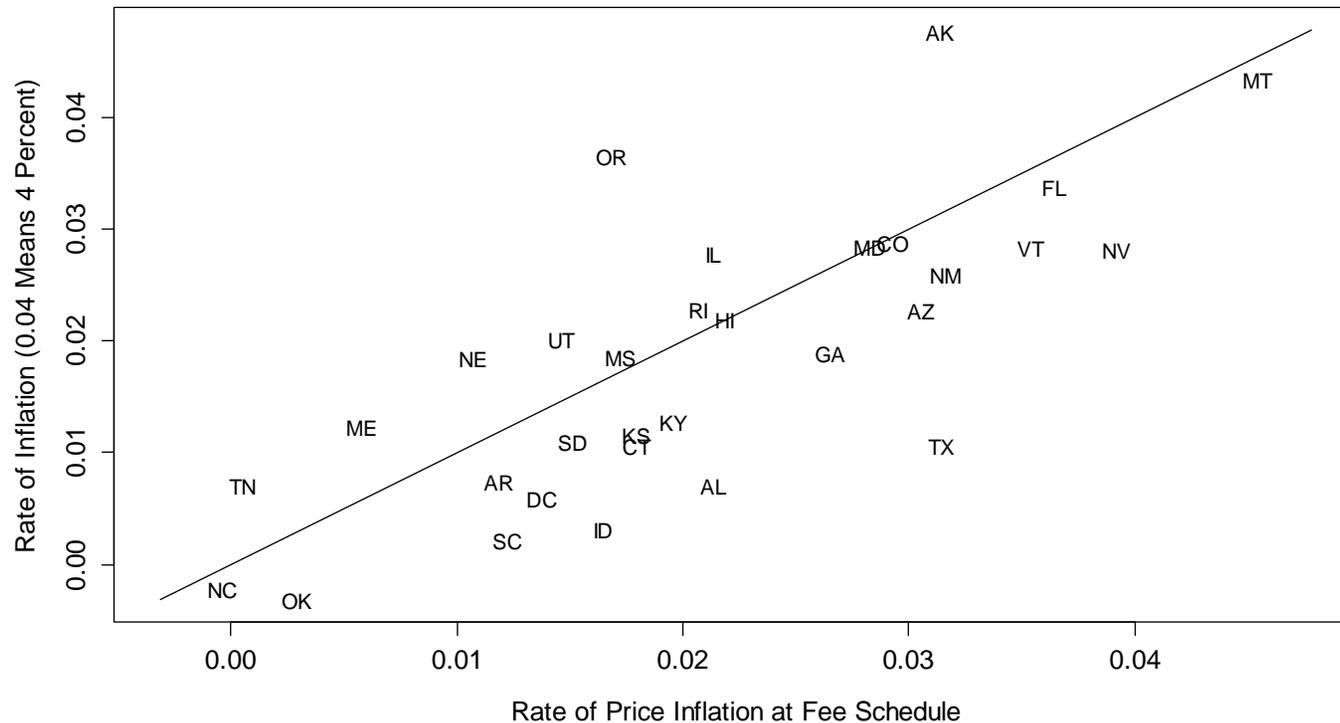
Non-fee schedule states are states that do not use a fixed-value MAR (Maximum Allowable Reimbursement) for the relevant physician services at any point during the time period covered by the analysis. Non-fee schedule states may have fee schedules for hospital or other non-physician entities.

Likewise, they may regulate physician reimbursement based on the charged amount or on what is considered usual and customary

All growth rates shown are CAGRs; the first observed indexes are as of February 2000

Fee Schedule Versus Actual Inflation

Physician Services Subject to Fee Schedule, 31 States, 2000–2010



Inflation Rates Restricted to Applicable Fee Schedule Time Windows

Strong correlation between rate of price inflation and rate of fee schedule increase

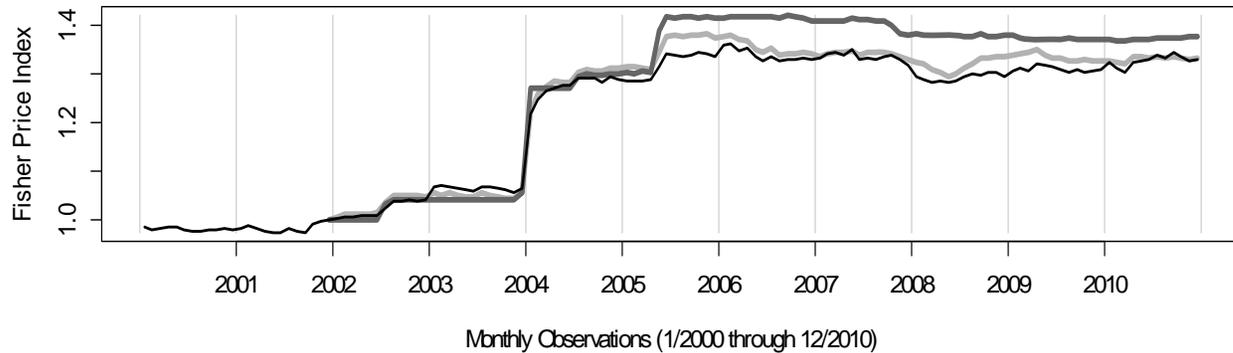
Rate of price inflation and fee schedule increase can differ materially

The price indexes are Fisher indexes; these indexes are computed at actual prices and at MAR, respectively, and comprise only CPT codes subject to a fixed-value MAR. No non-fee schedule states are displayed. Non-fee schedule states are states that do not use a fixed-value MAR for the relevant physician services at any point during the time period covered by the analysis. All growth rates shown are CAGRs; the first observed price indexes are as of February 2000. The fee schedule time window starts with the third month following the first fee schedule considered in the analysis

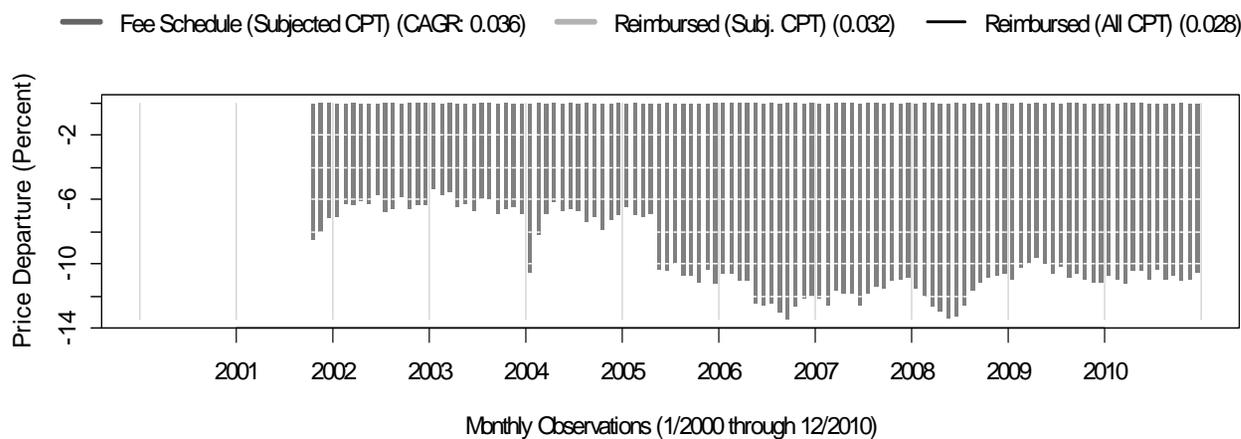


Florida

Fee Schedule, Price Level, and Price Departure All Categories



The price indexes are normalized to start at the same point



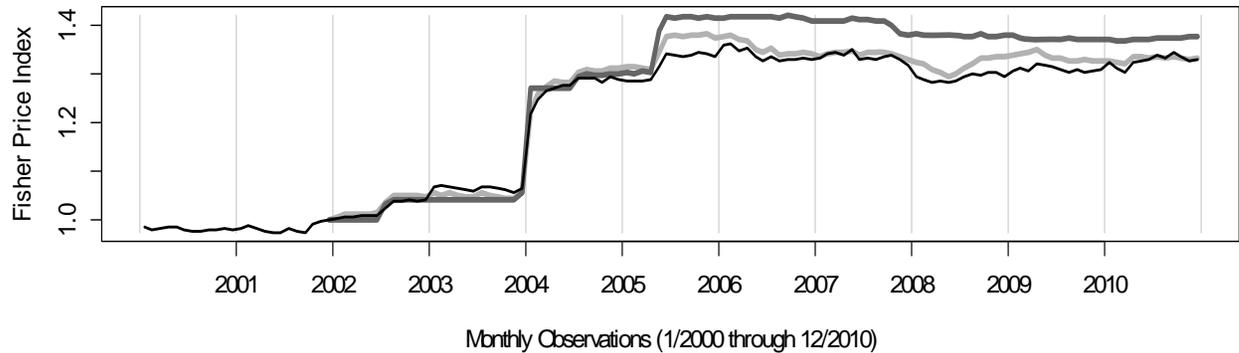
When the price series exceeds the fee schedule series, it has grown faster. This does not imply prices exceed mar

Price indexes are shown at actual and at fee schedule prices. Two types of price indexes at actual prices are shown: (1) comprising only CPT codes subject to a MAR stipulated in dollar terms (fixed-value MAR, for short) and (2) comprising all CPT codes. Price departure is the relative difference between actual and fee schedule prices. The price departure computation is based on all CPT codes, implicitly assuming no price departure for CPT codes that are not subject to a fixed-value MAR

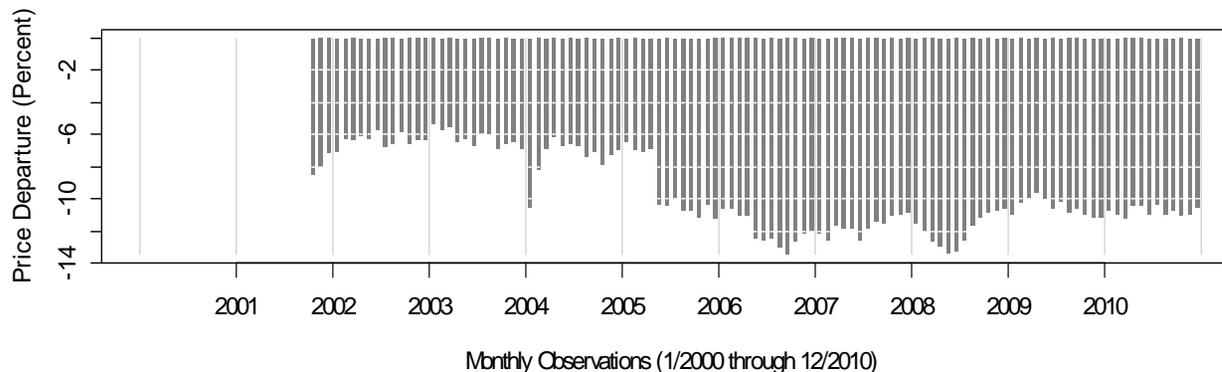
Price indexes change only if prices change. Price departure, on the other hand, may change without prices changing

Florida

Fee Schedule, Price Level, and Price Departure All Categories



— Fee Schedule (Subjected CPT) (CAGR: 0.036) — Reimbursed (Subj. CPT) (0.032) — Reimbursed (All CPT) (0.028)



The price departure does not correspond directly with price changes

We see the price departure increase in mid-2005 when the fee schedule increases

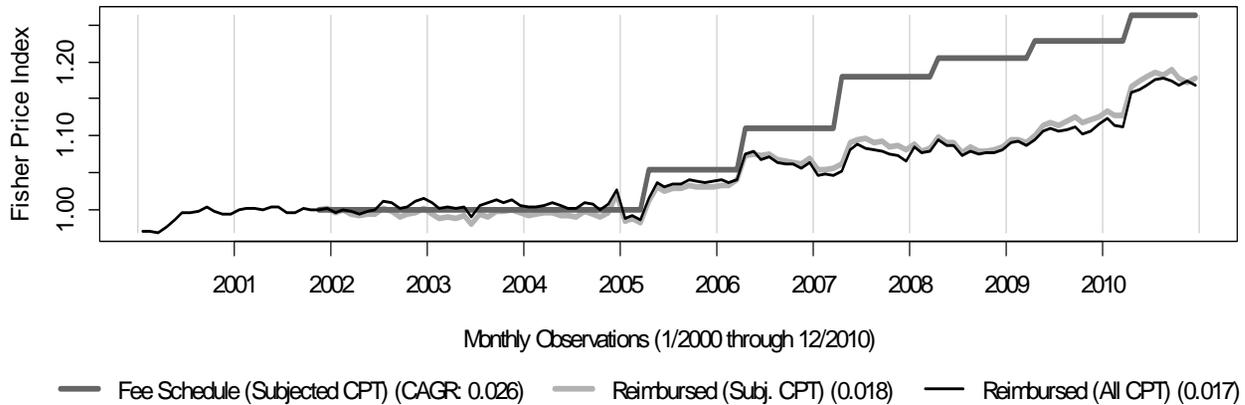
We see a similar rise in the fee schedule relative to prices

Price indexes are shown at actual and at fee schedule prices. Two types of price indexes at actual prices are shown: (1) comprising only CPT codes subject to a MAR stipulated in dollar terms (fixed-value MAR, for short) and (2) comprising all CPT codes. Price departure is the relative difference between actual and fee schedule prices. The price departure computation is based on all CPT codes, implicitly assuming no price departure for CPT codes that are not subject to a fixed-value MAR

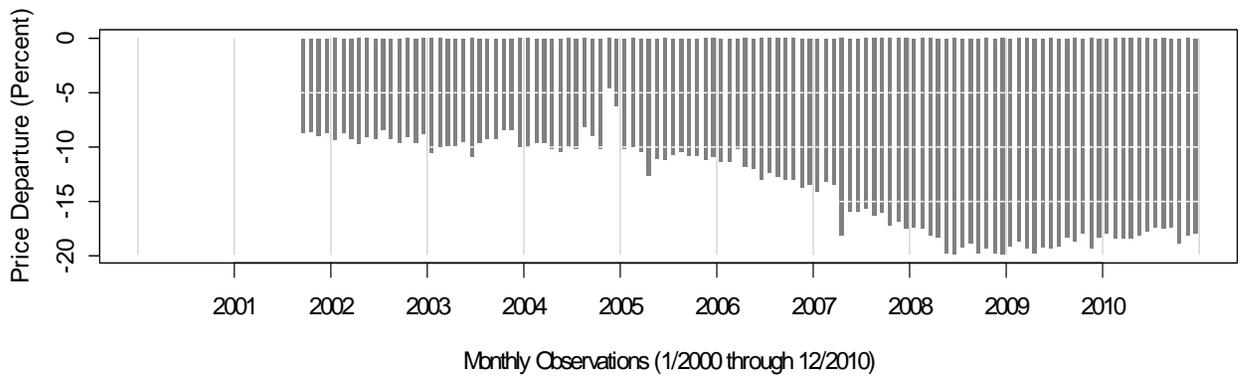
Price indexes change only if prices change. Price departure, on the other hand, may change without prices changing

Georgia

Fee Schedule, Price Level, and Price Departure All Categories



As the fee schedule continues to increase the relationship between fee schedule change and price inflation breaks down



As the fee schedule continues to increase the departure increases as well

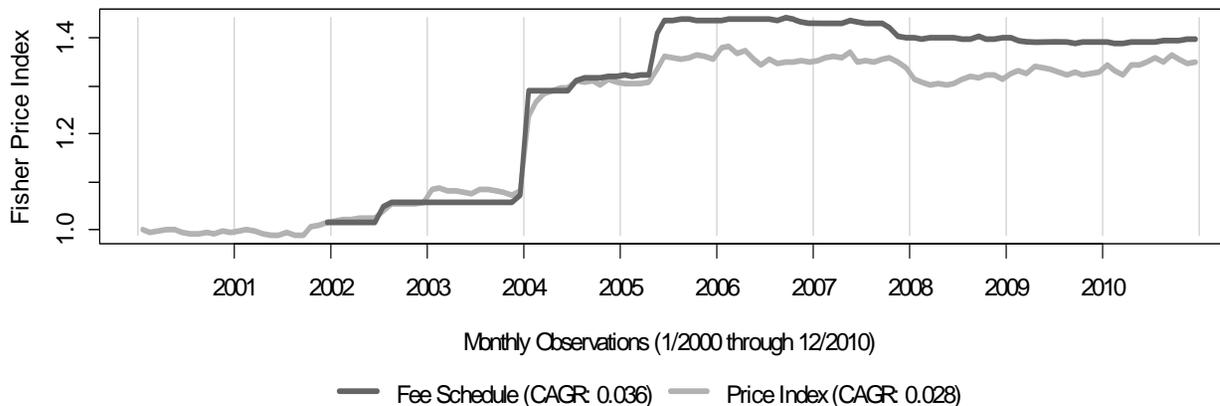
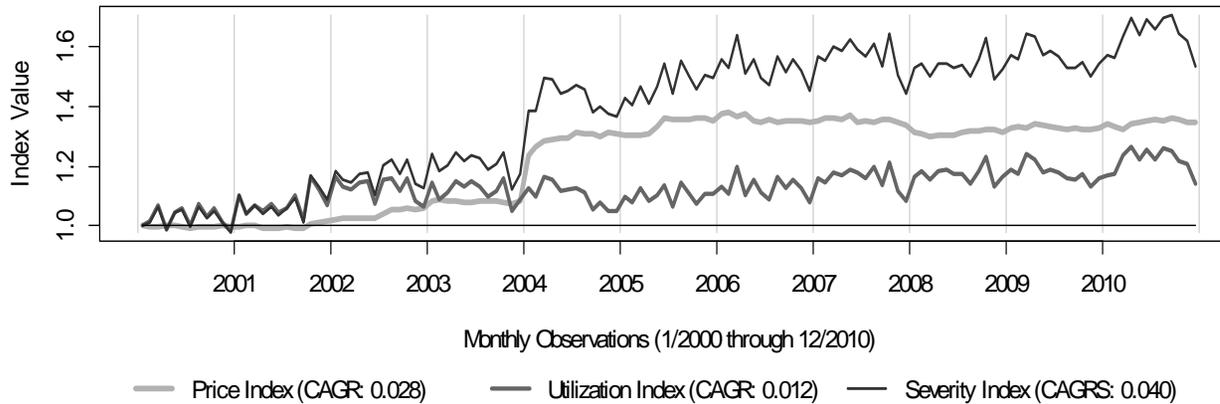
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Price indexes change only if prices change. Price departure, on the other hand, may change without prices changing



Florida

Price Level, Utilization, and Severity All Categories

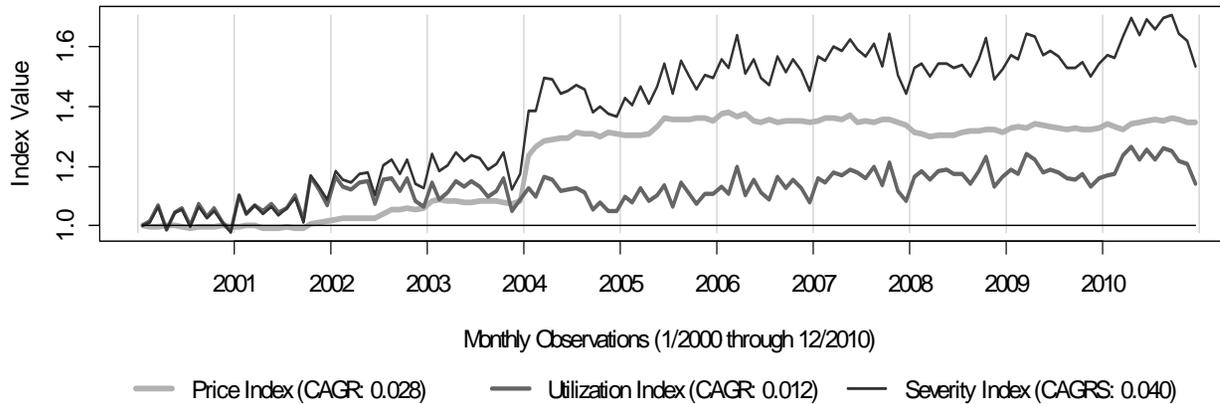


In these graphs, we see no obvious relationship between fee schedule change and utilization change

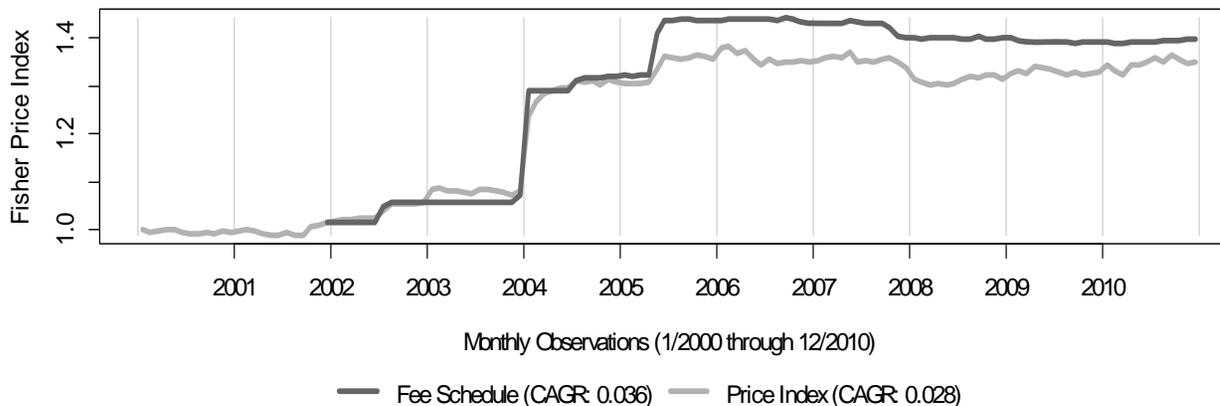
The severity index is the product of the Fisher price index and the utilization index. The utilization index equals the Fisher quantity index, normalized by the number of active claims. In this context, a claim is considered active (in a given service category or overall) if there was a transaction (in a given service category or, when overall, in any given service category) associated with this claim included in the price index for the month. The Fisher price index is computed at actual prices and comprises all CPT codes. The indexes in the top panel are shown as original values (thin gauge) and smoothed (thick). Close to the endpoints, the smoothed values have to be interpreted with caution as there are no neighbors to the right that weigh on the direction of the trajectory generated by the smoother.

Florida

Price Level, Utilization, and Severity All Categories



The growth in severity is comprised of the growth in price and utilization

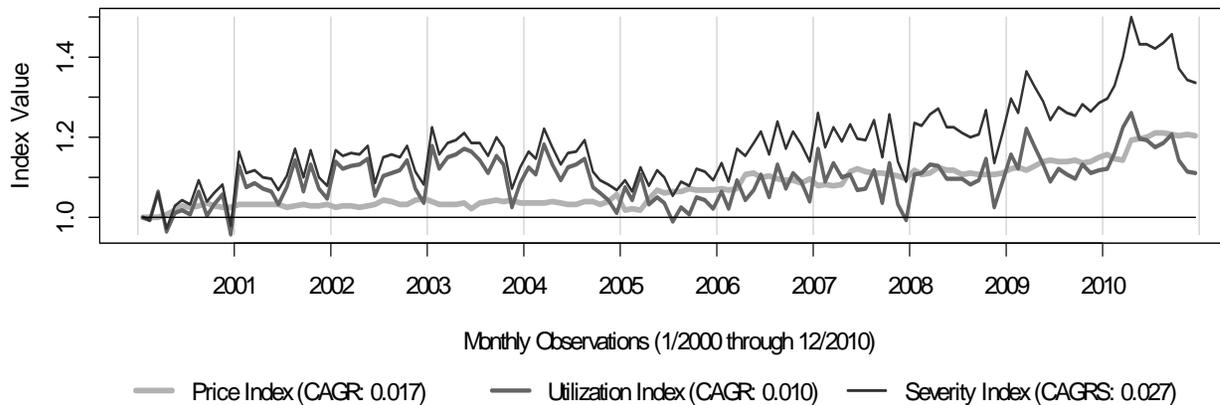


Price inflation's contribution to severity change (2.8% per annum) is more than double utilization's contribution (1.2% per annum)

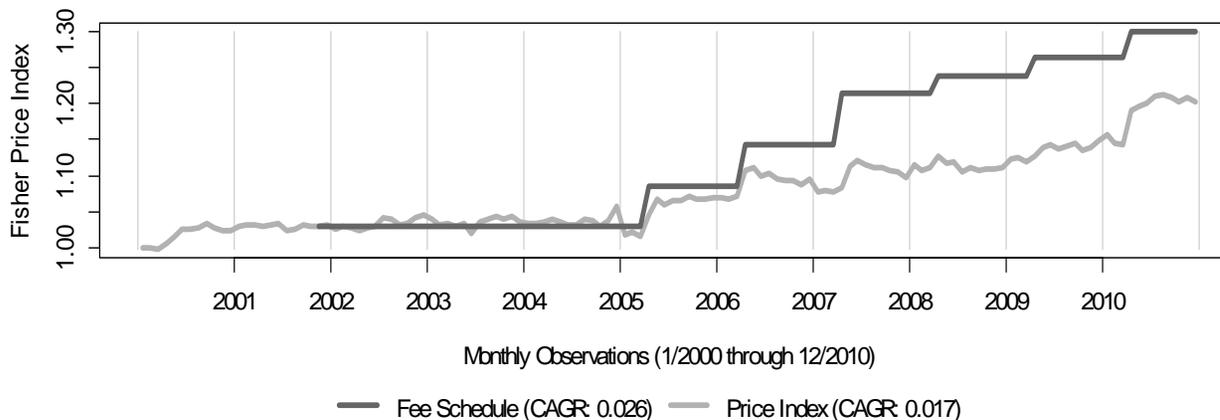
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Georgia

Price Level, Utilization, and Severity All Categories



Likewise, in Georgia, price contributed 1.7% annually and utilization only contributed 1.0% annually to overall severity change



The severity index is the product of the Fisher price index and the utilization index. The utilization index equals the Fisher quantity index, normalized by the number of active claims. In this context, a claim is considered active (in a given service category or overall) if there was a transaction (in a given service category or, when overall, in any given service category) associated with this claim included in the price index for the month. The Fisher price index is computed at actual prices and comprises all CPT codes. The indexes in the top panel are shown as original values (thin gauge) and smoothed (thick). Close to the endpoints, the smoothed values have to be interpreted with caution as there are no neighbors to the right that weigh on the direction of the trajectory generated by the smoother.

Statistical Models

We observe a relationship between reimbursements and fee schedule changes.

How do we capture it in a model?



Statistical Models

- Two Bayesian impulse-response models were estimated⁽¹⁾
 - Price, Utilization, and Severity⁽²⁾
 - Severity only, accounting separately for price departure and the MAR level⁽³⁾
- The impulse was the product of the MAR index⁽³⁾ and the proportion⁽⁴⁾ of services covered by the fee schedule
- The response may spread over several months
 - Almost all of the response is in the first three months
 - The models allow for a response for up to a year (11 months after the change)
- We found a price and severity response, but no discernible utilization response

(1) After accounting for drift and seasonality

(2) In the first model, price, utilization, and severity were modeled simultaneously subject to the price change and utilization change adding up to the severity change (in log space)

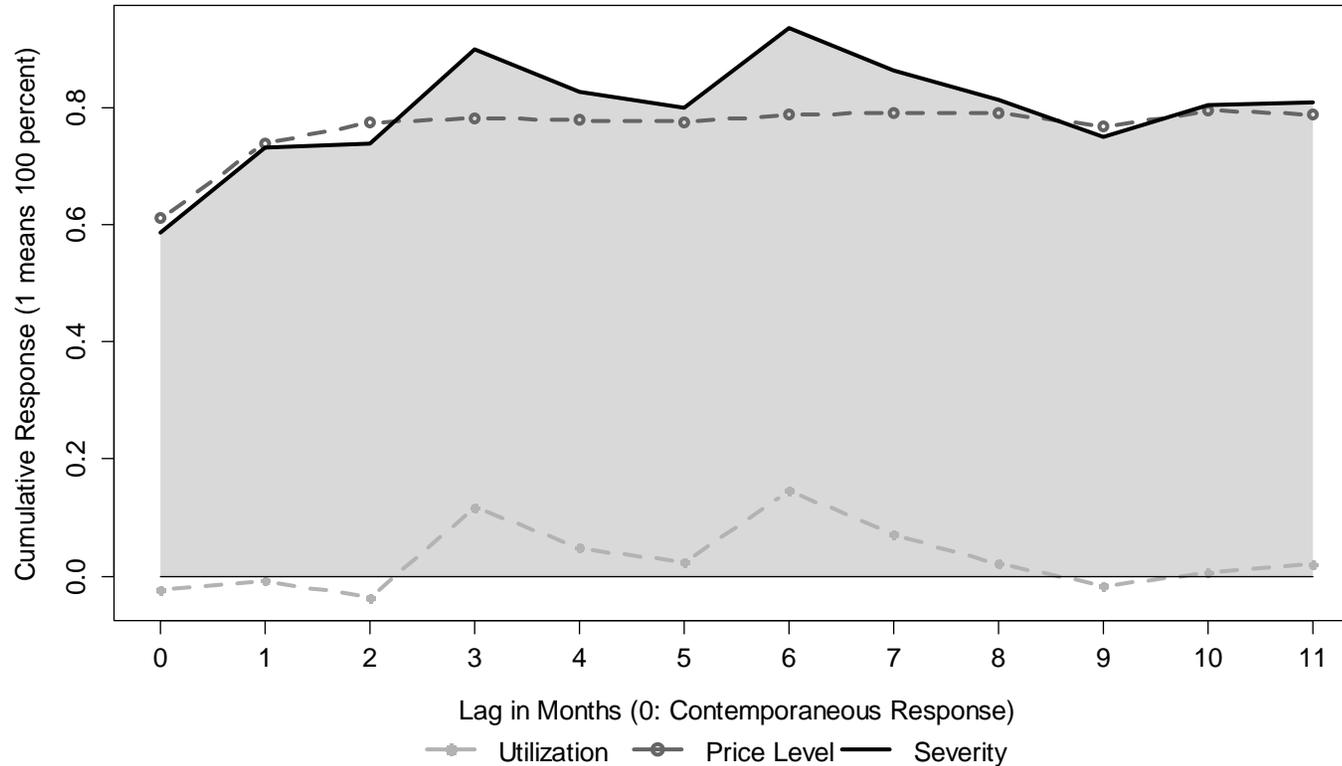
(3) The second model, is comprised of three distinct models. One only measuring severity response, a second measuring severity response accounting for price departure, and a third measuring severity response accounting for the MAR level. Departure and MAR level are not independent and could not both be captured in the same model

(3) Star price index at MAR

(4) This proportion is calculated as the dollars spent on services covered by the fee schedule divided by total dollars spent in the month prior to the fee schedule change



Fee Schedule Increase Utilization, Price Level, and Severity

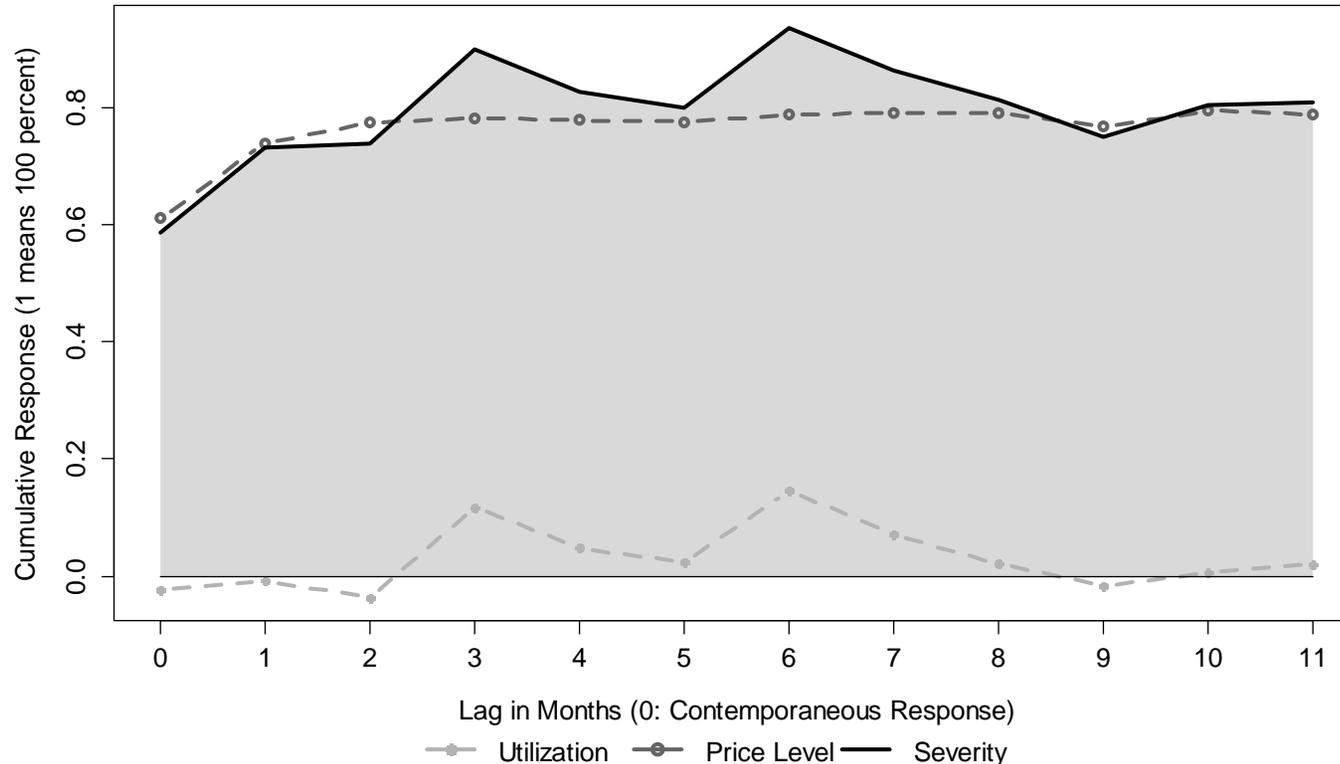


The estimated impact of a fee schedule change is cumulative across 12 months

The solid line (Severity) is the sum of the two dotted lines (Price and Utilization)

The severity index is the product of the Fisher price index and the utilization index. The utilization index equals the Fisher quantity index, normalized by the number of active claims. In this context, a claim is considered active (in a given service category or overall) if there was a transaction (in a given service category or, when overall, in any given service category) associated with this claim included in the price index for the month. The Fisher price index is computed at actual prices and comprises all CPT codes

Fee Schedule Increase Utilization, Price Level, and Severity



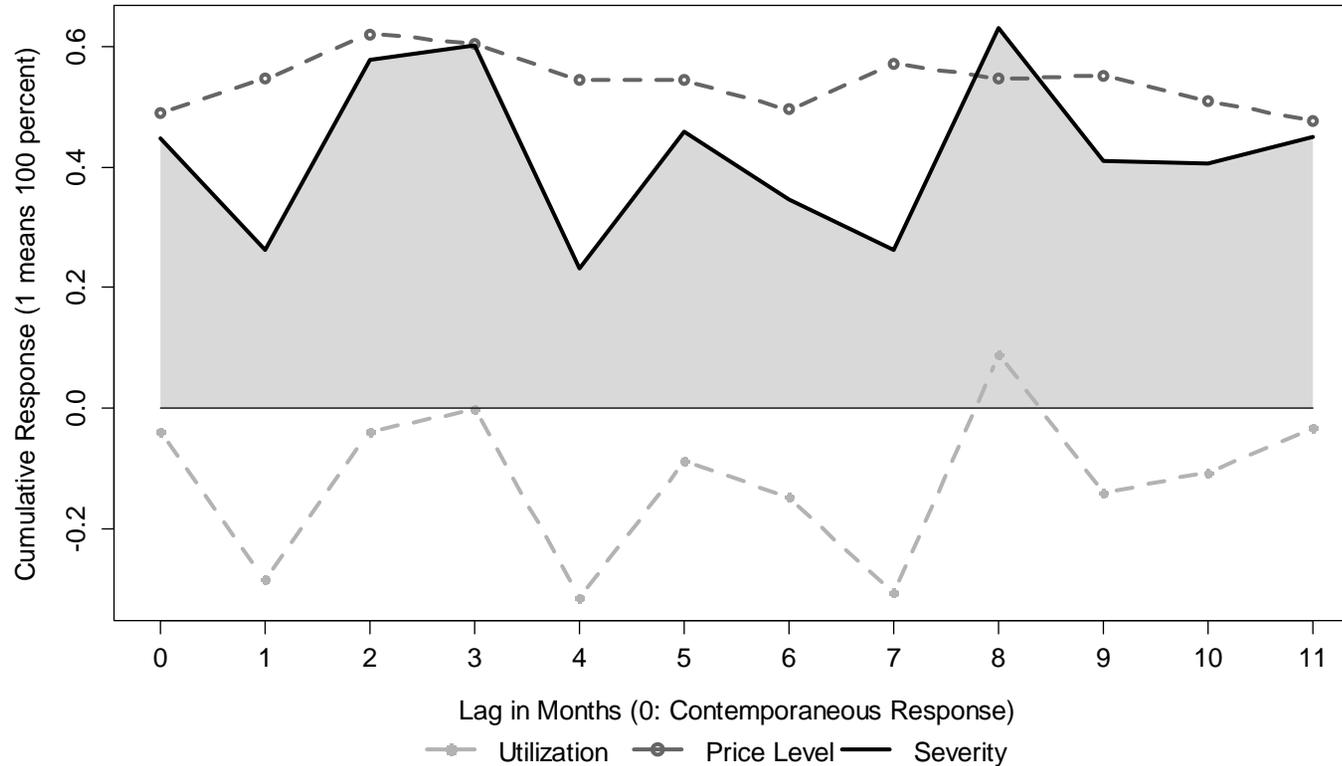
Price and severity both respond with approximately 80% of the fee schedule change (over the course of a year)

Utilization plays no discernible role in the severity response

The severity index is the product of the Fisher price index and the utilization index. The utilization index equals the Fisher quantity index, normalized by the number of active claims. In this context, a claim is considered active (in a given service category or overall) if there was a transaction (in a given service category or, when overall, in any given service category) associated with this claim included in the price index for the month. The Fisher price index is computed at actual prices and comprises all CPT codes



Fee Schedule Decrease Utilization, Price Level, and Severity

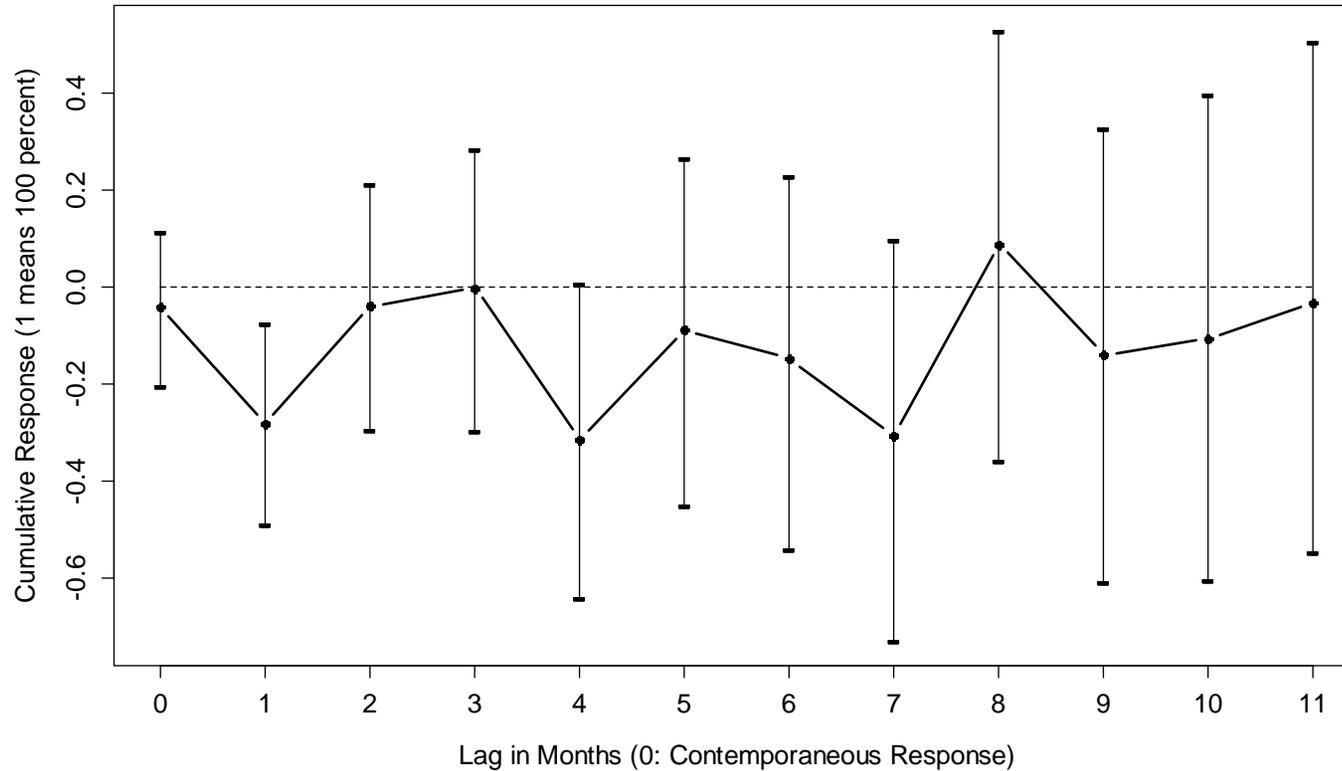


Price and severity both respond with approximately 50% of the fee schedule change (over the course of a year)

The severity index is the product of the Fisher price index and the utilization index. The utilization index equals the Fisher quantity index, normalized by the number of active claims. In this context, a claim is considered active (in a given service category or overall) if there was a transaction (in a given service category or, when overall, in any given service category) associated with this claim included in the price index for the month. The Fisher price index is computed at actual prices and comprises all CPT codes

Fee Schedule Decrease

There Is No Lasting Utilization Effect



The bands represent 80% credible intervals

We found no measurable impact on utilization

The utilization index equals the Fisher quantity index, normalized by the number of active claims. In this context, a claim is considered active (in a given service category or overall) if there was a transaction (in a given service category or, when overall, in any given service category) associated with this claim included in the price index for the month
The vertical bars indicate 80 percent credible intervals

The Findings

There are alternative ways of quantifying the impact of fee schedule changes on severity (that is, price and utilization combined), depending on the amount of information available

- Percentage of the fee schedule increase that translates into a severity increase:
 - 0.76
 - $0.76 \times (1.125 + 1.25 \times \text{Price Departure}^{(1,2)})$
 - $0.76 \times (0.94 - 1.17 \times \text{Fee Schedule Relative to Neighbors})^{(3,4,5)}$
- Percentage of the fee schedule decrease that translates into a severity decrease:
 - 45 percent⁽⁶⁾

(1) The average price departure is negative 10.3%.

(2) The model was executed in log space, so this is the natural log of the price departure. In the neighborhood of 1 log space and dollar space closely approximate each other

(3) The regression coefficients in this approach are only identified up to a proportionality constant; hence, the simultaneous estimation with the approach that makes no use of the Price Departure and Fee Schedule Relative to Neighbors covariates

(4) Using both covariates causes undesirable variance inflation in the Price Departure coefficient

(5) In the data, most states have fee schedules that are lower than the equally-weighted average of the fee schedules of their neighbors; such a situation may arise where the larger states have the higher fee schedules

(6) There were not enough observations in the data for a reliable quantification of the influence of the two covariates (Price Departure and Fee Schedule Relative to Neighbors) in the context of fee schedule decreases

Conclusion

The study is a comprehensive analysis of the price level and severity responses of physician services to fee schedule changes

- When a fee schedule increases, prices and severity increase, but not by as much
 - The expected impact of a fee schedule increase can be quantified as a function of price departure
- Response to a fee schedule decrease is weaker than the response to an increase
- Fee schedule changes have no discernible impact on utilization
 - The severity response seems to be a function of the price response



Appendix

Statistical Models

- After establishing stationarity in the price and severity changes, two Bayesian impulse-response models were estimated
- Both models quantify the logarithmic rates of change in the severity index in response to fee schedule changes (and to an autonomous component, i.e., drift)
- The impulse originating in the fee schedule change was quantified as the product of a Laspeyres price index and the transaction volume affected by the fee schedule change
 - A Laspeyres index evaluates the prior month's quantities at the current month's prices (numerator) and the prior month's prices (denominator)—this way, the index isolates the price effect of a fee schedule change
 - If a fee schedule change occurs mid-month, the impulse extends over two time periods
 - The transaction volume, which serves as a weight, dates from the same month as the quantities in the corresponding Laspeyres index

Appendix

Statistical Models

Potential Time Lag in Response

- The response to an impulse may spread out over several months
 - One way of modeling such lagged responses is to impose a specific functional form—this is to avoid the proliferation of regression coefficients where impulses are highly correlated over time
 - Due to the comparative sparseness of fee schedule changes in a data set of monthly observations, there is little potential for correlation among the covariates in an unstructured lag
 - Further, with unstructured lags, there is no risk of imposing a potentially inappropriate functional form on the impulse
- The unstructured lag has a length of 11 months
 - By allowing a full calendar year for the effect to manifest itself in the data, it is ensured that seasonal effects (which may be present even after a seasonal adjustment) do not adversely affect the estimated response
 - In part, fee schedule increases serve the re-alignment of prices with operating costs—if the latter increase continually, the discontinuous nature of fee schedule increases may lead to temporary supply changes

Appendix

Statistical Models – Impulse-Response Model I

Discerning Price, Utilization, and Severity Responses

- The first statistical model is a three-equation approach that quantifies the responses of the price, utilization, and severity indexes to fee schedule changes
- The three responses are estimated simultaneously
 - The statistical model incorporates a constraint that stipulates that the predicted (“fitted”) values of the severity response be equal to the sum of the predicted values of the corresponding price and utilization responses
- The results provide little evidence for lasting utilization responses to fee schedule changes

Appendix

Statistical Models – Impulse-Response Model II

Investigating the Role of Covariates

- The second statistical model, which is again a three-equation approach, quantifies the responses of the severity index only
- The first equation has no covariates—the response parameters of this equation are shared by the other two equations
- The second equation accounts for the influence of the price departure that is present in the month prior to the fee schedule change
- The third equation accounts for the influence of the price difference between the state’s fee schedule relative to the fee schedules of neighboring states, as observed in the month prior to the fee schedule change
 - This price difference was calculated by means of a Lowe index, using the star method
- Including both covariates in a single equation caused an inflation of the variance in the price departure parameter estimate

Appendix

Statistical Models

Hypothetical Numerical Example for a Fee Schedule Increase

Impulse

- The Laspeyres price index at MAR from the month prior to the change to the month of the change is 1.1
 - indicating a 10 percent increase in the fee schedule
- 90 percent of the services (by expenditure) was subject to the fee schedule⁽²⁾
 - Use the month prior to the fee schedule change
- Then the impulse is $0.1 \times 0.9 = 0.09$, or 9 percent

The “multiplier” (Percentage response to impulse)

- The price departure is negative 5% ^(1,2)
 - The ratio of actual prices to MAR is 95%⁽¹⁾
 - Then the multiplier is:^(2,4) $0.76 \times [1.125 + 1.25 \times \ln(0.95)] \approx 0.8$
- The state’s Lowe index relative to its neighbors is 0.90^(2,3)
 - Then the multiplier is:^(2,4) $0.76 \times [0.94 - 1.17 \times \ln(0.9)] \approx 0.8$

The response

- $9\% * 0.8 = 7.2\%$

(1) Actual price substitutes for MAR where no fixed-value MAR applies; see the definition of the variable Price Departure

(2) Using data from the month prior to the fee schedule change

(3) This is calculated as the state’s Lowe index (country wide) divided by the equally-weighted average of the Lowe indexes of other states in the same region

(4) Because the model was estimated on the (natural) logarithmic scale, the effect of the fee schedule increase reads:
 $\exp(\ln(1 + 0.1) \times 0.9 \times 0.8) - 1 \approx (1.1 - 1) \times 0.9 \times 0.8 \approx 7.2\%$



Appendix

Statistical Models

Zero-Price-Departure Constraint Bounds Price Level Changes

Assuming that price departure cannot be positive (that is, quantity-weighted, actual prices cannot exceed fee schedule prices), there are bounds to the price level responses to fee schedule changes

- In the event of a fee schedule increase, the response in the price level cannot exceed the initial impulse by an amount so large as to engender a positive price departure—this constraint was never found to be binding in the analyzed data set
- In the event of a fee schedule decrease, the price level must follow the fee schedule down at least to the extent necessary for maintaining a non-positive price departure
 - The only observation in the data set where the fee schedule decrease was close to having the potential of completely eliminating the existing price departure is Tennessee
 - In March 2008, the fee schedule reduction amounted to a 13.1 percent price decrease (CPT codes subject to a fixed-value MAR only), ⁽¹⁾ while the price departure (comprising all CPT codes) in the prior month equaled 14.0 percent; ⁽²⁾ more than half of the original price departure withstood the fee schedule decrease

(1) This is prior to weighting the fee schedule change with the volume of fixed-value MAR services to arrive at the impulse

(2) The fee schedule took effect on March 4, 2008, which was a Tuesday



Appendix

Price Departure

Price departure is based on the ratio of fee schedule prices to actual prices, weighted by the observed quantities

- The numerator of this ratio equals the quantity of consumed physician services evaluated at actual prices, which is simply the (data-cleansed) observed dollar volume
- The denominator equals the quantity of consumed physician services evaluated at the respective fixed-value MAR; for CPT codes that are not subject to a fixed-value MAR, actual prices substitute for the MAR
- When used in charts, price departure is defined as the ratio minus 1
- When used in the statistical model, price departure is defined as the (natural) logarithm of the ratio

(1) Technically, this ratio is a Lowe index



Appendix

Fee Schedule Relative to Neighbor

The variable Fee Schedule Relative to Neighbor equals the logarithm of the ratio of the fee schedule price level of a given state to the equally-weighted mean of the fee schedule price levels of its neighbors ⁽¹⁾

- The neighbors are defined based on Census regions and divisions
- The fee schedule price level of a given state is calculated as a Lowe index using the star method ⁽²⁾
 - The numerator of this Lowe index of a given state in a given month is the weighted sum of the quantities of all states, where the weights are the prices of that state
 - The denominator of the Lowe index is the weighted sum of the quantities of all states, where the weights are the prices paid in the respective states

(1) See the appendix for a list of the states' neighbors

(2) See Peter Hill, "Lowe Indices," presented at the 2008 World Congress on National Accounts and Economic Performance Measures for Nations, Washington DC, May 13-17, 2008, www.indexmeasures.com/dc2008/papers/Lowe%20indices%20revised.doc



Appendix

Seasonal Adjustment – Census Bureau Approach

- In many states, the severity index (and, hence, the utilization index) exhibits a seasonal pattern
- For this reason, the utilization index is seasonally adjusted using the X-12-ARIMA software (Version 0.3, 2011) of the Census Bureau; a seasonally adjusted severity index is then calculated as the product of the price index and the seasonally adjusted utilization index
- Because fee schedule changes themselves exhibit a seasonal pattern, there is a risk of tempering the quantity responses to fee schedule changes
 - The statistical model was applied to non-seasonally adjusted data in a sensitivity analysis—the overall impact is little changed
 - On the other hand, without seasonal adjustment, a correlation of seasonal increases of utilization with the seasonality of fee schedule changes may cause an overestimation of the effect of fee schedule changes

Appendix

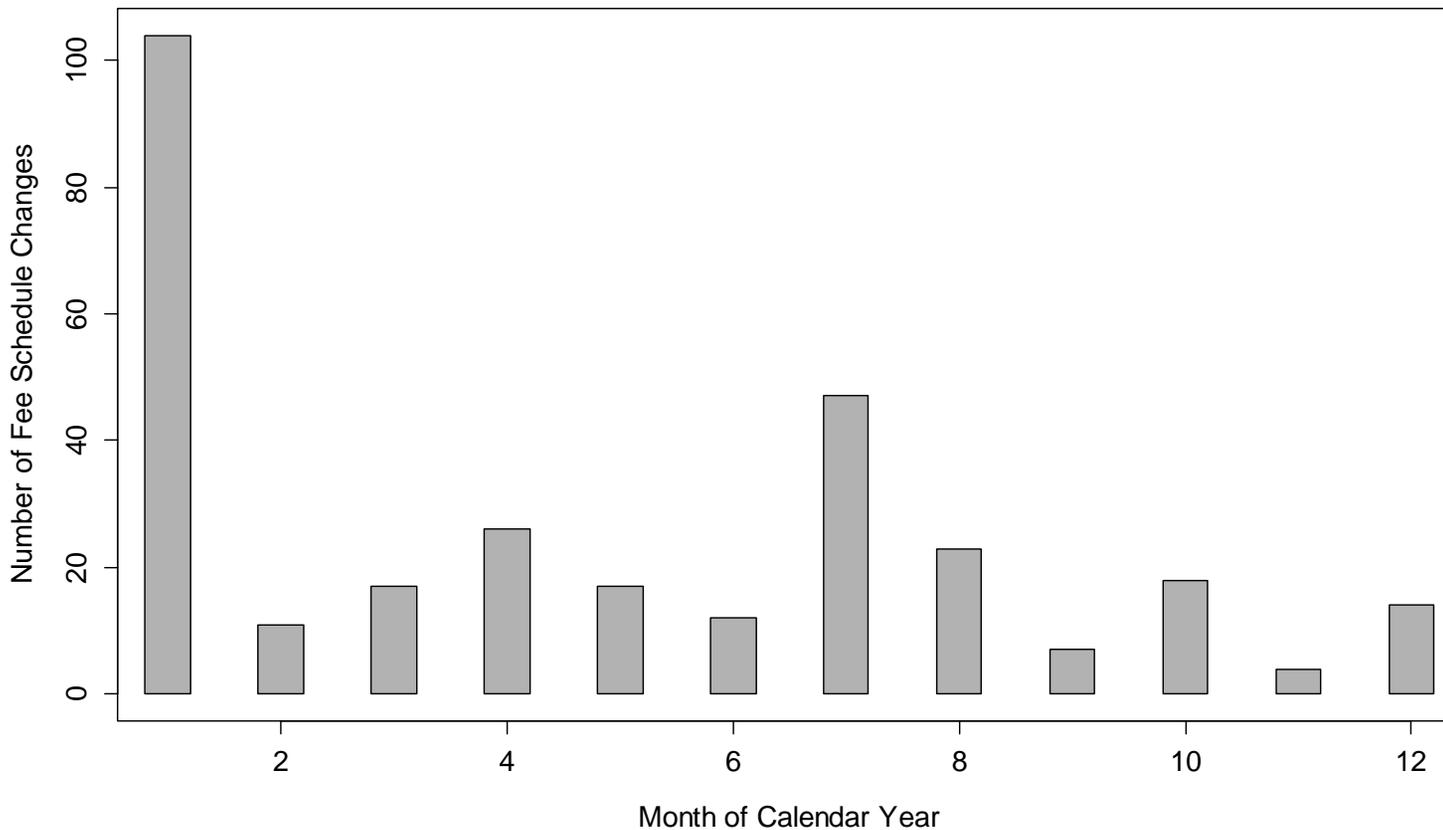
Seasonal Adjustment – Sensitivity Analysis

- We repeated the analysis without seasonally adjusting the utilization and severity indexes
 - In the event of a fee schedule increase, the percentage severity response amounts to 79 percent of the impulse (compared to the seasonally adjusted estimate of 76 percent)
 - When there is a fee schedule decrease, 48 percent of the impulse manifests itself in a severity change (compared to the seasonally adjusted estimate of 45 percent)
- As discussed, without seasonal adjustment, there is a risk of spurious correlation (between the seasonality of severity changes and the seasonality of fee schedule changes)



Appendix

Seasonality of Fee Schedule Changes 31 States, 300 Fee Schedule Changes, February 2000 – December 2010



There were 219 increases, 54 decreases, and 24 instances where the fee schedule change did not affect the maximum reimbursement of physician services; the 17 fee schedules that became effective after the beginning of the study without having had a precedent in the data, do not count toward the number of fee schedule changes (see the appendix for a list of these 17 instances)



Appendix

Data Cleansing – Outlier Detection

- We apply box plots to the observed transaction prices on the logarithmic scale,⁽¹⁾ using the following algorithm (where percentiles on the raw scale are indicated by capital letters and percentiles on the logarithmic scale are indicated by lowercase letters):
 - If $P75 \neq P25$, then we define the service-level price fences as $p75 + .6$ and $p25 - .6$
 - Records with a paid value greater than $p25 - .7$ and, simultaneously, a paid-to-submit ratio greater than .5, are also retained
 - If $P75 = P25$,⁽²⁾ then we define the service-level price fences as $p85 + .2$ and $p15 - .2$
 - Records within the service-level price fences are used to calculate category-level price fences, which are defined as $p90 + .5$ and $p10 - .5$, subject to constraints
- All records that fall between both the service-level and category-level price fences are retained unedited and are used to calculate the average price and median units

(1) The natural logarithm is applied

(2) The distributions of prices by CPT code may be multi-modal; such multimodality may originate in variation in reimbursement transaction rates across the reimbursing institutions. Because the frequency distribution of reimbursing institutions may be highly skewed in a given CPT code, setting the service-level fences dependent on the 25th and 75th percentiles poses the risk of discarding entire institutions as outliers



Appendix

Data Cleansing – Outlier Management

- Records within service-level and category-level fences are retained unedited, subject to constraints
- Records with prices above any applicable price fence have these prices reset to the mean price for that service; the quantity information remains unaltered
- Records with prices below any applicable price fence have the unit values reset
 - The price is recalculated with the number of units reset to the median number of units of this service⁽¹⁾
 - If this recalculated price falls below any of the lower price fences, then the price is recalculated once more, with the number of units set to unity
 - If the so recalculated price still falls below any of the lower price fences, then the record is discarded as a nuisance transaction⁽²⁾
- Services with less than 12 records in a given state in a given year are excluded from the price index computation

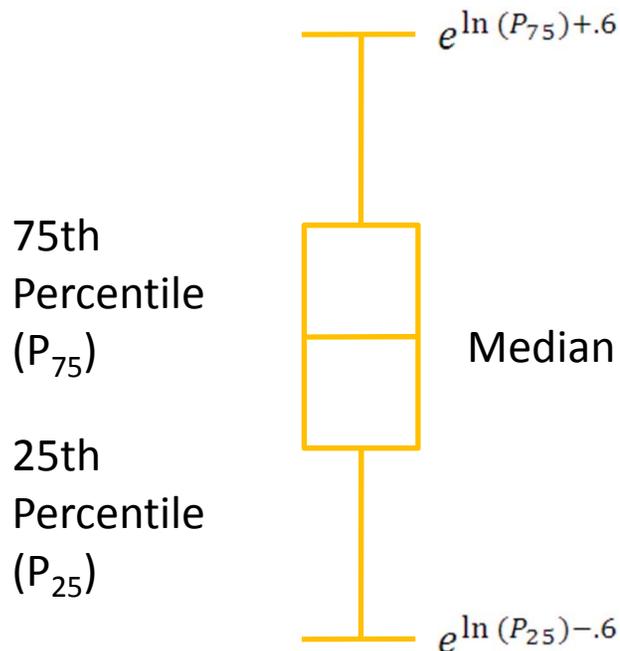
(1) The median is usually equal to unity

(2) If the price exceeds any upper fence, then the price is set to the mean of the applicable service level



Appendix

Data Cleansing – Tukey’s Schematic Plot (“Box Plot”)



- Shown is Tukey’s schematic plot, the objective of which is to report major location parameters (median, 25th, and 75th percentiles) of a data set and to identify outliers
- The hinges identify the inter-quartile range (IQR), which comprises 50 percent of the data
- The fences signify (1) the sum of the 75th percentile and .6 on the logarithmic scale (approximately the 75th percentile, multiplied by 1.8) and (2) the difference between the 25th percentile and .6 on the logarithmic scale (approximately the 25th percentile, divided by 1.8)
- Values beyond the fences are considered outliers

Source: John W. Tukey (1977) Exploratory Data Analysis, Reading (MA): Addison-Wesley

Appendix

Laspeyres and Paasche Price Indexes Arithmetic

- The Laspeyres price index (PL) and the Paasche price index (PP) are calculated as follows:⁽¹⁾

$$P_L \equiv \frac{\sum_{i=1}^n p_i^1 q_i^0}{\sum_{i=1}^n p_i^0 q_i^0} \qquad P_P \equiv \frac{\sum_{i=1}^n p_i^1 q_i^1}{\sum_{i=1}^n p_i^0 q_i^1}$$

- where p and q indicate prices and quantities, respectively; 0 and 1 indicate the base period and the current period, respectively; and n is the number of items
 - In order for the Fisher index to be a chained index, the base periods of the PL and PP indexes must be the time period immediately preceding the current period (as opposed to a more distant past time period) ⁽²⁾

(1) International Labor Office (2004) *Consumer Price Index Manual: Theory and Practice*, Geneva, p. 265

(2) Ibid., p. 280

Appendix

First Fee Schedule Considered in the Analysis

For the following 17 (of the total 31) states, the start date of the study⁽¹⁾ pre-dates the first fee schedule considered in the analysis

- The states enter the analysis in the third month following the first fee schedule

NC	3/ 1/2000
AL	3/15/2000
OR	4/ 1/2000
CT	5/ 1/2000
NV	5/ 1/2000
AR	5/15/2000
NE	6/15/2000
RI	7/ 1/2000
SD	7/19/2000
UT	1/ 1/2001
VT	1/ 1/2001
GA	9 /1/2001
FL	9/30/2001
TX	9/ 1/2002
TN	7/ 1/2005
IL	2/ 1/2006
ID	4/ 1/2006

(1) Utilization, price level, and severity rates of growth range from March 2000 through December 2010



Appendix

States' Neighbors

- When calculating the Lowe index for the covariate Fee Schedule Relative to Neighbors, a state's neighbors were defined based on Census divisions and, where applicable, regions⁽¹⁾
 - New England: CT, MA, ME, NH, RI, VT
 - North Central: IA, IL, IN, KS, MI, MN, MO, ND, NE, OH, SD, WI
 - South Atlantic: DC, DE, FL, GA, MD, NC, SC, VA, WV
 - South Central: AL, AR, KY, LA, MS, OK, TN, TX
 - Mountain: AZ, CO, ID, MT, NM, NV, UT, WY
 - Pacific: AK, CA, HI, OR, WA

(1) See www.census.gov/econ/census07/www/geography/regions_and_divisions.html

