How Do Medicare Advantage Prices Vary Geographically?
Evidence from a New Price Index

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Abstract

In this paper, we investigate geographic variation in the prices paid by Medicare Advantage plans across counties. To document price variation, we create novel county-level price indices using itemized transaction-level claims data. In 2016, we find that prices vary substantially across the country, with counties at the 75th percentile of the distribution paying 48.7% more for outpatient procedures and 11.2% more for inpatient care compared to the median. We also examine variation in prices for categories of procedures and admissions, such as radiology and emergency care to uncover the potential drivers of the price variation. Finally, we document persistence in high prices over time and show the relationship between prices and Medicare Advantage penetration rates.

1 Introduction

The United States exhibits significant regional variation in medical spending per capita beyond what is readily explained by observable demographic and economic factors (Institute of Medicine, 2013; Finkelstein et al., 2016). Coupled with the observation that health outcomes do not appear to be meaningfully better in high-spending regions, this variation has raised concerns about inefficient or wasteful spending (Fisher et al., 2013; Skinner, 2011). These concerns are particularly relevant in the context of publicly-funded medical spending, such as what is delivered through the Medicare program.†

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†While much of the literature on geographic variation in medical spending has focused on the Medicare program, similar variation has been documented in the commercially-insured population; see, e.g., Cooper et al. (2018), Chernew et al. (2010).
While Medicare is a publicly-financed program, beneficiaries can choose to enroll in a version of Medicare that is operated by private insurers: Medicare Advantage (MA). Recent work has documented that variation in spending in Medicare Advantage is 20 percent higher than variation in traditional Medicare (Curto et al., 2019). This variation in MA spending could be driven by the prices paid by MA insurers to providers, the quantity or type of care purchased, or a combination of both price and quantity factors. Critically, the policy solutions that are relevant if high spending is driven by prices are very different than what would be relevant if quantity or type of service was largely responsible for spending variation.

In this paper, we present new evidence on how prices paid by MA insurers vary across geography. We construct county-level price indices using itemized claims-level outpatient and inpatient data. These data, provided by the Health Care Cost Institute (HCCI), are unique in that they allow us to observe actual transaction prices that occurred between MA insurers and providers. Using more than 235 million outpatient and inpatient claims, we construct these county-level price indices using a regression analysis that controls for claim characteristics such as procedure code, diagnosis, and patient characteristics, depending on the type of claim (inpatient vs outpatient). Since we estimate our price index separately by year, we are able to incorporate any year to year variation in average procedure prices that may be driven by, e.g., new technologies. We also document how variable these indices are by reporting the standard error of the price index, and how persistent they are over time. This method allows us to flexibly control for national trends in prices across procedures. We repeat our analysis for different categories of procedures and admissions, such as radiology and emergency care, which allows us to uncover potential drivers of the price variation.

We find substantial variation in the prices paid by MA across counties. In 2016, counties at the 75th percentile of the price distribution face prices that are 48.7 percent higher for in-network outpatient procedures than the median county, while the county at the 25th percentile of the price distribution faced prices that are 11.7% lower than the median county. In relative terms, in the same year, this difference between the top quartile and median county is largest for “Lab/Pathology” and smallest for “Administered Drugs, Incl Chemo Drugs”. Over time, the percent gap between the 75th percentile and the median has gotten smaller: in 2012, the first year in which we have in-network data, we see a difference of 66.9% between the top quartile and the median for in-network outpatient procedures; by 2016, the same difference was 48.7%. We see a similar decrease in this difference for out-of-network outpatient procedures as well. While in 2014, the first year in which we have out-of-network data,
there’s a difference of 47.4% between the top quartile and the median, this difference shrinks to 39.9% by 2016. We also document that counties tend to exhibit either persistently high, or persistently low, prices over time; a county’s price index in the first year of our data is highly predictive of the price index in later years.

For inpatient procedures, we find similar evidence that MA prices vary across geography, although the range of prices is somewhat less than those observed with outpatient procedures. In 2016, counties at the 75th percentile of the price distribution face 11.2% higher prices for inpatient stays than the median county, while counties at the 25th percentile face 8.8% lower prices than the median county. Within inpatient stays, in 2016, these differences are largest for the “Mental Health” and “SNF” categories, and smallest for the “Surgical” category. Across years, the difference between the 75th percentile and the median has remained relatively constant: in 2012, we see a difference of 10.6% between the top quartile and the median for in-network inpatient stays; by 2016, this difference grew slightly to 11.2%. We observe a similar small increase for out-of-network inpatient stays as well. In 2014, the difference between the top quartile and the median was 11.7%. By 2016, this difference has slightly increased to 13.2%. We also document a similar persistence in expense levels for inpatient stays; more expensive counties in early years remain more expensive counties in later years.

Finally, we examine the extent to which the MA penetration rate is associated with MA prices. We find higher variation in our price index at lower levels of MA penetration. This could suggest a dynamic between MA insurers and providers where MA penetration impacts price negotiations, and the price levels impact MA insurers ability to attract enrollees.

2 Data

In this paper, we use MA claims data from the HCCI. HCCI data contains detailed inpatient, outpatient, and pharmaceutical claims for over 50 million commercially insured individuals per year and Medicare Fee for Service claims for roughly 40 million Medicare Fee for Service individuals from 2012 to 2016. These data have been used to study health care costs in a variety of contexts ranging from children’s hospitals to prescription drugs to dialysis centers (see McCarthy and Raval (2022), Dafny et al. (2022), League et al. (2022)). The data cover the utilization of about 40 percent of MA enrollees. These data include information on the procedures performed and the diagnosis codes (Diagnosis Re-

2See https://www.healthdatamanagement.com/articles/hcci-gets-full-access-to-medicare-claims-data. Note that this figure was calculated in 2014, and coverage may have changed between that period and the point at which we first accessed the data, 2019.
lated Groups, or DRGs). Importantly, for our purposes, claims in the HCCI data are itemized and include information on the actual transaction prices paid. The availability of transaction prices in the HCCI data contrasts with other data sources, such as hospital discharge databases, which report the charge for each visit but not the actual amount paid. The HCCI data also includes demographic information about enrollees and geographic information about the point of service for each claim, as well as information on whether or not the claim is submitted to a Medicare Advantage plan. While we observe in-network claims across all years of our sample, we observe out-of-network claims only from 2014 through 2016.

We construct two datasets using the HCCI data: 1) A MA outpatient procedure dataset and 2) A MA inpatient admission dataset. The MA outpatient data include itemized claims for over 235 million outpatient procedures. The MA inpatient admissions dataset includes roughly 7 million inpatient admissions. Both datasets cover a period from 2012 through 2016. We match these data to patient demographic information on age and gender. For inpatient and outpatient data, we use provider zip codes associated with each claim to aggregate our data to the county level. This information allows us to examine geographic differences in prices.

3 Price Index Estimation

Our goal is to generate information about how medical prices vary across counties. However, this is challenging given the multi-faceted nature of medical care: the cost of medical encounters could vary for different reasons based on the patients’ diagnosis, the procedures conducted, and other factors. In order to generate county price indices, we need to combine data on all of these elements from the claims-level HCCI data. We do this separately each year for outpatient and inpatient claims and, within these broader groups, for categories of claims (e.g., Ambulance, Emergency Room, Outpatient Surgery). Below, we describe our procedure to construct the price index for each of these types of claims in greater detail.

3.1 Outpatient Procedure Price Index Empirical Model

We observe outpatient MA claims from 2012 through 2016. We first identify the top 200 outpatient procedures by revenue each year and include all of these procedures in our analysis. Since the top 200 procedures by revenue change across years, this results in a set of around 270 total outpatient proce-

3For observations from zipcodes that span multiple counties, we split these observations to each associated county, and weight by county population, with the weights summing to one.
cedures across all years, roughly 235 million procedure charges from itemized claims corresponding to
around 80% of total MA outpatient procedure revenue in the HCCI claims data.

We model prices as a function of the county, the procedure, units of the procedure, other controls,
and a noise term. We estimate parameters from the following specification in equation 1. We index all
data and parameters by year, \( t \), since we separately estimate the model parameters for each year.

\[
\log(p_{ijct}) = \rho_{ct} + \kappa_{jt} + \alpha x_{it} + \epsilon_{ijct}
\]  

(1)

Where \( \log(p_{ijct}) \), the log price of claim \( i \) for procedure \( j \) in county \( c \) during year \( t \). \( \rho_{ct} \) is the county
fixed effect parameter and our parameter of interest. \( \kappa_{jt} \) is the procedure specific parameter. \( x_{it} \) are a
set of controls, including log of units. Under our primary specification, \( x_{it} \) also includes information
on the patient age and gender. We also include alternative specifications that also include controls for
common modification codes. These specifications are as follows:

OP Base: \( \alpha x_{it} = \alpha_1 \log(\text{units}_{ijct}) \)

With demographics: \( \alpha x_{it} = \alpha_1 \log(\text{units}_{ijct}) + \alpha_2 \text{age}_{it} + \alpha_3 \text{gender}_{it} \)  

(2)

With demographics and mods: \( \alpha x_{it} = \alpha_1 \log(\text{units}_{ijct}) + \alpha_2 \text{age}_{it} + \alpha_3 \text{gender}_{it} + \alpha_4 \text{mods}_{it} \)

Note that no specification includes a constant term, which allows us to generate a price index for
each county with sufficient data. Separately estimating model parameters for each year controls for
any changes to procedure prices over time, while \( x_{it} \) controls for claim-level differences, including
log of the number of associated units and, in an additional version, modification codes. We include
alternative specifications as one might interpret regional differences in the prevalence of modifications
as part of the difference in price that a price index should capture.

Additionally, we observe both the procedure category (e.g., Ambulance, Emergency Room, Out-
patient Surgery, etc.) for each claim and whether or not the claim was in-network or out-of-network.

We can restrict our sample to each procedure category \( g \) and in-network/out-of-network status \( n \) and
re-estimate the above model to estimate procedure category \( g \)-network \( n \) price indices \( \rho_{ct}^{gn} \).

3.2 Inpatient Admission Price Index Empirical Model

Inpatient hospital stays often vary from outpatient visits. During a hospital stay, a patient may receive
a number of different procedures or interventions to address his or her condition. We therefore treat
inpatient stays differently than outpatient encounters. We first collapse itemized claims data data to a single inpatient admission using an admission identifier. Note that while we look at outpatient procedures, for inpatient care, we use admissions as the unit of analysis, which may include a bundle of procedures and services. To characterize the type of procedures and services that may be provided during a hospital stay, we use information on the diagnosis associated with the hospitalization. We restrict the sample to stays with non-missing information on the diagnosis related group (DRG) and, for computational efficiency, include only inpatient stays associated with one of the top 300 DRGs by revenue. This sample restriction results in nearly 7 million hospital admissions and covers 91 percent of inpatient revenue and about 97 percent of stays. We then estimate the following four versions of the inpatient price index model in 3 using data from each year. We again index all data and parameters by year, t, since we separately estimate the model parameters for each year.

\[
\text{Base Specification: } \log (p_{ijct}) = \rho_{ct} + \delta_{jt} + \epsilon_{ijct}
\]

With LOS:

\[
\log (p_{ijct}) = \rho_{ct} + \delta_{jt} + \lambda \log (\text{los}_{ijct}) + \epsilon_{ijct}
\]

With demographics:

\[
\log (p_{ijct}) = \rho_{ct} + \delta_{jt} + \alpha x_{it} + \epsilon_{ijct}
\]

With demographics and LOS:

\[
\log (p_{ijct}) = \rho_{ct} + \delta_{jt} + \lambda \log (\text{los}_{ijct}) + \alpha x_{it} + \epsilon_{ijct}
\]

Here \( \rho_{ct} \) is the county fixed effect, our parameter of interest. The \( \delta_{jt} \) are fixed effects for diagnosis related groups (DRG). Depending on the specification, additional controls include \( \log \) of the length of stay (LOS) and patient demographic information, including age group and gender.

### 3.3 Indexing to Median County

We use our county fixed effect parameters estimates, \( \hat{\rho}_{ct} \), to construct price indices. To facilitate interpretation, we use the differences in \( \hat{\rho}_{ct} \)s to construct relative price indices; i.e., the \( \log \) of prices in one county relative to the prices another benchmark county. For each year we choose the median county as our benchmark, and use the property that \( \log (a) - \log (b) = c \) implies \( a = e^c b \) to create a price index according to equation 4.

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\(^4\)We further exclude a small number of stays that report non-positive prices or length of stay, and visits with greater than 50 days length of stay. We exclude this small percent of visits with very long lengths of stays as they seem to be significantly different than short stays and costs may vary across shorter vs long stays in ways that are not captured by our regression model.
\[ \hat{P}_{ct} = 100 \left( e^{\hat{\rho}_{ct}} - e^{\hat{\rho}_{cmt}} \right) = 100 \left( e^{\hat{\rho}_{ct}} - e^{\hat{\rho}_{cmt}} \right) \] (4)

For example, \( \hat{P}_{ct} = 125 \) would tell us that prices in county \( c \) are 25 percent higher than the median county for that year after accounting for control variables. \( \hat{P}_{ct} = 100 \) would mean that prices in county \( c \) are the same as the median county. Similarly, \( \hat{P}_{ct} = 75 \) would mean that prices in county \( c \) are 25 percent lower than the median county.

4 Results

We present our results in graphical form, accompanied by county-level tables that are available for download by clicking on the hyperlink provided under each figure. We present results for pilot specifications and select categories below. We include the complete set of remaining figures in Appendix 1 and Appendix 2.

4.1 Geographic Variation

Figure 1 below and Figure 6 show maps of our estimated in-network price indices for all outpatient procedures included in our analysis.\(^5\) Darker values indicate less expensive counties and lighter values indicate more expensive counties, with values ranging from around 300 (3 times the price index of the median county) to 75 (0.75 times the price index of the median county). For ease of presentation, we top code the most expensive 5 percent of counties and bottom code the least expensive 5 percent of counties, although the uncensored version of this data is available at the hyperlink. We see considerable variation in prices across the United States, with generally higher prices in the west and lower prices in the southeast. Similarly, we observe significant geographic variation when we examine out of network prices (Figure 7).

In Figure 6, across all years, we see price variation across the United States. While the least expensive counties are almost 25 percent cheaper than the median, the most expensive counties can be more than twice as costly as the median county. We observe relatively similar gaps across all years, with perhaps a slight narrowing in later years. The geographic variation remains relatively constant across time as well. In general, we see less expensive counties in the eastern portion of the United States, predominately in the Southeast. Across years, these counties generally remain relatively inexpensive compared to the median county. We see the opposite result in the West and Midwest however. These

\(^{5}\)Results for our alternative methods of estimating the price index are found in the Appendices.
western areas are relatively more expensive across all years, sometimes nearly twice as expensive as the median county. Crucially, these relatively inexpensive and relatively expensive counties remain so across time, showing a persistence in relative price levels across years.

Figure 7 shows the same results for out-of-network outpatient procedures. We find similar results to Figure 6: a wide distribution of price indices across counties, with less expensive counties located predominately in the East and more expensive counties located in the West and Midwest. We see a similar range for our out-of-network outpatient price index, with the least expensive counties displaying roughly 20 percent lower prices than the median and the most expensive counties being around 150 percent more expensive than the median county. Similar to our in-network outpatient procedures results, we see these relative expense levels persist across years for out-of-network outpatient procedures as well.

Figures 8-10 show similar in-network price indices within three selected categories of outpatient
care: “Emergency Room”, “Administered Drugs, Incl Chemo Drugs”, and “Lab/Pathology”. We choose to focus on these specific categories due to the “Emergency Room” category having the highest revenue procedures, “Lab/Pathology” having the most variation across counties, and “Administered Drugs, Incl Chemo Drugs” having the least variation. While the top quartile county for in-network “Lab/Pathology” ranges from 141.5% to 179.2% more expensive than the median county across years, the same difference for “Administered Drugs, Incl Chemo Drugs” ranges from 2.2% to 5.6%. “Emergency Room” also shows a large amount of variation in 2012, with the top quartile county being 86.3% more expensive than the median county, although this difference drops to 30.3% by 2016. Within the maps for the “Emergency Room” and “Lab/Pathology” categories, we see a similar pattern to Figures 6 and 7, with more expensive counties located in the West and Midwest, and less expensive counties in the east. In contrast, “Administered Drugs, Incl Chemo Drugs” not only shows less variation across counties, but no clear geographic patterns across the United States. These same general trends for these three categories can be seen in the out-of-network results in the second appendix as well.

Figures 11-12 show price indices for all inpatient stays within our analysis. Overall, we find less variation across counties for inpatient care than we did for outpatient procedures. Across all years, we find differences of roughly 9 to 11% between the top quartile and median counties for in-network inpatient care, while this difference was roughly 3-4 times as large for in-network outpatient procedures. The range amongst all counties is smaller as well, with the least expensive counties roughly 30% less expensive than the median and the most expensive counties roughly 40% more expensive. Similar trends are seen for out-of-network inpatient stays as well. We do, however, see the same overall geographic differences observed for outpatient procedures. Generally, inpatient stays are relatively less expensive in the eastern and southeastern portions of the United States and more expensive in the West, mirroring the geographic differences observed for outpatient procedures.

Figures 13-14 show price index maps for our two selected categories of inpatient stays: “Mental Health,” selected for the high amounts of variation across counties, and “Surgical,” selected for having claims in a high number of counties. Within these categories, we see substantial variation between counties, although there is less variation within these categories than many outpatient categories. For both of these categories, we see the same geographic differences observed previously for outpatient procedures and inpatient care overall: higher prices in the West than in the Southeast.

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6Additional figures with in-network results for all outpatient categories can be found in the first appendix, with broadly similar results to those described above. Out-of-network category-level results can be found in the second appendix.
4.2 How Persistent are Price Indices Over Time?

We also examine how persistent high or low spending designation is over time. If counties demonstrate price indices that remain consistently high (or low) across years, then price levels likely reflect time invariant factors about the county such as market structure, characteristics of patients, labor market conditions, or policies that do not vary much year to year. In contrast, if a county’s rank in the price index changes considerably over time, we might instead hypothesize that the price index captures idiosyncratic changes in demand rather than these underlying structural features.

4.2.1 Year to Year Scatter Plots

We first characterize time persistence using scatter plots that show our county fixed effect estimates of equations (4) and (3) in the first observed year against estimates from later years. We re-center each county fixed effect by the median value for that year. Figure 2 plots in-network outpatient county fixed effect estimates for 2012 and 2016 with extended results in Figures 15-23. The out-of-network comparisons benchmark to 2014, the first year HCCI tracked out-of-network data. These figures demonstrate that the relative price level in the base year is highly predictive of relative price levels in subsequent years.
Results for all years in figures 15-23

Beginning with Figures 15 and 16, showing yearly county fixed effect comparisons for in-network and out-of-network outpatient procedures, we show high correlations between the base year (2012 for in-network, 2014 for out-of-network) county fixed effects and the county fixed effects in later years, illustrating the persistence of high/low spend counties. We additionally observe drops in correlation as we approach the later years of our sample, showing that while the base year county fixed effects are predictive of county fixed effects in subsequent years, it may become slightly less predictive as years pass.

We see similar results in Figures 17-19, focusing on our in-network county fixed effects for our selected outpatient categories. For all three selected categories, we observe similar results to overall outpatient procedures: the county fixed effect from the base year is very predictive of the county fixed effect in later years. We do observe a weaker relationship within the “Administered Drugs, Incl
Chemo Drugs” category, which could be due to either this category containing fewer observations, or this category being relatively lower variance than the other outpatient categories.

Figures 20 and 21 show this relationship for both in-network and out-of-network inpatient stays. Once again, we see a high correlation between our county fixed effects in the base year and the fixed effects in later years, although the correlation decreases as years progress. These results are mirrored in our selected inpatient categories (Figures 22 and 23) as well.

4.2.2 Quintile Transitions

We can also use our estimation results to track the evolution of relative prices over time. To do this, we group each county-year into five within-year quintiles based on the value of their county fixed effects, $\rho_{ct}$. We include another category for county-years with insufficient data. Counties may fall into this category if there are not enough observations in the county-year to estimate a price index, or if there are not enough observations to report the price index due to privacy requirements of data provider.

Figure 3 visualizes the transition between quintile groups from year to year for outpatient procedure prices. From these transitions, it is apparent that most high price counties in one year remain high price counties the subsequent year. Similarly, counties typically stay in the same quintile in other price groups from year to year. When counties transition to other groups, they generally move to adjacent quintiles. Last, it is worth noting the increased relative size of the insufficient data group in 2014, which is due to a change in the HCCI data.

Figure 3 visualizes the transition between quintile groups from year to year for inpatient care and demonstrates similar trends to outpatient procedure prices. Again, high price counties in one year remain high price counties the subsequent year. We see more switching between groups from year to year relative to outpatient care. This may be due in part to the enormous difference in sample sizes; the outpatient price index in 3 is based on 235 million itemized claim lines, while the 4 is based on 7 million inpatient admissions.
4.3 MA Penetration Rate Relationship

Additionally, we examine the relationship between our county MA price index and county MA penetration rates (calculated as a county’s MA enrolled population divided by the county’s MA eligible population).

Figure 5 and Figures 26 and 27 compare each county’s MA penetration rate to their price index, for both in-network outpatient procedures and in-network inpatient stays. Figure 26, focusing on outpatient procedures, shows higher variation in the distribution of our price index at lower levels of MA penetration. While these lower MA penetration counties may have more variation in part due to a lower number of MA claims per county, this could also be indicative of dynamics between MA insurers and providers in counties at different levels of MA penetration rates. These results are consistent across years.

Figure 27 shows the same comparison of county MA price index and county MA penetration rate, but now for in-network inpatient stays. While we see less variation overall, we still see either a slight
negative correlation between the price index and MA penetration rate, or no correlation between the two. While this relationship is weaker, and could point to important differences between inpatient and outpatient care, it does lend some support to our prior hypotheses.
5 Conclusion

A large body of work has documented the substantial regional variation in medical spending across the United States Institute of Medicine (2013). This variation in spending is apparent in both traditional Medicare and in the Medicare Advantage (MA) program, a large public-private partnership that insures over 26 million Medicare beneficiaries Curto et al. (2019). Since MA relies on private plans to negotiate prices with local provider networks, MA spending could be driven by variation in the amount of care provided or in the price paid for care. In this paper, we provide more insight into the latter explanation by investigating the extent to which prices paid by MA plans vary across counties, how this price variation has changed over time, and which types of care exhibit the greatest variation in price.
We conduct this study by analyzing more than 235 million inpatient and outpatient claims paid by MA insurers between 2012 and 2016. We combine this claims data into price indices for different categories of care by relying on characteristics of procedures, diagnoses, patients, and time trends that we observe in the data. After constructing these indices, we use them to document substantial variation in prices over geography after accounting for procedure mix and, for inpatient procedures, patient diagnosis. We find that counties at the top quartile of the price distribution pay, in 2016, prices that are about 49% higher for outpatient care and 11% higher for inpatient care. These patterns are relatively stable over time, with high (low) price counties remaining consistently expensive (inexpensive) over our sample period.

Variation in prices could reflect differences in underlying costs (e.g. local labor markets) that cannot be easily alleviated with public policy. Alternatively, these price differences could reflect differences in market structure and competition, or differences in how MA plans are paid. Such explanations would suggest that different policies could result in lower prices and generate price convergence (and, potentially, convergence in average spending). Future work should investigate the causal drivers of this variation and the scope of policy in reducing health care costs in the Medicare Advantage program.

References


Figure 6: Yearly Outpatient County MA Price Index Maps
All Outpatient Procedures; In-Network

2012 Outpatient County MA Price Index
All Outpatient Procedures; In-Network

Source: Authors' calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (75.018), top-coded at 95% (278.906).
Controls: Procedure code, log(units), demographics.

2013 Outpatient County MA Price Index
All Outpatient Procedures; In-Network

Source: Authors' calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (77.762), top-coded at 95% (299.985).
Controls: Procedure code, log(units), demographics.
Figure 6: Yearly Outpatient County MA Price Index Maps

All Outpatient Procedures; In-Network

2014 Outpatient County MA Price Index
All Outpatient Procedures; In-Network

Source: Authors' calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (78,223), top-coded at 95% (274,712).
Controls: Procedure code, log(units), demographics.

2015 Outpatient County MA Price Index
All Outpatient Procedures; In-Network

Source: Authors' calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (78,313), top-coded at 95% (271,122).
Controls: Procedure code, log(units), demographics.
**Figure 6:** Yearly Outpatient County MA Price Index Maps
All Outpatient Procedures; In-Network

Source: Authors' calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (78.06), top-coded at 95% (266.815).
Controls: Procedure code, log(units), demographics.

Link to County Fixed Effects and Price Indices Estimates.
Figure 7: Yearly Outpatient County MA Price Index Maps
All Outpatient Procedures; Out-of-Network

2014 Outpatient County MA Price Index
All Outpatient Procedures; Out-of-Network

Source: Authors' calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (80.055), top-coded at 95% (252.617).
Controls: Procedure code, log(units), demographics.

2015 Outpatient County MA Price Index
All Outpatient Procedures; Out-of-Network

Source: Authors' calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (80.062), top-coded at 95% (245.419).
Controls: Procedure code, log(units), demographics.
Figure 7: Yearly Outpatient County MA Price Index Maps
All Outpatient Procedures; Out-of-Network

2016 Outpatient County MA Price Index
All Outpatient Procedures; Out-of-Network

Source: Authors’ calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (80.565), top-coded at 95% (243.317).
Controls: Procedure code, log(units), demographics.

Link to County Fixed Effects and Price Indices Estimates.
Figure 8: Yearly Outpatient County MA Price Index Maps
Administered Drugs, Incl Chemo Drugs; In-Network

2012 Outpatient County MA Price Index
Administered Drugs, Incl Chemo Drugs; In-Network

Source: Authors' calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (68.52), top-coded at 95% (128.124).
Controls: Procedure code, log(units), demographics.

2013 Outpatient County MA Price Index
Administered Drugs, Incl Chemo Drugs; In-Network

Source: Authors' calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (90.711), top-coded at 95% (119.789).
Controls: Procedure code, log(units), demographics.
Figure 8: Yearly Outpatient County MA Price Index Maps
Administered Drugs, Incl Chemo Drugs; In-Network

2014 Outpatient County MA Price Index
Administered Drugs, Incl Chemo Drugs; In-Network

2015 Outpatient County MA Price Index
Administered Drugs, Incl Chemo Drugs; In-Network

Source: Authors' calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (83.026), top-coded at 95% (155.433).
Controls: Procedure code, log(units), demographics.
Figure 8: Yearly Outpatient County MA Price Index Maps
Administered Drugs, Incl Chemo Drugs; In-Network

Source: Authors' calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (85.876), top-coded at 95% (155.745).
Controls: Procedure code, log(units), demographics.

Link to County Fixed Effects and Price Indices Estimates.
Figure 9: Yearly Outpatient County MA Price Index Maps
Emergency Room; In-Network

Source: Authors' calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (80.377), top-coded at 95% (323.065).
Controls: Procedure code, log(units), demographics.
Figure 9: Yearly Outpatient County MA Price Index Maps
Emergency Room; In-Network

2014 Outpatient County MA Price Index
Emergency Room; In-Network

2015 Outpatient County MA Price Index
Emergency Room; In-Network

Source: Authors' calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (81.874), top-coded at 95% (233.794).
Controls: Procedure code, log(units), demographics.
Figure 9: Yearly Outpatient County MA Price Index Maps
Emergency Room; In-Network

Link to County Fixed Effects and Price Indices Estimates.
Figure 10: Yearly Outpatient County MA Price Index Maps
Lab/Pathology; In-Network

2012 Outpatient County MA Price Index
Lab/Pathology; In-Network

Source: Authors' calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (72.047), top-coded at 95% (409.653).
Controls: Procedure code, log(units), demographics.

2013 Outpatient County MA Price Index
Lab/Pathology; In-Network

Source: Authors' calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (76.45), top-coded at 95% (471.675).
Controls: Procedure code, log(units), demographics.
Figure 10: Yearly Outpatient County MA Price Index Maps
Lab/Pathology; In-Network

2014 Outpatient County MA Price Index
Lab/Pathology; In-Network

Source: Authors’ calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (80.099), top-coded at 95% (518.346).
Controls: Procedure code, log(units), demographics.

2015 Outpatient County MA Price Index
Lab/Pathology; In-Network

Source: Authors’ calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (85.156), top-coded at 95% (572.417).
Controls: Procedure code, log(units), demographics.
**Figure 10:** Yearly Outpatient County MA Price Index Maps  
Lab/Pathology; In-Network

Source: Authors' calculations from HCCI outpatient claims dataset.  
Note(s): Recentered at the median. Bottom-coded at 5% (83,628), top-coded at 95% (528,703).  
Controls: Procedure code, log(units), demographics.

[Link to County Fixed Effects and Price Indices Estimates.]
Figure 11: Yearly Inpatient County MA Price Index Maps
All Inpatient Stays; In-Network

2012 Inpatient County MA Price Index
All Inpatient Stays; In-Network

Source: Authors' calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (72.458), top-coded at 95% (137.185).
Controls: DRG, log(length of stay), demographics.

2013 Inpatient County MA Price Index
All Inpatient Stays; In-Network

Source: Authors' calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (76.577), top-coded at 95% (132.662).
Controls: DRG, log(length of stay), demographics.
Figure 11: Yearly Inpatient County MA Price Index Maps
All Inpatient Stays; In-Network

2014 Inpatient County MA Price Index
All Inpatient Stays; In-Network

Source: Authors' calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (73.978), top-coded at 95% (137.245).
Controls: DRG, log(length of stay), demographics.

2015 Inpatient County MA Price Index
All Inpatient Stays; In-Network

Source: Authors' calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (77.851), top-coded at 95% (137.846).
Controls: DRG, log(length of stay), demographics.
Figure 11: Yearly Inpatient County MA Price Index Maps
All Inpatient Stays; In-Network

2016 Inpatient County MA Price Index
All Inpatient Stays; In-Network

Source: Authors' calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (72.689), top-coded at 95% (145.324).
Controls: DRG, log(length of stay), demographics.

Link to County Fixed Effects and Price Indices Estimates.
Figure 12: Yearly Inpatient County MA Price Index Maps
All Inpatient Stays; Out-of-Network

2014 Inpatient County MA Price Index
All Inpatient Stays; Out-of-Network

Source: Authors’ calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (71.481), top-coded at 95% (137.736).
Controls: DRG, log(length of stay), demographics.

2015 Inpatient County MA Price Index
All Inpatient Stays; Out-of-Network

Source: Authors’ calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (68.166), top-coded at 95% (141.549).
Controls: DRG, log(length of stay), demographics.
Figure 12: Yearly Inpatient County MA Price Index Maps
All Inpatient Stays; Out-of-Network

Source: Authors' calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (71.976), top-coded at 95% (147.06).
Controls: DRG, log(length of stay), demographics.

Link to County Fixed Effects and Price Indices Estimates.
Figure 13: Yearly Inpatient County MA Price Index Maps
Mental Health; In-Network

2012 Inpatient County MA Price Index
Mental Health; In-Network

Source: Authors' calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (78.379), top-coded at 95% (145.428).
Controls: DRG, log(length of stay), demographics.

2013 Inpatient County MA Price Index
Mental Health; In-Network

Source: Authors' calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (80.494), top-coded at 95% (142.751).
Controls: DRG, log(length of stay), demographics.
**Figure 13:** Yearly Inpatient County MA Price Index Maps

Mental Health; In-Network

*Source: Authors' calculations from HCCI outpatient claims dataset.*

*Note(s): Recentered at the median. Bottom-coded at 5% (75.337), top-coded at 95% (151.061). Controls: DRG, log(length of stay), demographics.*
Figure 13: Yearly Inpatient County MA Price Index Maps
Mental Health; In-Network

Source: Authors' calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (55.204), top-coded at 95% (166.622).
Controls: DRG, log(length of stay), demographics.

Link to County Fixed Effects and Price Indices Estimates.
**Figure 14**: Yearly Inpatient County MA Price Index Maps

Surgical; In-Network

2012 Inpatient County MA Price Index
Surgical; In-Network

Source: Authors’ calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (77,839), top-coded at 95% (130,776).
Controls: DRG, log(length of stay), demographics.

2013 Inpatient County MA Price Index
Surgical; In-Network

Source: Authors’ calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (79,197), top-coded at 95% (130,616).
Controls: DRG, log(length of stay), demographics.
Figure 14: Yearly Inpatient County MA Price Index Maps
Surgical; In-Network

2014 Inpatient County MA Price Index
Surgical; In-Network

2015 Inpatient County MA Price Index
Surgical; In-Network

Source: Authors' calculations from HCCI outpatient claims dataset.
Note(s): Recentered at the median. Bottom-coded at 5% (83.295), top-coded at 95% (132.404).
Controls: DRG, log(length of stay), demographics.
Figure 14: Yearly Inpatient County MA Price Index Maps
Surgical; In-Network

Link to County Fixed Effects and Price Indices Estimates.
Figure 15: Yearly Outpatient County Fixed Effects Comparison Scatterplots
All Outpatient Procedures; In-Network

Source: Authors’ calculations from HCUP outpatient claims dataset.
Notes: Controls: Procedure code, log(units), demographics. Number of counties: 2890.
Bars show 95% confidence intervals for each estimate.
Figure 15: Yearly Outpatient County Fixed Effects Comparison Scatterplots

All Outpatient Procedures; In-Network

Link to County Fixed Effects and Price Indices Estimates.
**Figure 16:** Yearly Outpatient County Fixed Effects Comparison Scatterplots

All Outpatient Procedures; Out-of-Network

Source: Authors' calculations from HCCI outpatient claims dataset.
Notes: Controls: Procedure code, log(units), demographics. Number of counties: 2710. Bars show 95% confidence intervals for each estimate.

Link to County Fixed Effects and Price Indices Estimates.
Figure 17: Yearly Outpatient County Fixed Effects Comparison Scatterplots
Administered Drugs, Incl Chemo Drugs; In-Network

Source: Authors' calculations from HCCI outpatient claims dataset.
Notes: Controls: Procedure code, log(units), demographics. Number of counties: 677.
Bars show 95% confidence intervals for each estimate.

Correlation: 0.550

Correlation: 0.433
Figure 17: Yearly Outpatient County Fixed Effects Comparison Scatterplots
Administered Drugs, Incl Chemo Drugs; In-Network

Link to County Fixed Effects and Price Indices Estimates.
Figure 18: Yearly Outpatient County Fixed Effects Comparison Scatterplots

Emergency Room; In-Network

2012 and 2013 Outpatient County Fixed Effects
Emergency Room; In-Network

2012 Recentered County Fixed Effect

Source: Authors' calculations from HCCI outpatient claims dataset.
Notes: Controls: Procedure code, log(units), demographics. Number of counties: 2620.
Bars show 95% confidence intervals for each estimate.

2012 and 2014 Outpatient County Fixed Effects
Emergency Room; In-Network

2014 Recentered County Fixed Effect

Source: Authors' calculations from HCCI outpatient claims dataset.
Notes: Controls: Procedure code, log(units), demographics. Number of counties: 2268.
Bars show 95% confidence intervals for each estimate.
**Figure 18:** Yearly Outpatient County Fixed Effects Comparison Scatterplots

Emergency Room; In-Network

Source: Authors’ calculations from HCCI outpatient claims dataset.
Notes: Controls: Procedure code, log(units), demographics. Number of counties: 2327.
Bars show 95% confidence intervals for each estimate.

Link to County Fixed Effects and Price Indices Estimates.
**Figure 19:** Yearly Outpatient County Fixed Effects Comparison Scatterplots

Lab/Pathology; In-Network

2012 and 2013 Outpatient County Fixed Effects
Lab/Pathology; In-Network

Source: Authors’ calculations from HCCI outpatient claims dataset.
Notes: Controls: Procedure code, log(units), demographics. Number of counties: 2626. Bars show 95% confidence intervals for each estimate.

2012 and 2014 Outpatient County Fixed Effects
Lab/Pathology; In-Network

Source: Authors’ calculations from HCCI outpatient claims dataset.
Notes: Controls: Procedure code, log(units), demographics. Number of counties: 2253. Bars show 95% confidence intervals for each estimate.
Figure 19: Yearly Outpatient County Fixed Effects Comparison Scatterplots
Lab/Pathology; In-Network

2012 and 2015 Outpatient County Fixed Effects
Lab/Pathology; In-Network

2012 and 2016 Outpatient County Fixed Effects
Lab/Pathology; In-Network

Source: Authors’ calculations from HCCI outpatient claims dataset.
Notes: Controls: Procedure code, log(units), demographics. Number of counties: 2311.
Bars show 95% confidence intervals for each estimate.

Link to County Fixed Effects and Price Indices Estimates.
Figure 20: Yearly Inpatient County Fixed Effects Comparison Scatterplots

All Inpatient Stays; In-Network

Source: Authors' calculations from HCCI inpatient claims dataset.
Notes: Controls: DRG, log(length of stay), demographics. Number of counties: 1811.
Bars show 95% confidence intervals for each estimate.
Figure 20: Yearly Inpatient County Fixed Effects Comparison Scatterplots
All Inpatient Stays; In-Network

Source: Authors’ calculations from HCCI inpatient claims dataset.
Notes: Controls: DRG, log(length of stay), demographics. Number of counties: 1772.
Bars show 95% confidence intervals for each estimate.

Link to County Fixed Effects and Price Indices Estimates.
Figure 21: Yearly Inpatient County Fixed Effects Comparison Scatterplots
All Inpatient Stays; Out-of-Network

Link to County Fixed Effects and Price Indices Estimates.
Figure 22: Yearly Inpatient County Fixed Effects Comparison Scatterplots

Mental Health; In-Network

Source: Authors’ calculations from HCCI inpatient claims dataset.
Notes: Controls: DRG, log(length of stay), demographics. Number of counties: 299.
Bars show 95% confidence intervals for each estimate.
**Figure 22:** Yearly Inpatient County Fixed Effects Comparison Scatterplots

Mental Health; In-Network

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**2012 and 2015 Inpatient County Fixed Effects**
**Mental Health; In-Network**

- Source: Authors' calculations from HCCI inpatient claims dataset.
- Notes: Controls: DRG, log(length of stay), demographics. Number of counties: 355. Bars show 95% confidence intervals for each estimate.

**2012 and 2016 Inpatient County Fixed Effects**
**Mental Health; In-Network**

- Source: Authors' calculations from HCCI inpatient claims dataset.
- Notes: Controls: DRG, log(length of stay), demographics. Number of counties: 295. Bars show 95% confidence intervals for each estimate.

**Link to County Fixed Effects and Price Indices Estimates.**
Figure 23: Yearly Inpatient County Fixed Effects Comparison Scatterplots
Surgical; In-Network

Source: Authors' calculations from HCCI inpatient claims dataset.
Notes: Controls: DRG, log(length of stay), demographics. Number of counties: 955.
Bars show 95% confidence intervals for each estimate.

Source: Authors' calculations from HCCI inpatient claims dataset.
Notes: Controls: DRG, log(length of stay), demographics. Number of counties: 972.
Bars show 95% confidence intervals for each estimate.
Figure 23: Yearly Inpatient County Fixed Effects Comparison Scatterplots
Surgical; In-Network

Source: Authors' calculations from HCCI inpatient claims dataset.
Notes: Controls: DRG, log(length of stay), demographics. Number of counties: 972.
Bars show 95% confidence intervals for each estimate.

Link to County Fixed Effects and Price Indices Estimates.
Figure 24

Outpatient Price Index Group Transitions
Quintiles by Year
in network, all procedure categories, with demographic controls

Percent of Counties

Year


5th Price Quintile (Highest Prices) 4th Price Quintile 3rd Price Quintile
2nd Price Quintile 1st Price Quintile (Lowest Prices) Insufficient Data

Link to County Fixed Effects and Price Indices Estimates.
Figure 25

Inpatient Price Index Group Transitions
Quintiles by Year
in network, all DRG categories, with length of stay and demographic controls

Percent of Counties

Year


5th Price Quintile (Highest Prices)  4th Price Quintile  3rd Price Quintile
2nd Price Quintile  1st Price Quintile (Lowest Prices)  Insufficient Data

Link to County Fixed Effects and Price Indices Estimates.
**Figure 26:** Yearly Outpatient County MA Price Index and Penetration Rate

All Outpatient Procedures; In-Network

Source: Authors' calculations from HCCI outpatient claims dataset. CMS.
Notes: Controls: Procedure code, log(units), demographics.
Bars show 95% confidence intervals for each estimate. Bottom and top 1% of counties by price index dropped.
Figure 26: Yearly Outpatient County MA Price Index and Penetration Rate
All Outpatient Procedures; In-Network

Source: Authors' calculations from HCCI outpatient claims dataset. CMS.
Notes: Controls: Procedure code, log(units), demographics.
Bars show 95% confidence intervals for each estimate. Bottom and top 1% of counties by price index dropped.
Figure 26: Yearly Outpatient County MA Price Index and Penetration Rate
All Outpatient Procedures; In-Network

Source: Authors’ calculations from HCCI outpatient claims dataset. CMS.
Notes: Controls: Procedure code, log(units), demographics.
Bars show 95% confidence intervals for each estimate. Bottom and top 1% of counties by price index dropped.

Link to County Fixed Effects and Price Indices Estimates.
Figure 27: Yearly Inpatient County MA Price Index and Penetration Rate
All Inpatient Stays; In-Network

Source: Authors’ calculations from HCCI inpatient claims dataset. CMS.
Notes: Controls: DRG, log(length of stay), demographics.
Bars show 95% confidence intervals for each estimate. Bottom and top 1% of counties by price index dropped.
Figure 27: Yearly Inpatient County MA Price Index and Penetration Rate
All Inpatient Stays; In-Network

Source: Authors' calculations from HCCI inpatient claims dataset. CMS.
Notes: Controls: DRGs, log(length of stay), demographics.
Bars show 95% confidence intervals for each estimate. Bottom and top 1% of counties by price index dropped.
Figure 27: Yearly Inpatient County MA Price Index and Penetration Rate
All Inpatient Stays; In-Network

2016 Inpatient County MA Price Index and Penetration Rate
All Inpatient Stays; In-Network

Source: Authors' calculations from HCCI inpatient claims dataset. CMS.
Notes: Controls (DRG, log(length of stay), demographics).
Bars show 95% confidence intervals for each estimate. Bottom and top 1% of counties by price index dropped.

Link to County Fixed Effects and Price Indices Estimates.