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Diversion Analysis as Applied to Hospital Mergers: A Primer

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Introduction

Driven by a variety of factors, including changes in the reimbursement environment and the need to have scale to successfully bear risk and support delivery models that emphasize population-based health management, merger activity among hospitals has been robust over the last couple of years. In fact, the annual number of transactions is nearly double what it was five years ago. With continued debate over the benefits of hospital consolidation and whether these benefits outweigh a possible harm to competition, hospital mergers have come under renewed scrutiny from the Federal Trade Commission (FTC) and, on occasion, the Department of Justice's (DOJ's) Antitrust Division.

Coincident with this increased scrutiny has been a change in the tools used by these agencies in the analysis of hospital mergers. Many credit these new tools—such as hospital merger simulation, the Willingness-to-Pay (WTP) framework, and diversion analysis—with explaining the recent string of successes the FTC has had in litigating hospital merger cases.[2] With the use of these news tools, the analysis of hospital competition has moved away from patient flow-based methods towards more structural models that aim to better capture the underlying dynamics of the industry and come up with a prediction for the impact of the transaction on prices.

Specifically, these tools are based on a "two-stage" model of competition, in which health plans and hospitals bargain over prices and network composition in the first stage, and once hospital networks have been formed, consumers choose from a set of hospitals in the second stage based on a variety of factors under the assumption that they face the same out-of-pocket costs across all hospitals within this set.[3] This model of competition is used to construct a WTP measure for each hospital (or system)—which is essentially the incremental value added by that hospital (or system) to an insurer network. The model then estimates the change in WTP resulting from the merged entity being part of the network as compared to a situation where each hospital is in the network separately, and attempts to predict the change in price post-merger based on this change in WTP.[4]

While potentially a useful tool in assessing the impact of a proposed transaction on prices, implementation of the full merger simulation model can be a substantial undertaking owing to the data requirements of the model. Specifically, one needs to construct price indices for each hospital based on insurer claims data, which usually requires third-party discovery and can be a time-intensive undertaking.[5] Thus, a full merger simulation is better suited for later stages of the merger review process where a challenge is likely.[6]

Given these limitations, the closely-related tool of diversion analysis is being increasingly used in hospital merger reviews, particularly in the screening stage. The diversion analysis is built off the same underlying theoretical principles as the WTP model but has the added benefit of being estimable using publicly available data. This benefit comes with a tradeoff of not being able to predict the magnitude of potential price increases resulting from a merger, but rather, the analysis allows for the analyst to make an estimate of the upward pricing pressure incentive that the combined entity will have to engage in anti-competitive pricing, as explained in Section IV.

Conceptual Framework

The notion of diversion is commonly used in antitrust economics to analyze mergers involving differentiated products. The diversion ratio between two products, A and B, measures the extent to which these products are close substitutes to each other. In particular, in the context of hospital mergers, the diversion ratio aims to estimate the share of patients of each merging hospital (or hospital system) that would switch to various competing hospitals in the market, including the potential merger candidate, if the first hospital (or system) were no longer available to patients as a possible option. That is, in evaluating a merger between hospitals A and B, B would be considered a close substitute of A if a high share of patients would switch to B if they were unable to use hospital A. Of course, the merger of firms that are close substitutes presents a greater danger that post-merger price increases might be profitable.

A key feature to note here is that diversion is modeled in this case as arising from a hypothetical scenario in which the merging hospital is excluded from the provider network. This is in contrast to typical diversion analyses (in other differentiated products industries) which analyze customer switching behavior in the wake of a hypothetical price increase. This is driven by the modeling assumption that price differences do not matter to patients while making hospital choices within their network, given that they would pay the same amount regardless of their choice, or would likely exhaust their out-of-pocket co-payments under their health insurance plan.

A high value for the diversion ratio between two merger candidates indicates that these hospitals are perceived by consumers as being close substitutes. In a scenario where the hospitals bargain with insurers on an all-or-nothing basis post-merger (as is typically assumed in the merger simulation model), a merger between two such hospitals has the potential to enhance the bargaining power of the now-merged hospitals vis-à-vis the insurer, given that the merger removes whatever competitive constraint these hospitals imposed on each other. Put differently, the close substitutability of the hospitals leads to the combined hospital entity having a WTP that is larger than the sum of the WTPs of the individual hospitals.

This analysis can be extended to a scenario where the merged hospitals bargain separately with insurers post-merger. In such a case, if the hospitals are close substitutes, a merging hospital may have a strong incentive to raise prices post-merger given that its merger partner will likely recapture much of the lost patient volume in the event that the price increase leads to the hospital being dropped from the network or "tiered". Conditional on the level of gross margins and the potential efficiencies generated by the merger (a point which we expand on in Section IV), a price increase at one of the merging hospitals is then likelier to be profitable given that the partner firm will recapture many of the patients of that hospital who seek care elsewhere. As explained below, the diversion ratio becomes a crucial input to estimating the degree to which there is upward pricing pressure following the merger. To the extent significant upward pricing pressure is predicted, the merger is more likely to move to a second request and possibly a challenge.

The diversion analysis thus acts as a useful merger screen given that the diversion ratios are closely related to the likely changes in WTP, and thereby, to the magnitude of predicted price changes stemming from the merger. Further, as discussed in the next subsection, the diversion analysis can be implemented using publicly available data, which makes it a useful tool for assessing the potential lessening of competition in a timely way during the initial 30-day period of a merger review.[7]

Estimating Diversion Ratios

The diversion analysis in hospital mergers is built on a foundation of patient choice. The basic approach is to estimate a model of how patients chose the hospital they use with an objective of determining the extent to which this choice is influenced by characteristics of the patient, the hospital, the driving distance to each hospital, and the match between the patient and the provider (e.g., does the hospital provide the service the patient is seeking care for?). The information obtained from this initial choice model is then used to estimate how patient choices are expected to change in the event that the hospital(s) involved in the proposed transaction is excluded from the network. Put differently, if one of the merging hospitals were to be excluded from the network, the estimates from the model can be used to determine the proportion in which patients that originally chose that hospital would switch to other competing hospitals, including the proposed merger partner. We provide detail on each of these steps below.

The data used to estimate diversion ratios are typically inpatient discharge data organized at the patient level. Such data are usually made available by various state agencies, such as the Office of Statewide Health Planning and Development in California, the Agency for Healthcare Research and Administration in Florida, and the Texas Health Care Information Collection in Texas.[8] These data contain information on a number of patient characteristics such as age, gender, race, payer and 5-digit ZIP code as well as clinical covariates such as the principal Diagnosis-Related Group (DRG) code, relevant diagnostic and procedure codes (if any), and discharge status code (that identifies where the patient is at the end of the visit). The data also identify the hospital the patient is being treated at, and can be merged to hospital-level data (usually also available from the same state agencies) containing information on hospital attributes like teaching status, ownership status (not-for-profit vs. for-profit), location, system membership, and specialization by types of services offered (e.g., children's hospital).

An important consideration here relates to the identity of the hospitals in the "choice set" for the patient. Because the model attempts to estimate the factors determining patient choice of hospital, we need information on not just the hospital the patient ultimately chose, but also on which other hospitals the patient could have chosen instead. In theory, while the model estimation obviates the need for a strict definition of a relevant geographic market, identifying the set of hospitals that could be potential alternative choices involves some analysis of the service areas of the combining hospitals. This generally leads to considering many hospitals over a broad geography. A key strength of the model, however, is that it is fairly robust to the inclusion of hospitals (or geographic areas) that may not have much actual competitive relevance. Computational limits do impose restrictions on the number of hospitals that can feasibly be included in the choice set, especially in larger markets like Texas or California. In such situations, a researcher can focus on the most competitively relevant set of hospitals and systems and include the others as part of an outside option.[9] The model is then estimated on a reshaped version of the dataset that is structured so that each observation corresponds to a patient-hospital dyad.[10]

Patient choices are then typically modeled and estimated using a standard discrete-choice conditional logit specification.[11] This model aims to capture the relationship between the actual hospital choices made by patients (as recorded in the data) and the characteristics of patients and hospitals in the sample that drive these choices. The price paid by the patient is assumed to be the same across all hospitals (assuming they are all part of the patients' managed-care network) and is hence not included as a determinant of hospital choice.[12] In particular,

> Patient Choice of hospital = f(hospital attributes, Driving distance, Patient demographics and clinical covariates interacted with driving distance, Patient-Hospital "Matching")

Hospital attributes that typically drive patient choice include teaching status, size, or quality rankings such as report cards.[13] Because the model analyzes the choice for each patient from among a set of hospital choices, patient characteristics (such as age, gender, DRG weight, whether or not this was an emergency admission) are invariant across the hospital alternatives and are hence not included in the model as separate variables. Interactions of these characteristics with hospital attributes still matter in explaining choice and are included as predictors.[14] A key driver of patient choice that is included in the model is the driving distance between the patient's residence and each hospital in the choice set, typically calculated as the distance between the residence zip-code centroid of the patient and the address of the hospital.[15] Not only is distance predicted to matter, the extent to which it drives choice of hospital might well vary by patient characteristics such as age, or severity of illness (e.g., patients that are older might be less able or willing to travel greater distances to visit a hospital) and such differences can be captured in the model by including the appropriate interaction terms as predictors. Finally, there is also an element of "matching" between the patient's specific healthcare needs and the services offered by each hospital. For example, patients with cardiac conditions may seek out a specialty heart hospital or a hospital that is particularly recognized for handling chronic cardiac patients (or might have specialized equipment to provide such care). Of course, such a patient would also not choose a hospital that did not have a cardiology service. Such types of interactions can also be included as predictors in the model.

The estimated parameters from the regression model provide a separate probability of each patient choosing each choice set hospital as well as the "outside option".[16] The probabilities are then used to calculate the predicted diversion ratios between relevant hospital pairs. The diversion ratio between two hospitals, A and B, when hospital B is hypothetically excluded from the network, is calculated as follows:

$$\textit{Diversion Ratio}_{B\rightarrow A} = \frac{\textit{(Share of Hospital A, on exclusion of Hospital B – Share of Hospital A)}}{\textit{(Share of Hospital B)}}$$

where the shares for each hospital are simply computed by adding the predicted probability of choosing that hospital across all patients in the sample. A similar calculation can be used to compute diversion ratios going in the other direction, i.e., from hospital A to hospital B, when hospital A is hypothetically excluded from the network.

$$\textit{Diversion Ratio}_{A\rightarrow B} = \frac{\textit{(Share of Hospital B, on exclusion of Hospital A – Share of Hospital B)}}{\textit{(Share of Hospital A)}}$$

It is important to highlight a couple of key assumptions underlying this whole exercise. First, the calculation of the diversion ratio assumes that all patients currently being treated at the hospital being hypothetically excluded from the network (because of a price increase, for example) leave and seek care elsewhere. This might not be entirely true in most cases as patients might continue using a hospital even if it is out-of-network, but measuring the actual decrease in patient volume because of exclusion can be difficult owing to data limitations. A second key assumption, as discussed earlier, is that patients do not face any differences in prices (or out-of-pocket expenses) while choosing across hospitals in their choice set. This assumption may well be violated for patients with commercial insurance who may face larger out-of-pocket costs at certain facilities that might be outside their network. An alternative is to estimate the model on a sample of Medicare or Medicaid patients that typically face far fewer restrictions on provider choice (and face no variation in out-of-pocket costs across these providers). However, the preferences of such patients (including their propensity to travel) may not be representative of patients with commercial insurance.

Using Diversion Ratios to Gauge Anti-Competitive Impact of a Prospective Merger

Of course, the diversion ratios are useful only to the extent that we can use them to gauge the extent to which the proposed merger might lead to a loss of competition. While a high diversion ratio between a pair of hospitals is an indication of the hospitals being close substitutes, it is helpful to have a measure of what this implies for post-merger pricing. Such a link is provided by the Upward Pricing Pressure (UPP) model, which was formulated by Farrell and Shapiro.[17]

The UPP theory provides a measure of the combined firm's incentives to increase price post-merger and uses three key inputs: the diversion ratios, the pre-merger gross margins and an estimate of or assumption about the likely efficiencies stemming from the merger. In examining a merger between two hospitals, A and B, the UPP theory states that there will be a positive incentive for firm A to raise prices if

$$UPP_A = Diversion\ Ratio_{A \rightarrow B} * Gross\ Margin_B - Efficiencies > 0$$

If the merging hospitals A and B are close substitutes, i.e., have high diversion ratios, that increases the likelihood that a post-merger price increase at hospital A would be profitable given that many of the patients that hospital A would lose as a result of the price increase, would in turn be recaptured by hospital B.[18] This incentive is also likely to be stronger if the recaptured customers are profitable for hospital B, as reflected by B's gross margin. However, it is possible that the merger also helps the hospitals realize efficiencies that decrease the marginal cost for the parties and hence exert a downward pressure on price. Hence, the net UPP accounts for these efficiencies to arrive at a measure of the likely overall incentive for the merging firm to increase prices post-merger.

Use of Diversion Ratios: Some Practical Considerations

The diversion ratios, once calculated, can be plugged into this model to estimate the "critical" values, i.e., the largest values of the diversion ratios for which the transaction will arguably not be deemed to be anticompetitive. Table 1 calculates the critical diversion ratios for various values of the contribution margin under the assumption that the merger generates a marginal cost savings of 10 percent.[19] If one were to assume that the contribution margin is 50 percent (as is typically the case for the hospital industry), the diversion ratio would have to be no l arger than 20 percent in order for the transaction to not be presumptively anticompetitive.
Of course, it is important to bear in mind that a merger screen based on UPP only estimates the strength of the incentive of the merged firm to raise prices, but does not actually measure the magnitude of the increase in price if an increase is projected by the model (as opposed to a merger simulation which aims to predict the magnitude of the price increase). It is thus possible for the diversion ratio to exceed the critical value but the actual merger to result in only a small increase in price.

Table 1: **Critical Diversion Ratios for Various Values of Contribution Margin**

Contribution Margin	Critical Diversion Ratio
40%	25%
50%	20%
60%	16.7%

Another consideration that often arises in practice is whether the two merging hospitals are each other's closest substitutes as measured by the diversion ratios between them. Consider a situation where the merging hospitals have high diversion ratios (going both ways, say) but there are other non-merging competitors to which diversion is higher. Put differently, how does one deal with a situation where the merging hospitals are close substitutes but are not each other's closest substitutes? Does the fact that a non-merging hospital is the closest substitute to (one or both) of the merging parties resolve any anticompetitive concerns that might arise from the merger?

Recent Court rulings indicate that such an argument would likely not be a sufficient defense. Commissioner Brill's opinion in the ProMedica case states that "…the merging parties do not need to be each other's closest rival for a merger to have unilateral anticompetitive effects."[20] The 2010 Horizontal Merger Guidelines also state that "a merger may produce significant unilateral effects for a given product even though many more sales are diverted to products sold by non-merging firms than to products previously sold by the merger partner." The upshot of these rulings is that, even if the diversion analysis predicts greater diversion to non-merging rivals than merger partners, defendants will have to prepare a case for showing why the merger will not be anticompetitive especially if the values exceed the critical thresholds discussed above. On the flip side, just because a transaction involves parties where diversion ratios between the merging parties exceed critical values does not necessarily mean that it will get a protracted review. The agencies clearly examine other factors in addition to the diversion ratios and in cases where extensive repositioning by competitors and payers is likely, the weight placed on diversion analysis might be minimized. The agencies generally require strong corroborating evidence and do not go forward with a challenge based only on diversion analysis or even the full merger simulation.

Discussion

In recent years, the FTC has increasingly adopted the WTP-based analysis of competition in hospital markets, and has made extensive use of diversion analysis (a related tool) as an important merger screen. There are several reasons underlying this shift towards using these tools, especially in hospital markets. The WTP and diversion analyses have a stronger grounding in rigorous economic theory as compared to past patient-flow based approaches. These approaches also do not require identifying a relevant geographic market, thereby avoiding long-drawn arguments with the merging hospitals on the appropriate size of the geographic market. Instead, these methods rely on identifying a reasonable set of competitors that patients see as alternatives to the merging hospitals. In addition, the estimates are largely unaffected by the inclusion of hospitals that are competitively less relevant.

The diversion analysis in particular is relatively easy to apply and can be readily estimated using publicly available data, thereby making it a good candidate for use as a merger screen. It is a fairly flexible approach and has the ability to control for a number of different factors that are not easy to incorporate into the standard geographic market tests that have been used traditionally.[21]

While it has been used extensively in the analysis of hospital mergers, the approach used can potentially be extended to the analysis of physician group mergers as well. A key deterrent in the analysis of physician group mergers is the lack of computational power to estimate models that include all providers in the market. While a model of patient choice of hospitals can be estimated with up to 50 or so hospitals without much computational burden, this is insufficient in physician services markets given the large number of physicians operating in each market.[22] One possible approach that has been recently employed by the FTC is to divide patients into various segments (for the sake of the analysis) and use the diversion ratios within each segment to construct an aggregate diversion ratio among physicians.[23]

While the diversion analysis has a number of strengths, one should not lose sight of the limitations of using this approach. While the model controls for a number of factors, price is not one of them. It is thus unclear how patients would respond if price were to increase and patients had to pay a greater co-insurance and/or deductible amount, as is more likely in current and future benefit designs.

The approach also does not account for repositioning—that is, the model is static and does not currently capture how competing hospitals, physicians, insurers, and employers would respond to a significant post-merger increase in price. Instead, it assumes that all of these parties will continue to act in the same manner that they have acted in the past. In addition, the model is not well-suited for handling markets that use limited provider networks. The model assumes that patients are free to choose any hospital in their choice set. However, limited or narrow networks are now coming back into play, driven in part by initiatives championed by the Affordable Care Act, such as the formation of Health Insurance Marketplaces. If patients are restricted in their choice of healthcare providers, the estimates from a choice model that assume otherwise might well be unreliable.

Finally, the diversion model is based only on patient hospital choice data. It does not really model how hospitals, particularly regional or statewide hospital systems, negotiate price with managed care. If prices over a wide set of geographies are negotiated all at once, then the structural conditions in one specific geographic area may not have much effect on the prices set for that area during negotiations.

All of these concerns suggest that the model may not always be a reliable predictor of the likely diversion or the actual degree of upward pricing pressure resulting from hospital mergers. It is a useful tool, but one of possibly many indicia that ought to be used while assessing likely anti-competitive impacts in such transactions. Further research especially looking at empirical validation of this method is required in order to better understand the set of conditions under which the model generates reliable predictions of pricing post-merger.

Notes

1 The author is a Senior Consultant at NERA Economic Consulting and would like to thank Thomas McCarthy and Scott Thomas for helpful comments and discussion. Email: subbu@nera.com

2 A prominent recent example was the proposed acquisition of Rockford Health System by OSF Healthcare System in Illinois, which was subsequently abandoned by the parties after the FTC won a preliminary injunction in federal district court.

3 The WTP model was developed and applied to insurer-hospital bargaining in a couple of influential academic articles: Town, R. and Vistnes, G. "Hospital Competition in HMO Networks," *Journal of Health Economics*, Vol. 20 (2001), pp. 733 – 753 and Capps, C., Dranove, D.D., and Satterthwaite M.A, "Competition and Market Power in Option Demand Markets," *The RAND Journal of Economics*, Vol. 34 (Winter 2003), pp. 737 – 763.

4 For a non-technical write up of the theory and implementation underlying hospital merger simulation, see Argue, D.A and Shin, R. T, "An Innovative Approach to an Old Problem: Hospital Merger Simulation," *Antitrust* (Fall 2009), pp. 49 - 54 and Brand, K.J and Garmon, C. "Hospital Merger Simulation," *AHLA Member Briefing* (2014).

5 In place of insurer claims data, it is possible to use publicly available financial data from state agencies or Medicare Cost Reports but one might have to sacrifice some accuracy in such cases. In any event, when compared to a diversion analysis, the data and analysis requirements for a merger simulation are much more substantial. Also, the merging parties may be able to gain access to the insurer claims data only if the merger is litigated, since these data are typically obtained by the agencies through third-party subpoenas. Otherwise, the merging parties have to rely upon the publicly available data if they want to get a feel for what the agencies are likely to find.

6 Another related data limitation here relates to the lack of data on consummated mergers that would allow for a "before-and after" comparison of WTP and prices driven by the merger. Given this lack of data, most merger simulations are run on cross-sectional data, i.e., the effect of a change in WTP on price is estimated using information on variation in WTP and prices across hospitals (and not over time within a hospital). For more information on this and other limitations of the model, see Brand and Garmon (2014) *supra* note 4.

7 Note that, in settings outside of healthcare, diversion ratios are computed using survey data or win/loss reports which may not be publicly available and might therefore be applicable only in later stages of the review process. In the absence of alternate information, diversion ratios may also be computed using data on market shares, but this would necessitate defining a relevant geographic market, a factor this approach was designed to avoid.

8 More information on the types of variables included, the ordering process, and the cost of procuring these data can be found online at the websites of these agencies: OSHPD (http://www.oshpd.ca.gov), THCIC (https://www.dshs.state.tx.us/thcic), and AHCA (http://ahca.myflorida.com).

9 The outside option includes hospitals that are typically on the periphery of the area being considered (or across state borders) as well as hospitals that have very little competitive relevance.

10 As an example, if the data contain 30 choices in the hospital choice set (including the outside option), and these hospital choices had a total of 50,000 patient discharges in that year, the sample on which the model is estimated would include a total of 1.5 million observations corresponding to each patient-hospital combination. Once the choice set includes more than 50-60 hospitals, the computational burden increases greatly, at which point the researcher might consider expanding the definition of the outside option to include a greater number of hospitals.

11 A discrete-choice model is used in situations where the dependent variable takes on a handful of discrete values (e.g., 0 or 1). In this case, the dependent variable takes the value 1 for the observation where the hospital is the patient's actual choice and 0 for all other hospital observations in the patient's choice set.

12 The price to the patient could be an important missing variable to the extent that hospitals are increasingly "tiered" with materially different copayments owed by the patients depending on which hospital is chosen. Similarly, narrow networks create a similar measurement problem if patients really cannot choose from any and all of the hospitals in the choice set. However, network configurations can change by the patient switching health plans and may not be as rigid as implied by initially being part of a narrow network.

13 An alternative to including various hospital attributes is to include an indicator variable (sometimes referred to as a "dummy" variable) for each hospital as a predictor. These indicators account for all hospital-specific attributes that are time-invariant.

14 An interaction term in a regression model is used when the effect that a particular predictor has on the final outcome depends on the values of another predictor. For example, one might introduce an interaction term between age and driving distance as a predictor in the hospital choice model above (this is done by simply introducing a product between the two variables as a predictor) in order to account for the possibility that the extent to which driving distance influences a patient's hospital choice is dependent on how old the patient is.

15 To the extent that the influence of driving distance on hospital choice may be non-linear, a researcher might include non-linear functions of driving distance (such as polynomial terms) as predictors to capture this effect.

16 These predicted probabilities are also used for computing WTP in the hospital merger simulation model discussed earlier. As such, the diversion analysis is closely related to the WTP model with diversion ratios being strongly correlated with changes in WTP. In fact, the diversion analysis is often thought of as the first step in the hospital merger simulation since the same conditional logit model is used in both analyses.

17 See Farrell, J. and Shapiro, C., "Antitrust Evaluation of Horizontal Mergers: An Economic Alternative to Market Definition," *The B.E. Journal of Theoretical Economics* (2010), Vol. 10(1).

18 Note that the diversion ratios are estimated under the assumption of hospital A being completely excluded from the network, and thus losing all of its patient volume to competing hospitals. While the UPP analysis is carried out in the context of a price increase, one can reconcile these by considering a situation where the price increase instituted by hospital A leads to it being dropped from the network. Note that applying the analysis in this way also assumes that the two hospitals, A and B, are not bargaining with the payer on an all-or-nothing basis (as they would then both be excluded from the network).

19 In their article outlining the UPP theory, Farrell and Shapiro suggest the use of a 10 percent efficiency credit for the purpose of screening transactions that might be presumptively anticompetitive. See Farrell, J. and Shapiro, C. *supra* note 18.

20 See *In the Matter of ProMedica Health System, Inc*. No. 9346, Opinion of the Commission by Commissioner Brill at 46-47.

21 It should be noted that, while the model includes a number of other factors impacting patient choice, they often end up having lower predictive power in comparison to the effect of the driving distance between the patient and the hospital.

22 In addition, many physicians split time across multiple hospitals or clinics, making it difficult to assign them to a particular location and increasing the number of possible alternatives patients face while choosing physicians.

23 Of course, one of the key advantages of the diversion ratio approach in hospital markets—the availability of public data—is lost while examining physician mergers with this approach. While a full discussion of this model is beyond the scope of this paper, see Carlson, J.A. et al., "Physician Acquisitions, Standard Essential Patents, and Accuracy of Credit Reporting," *Economics at the FTC* (2013) for more details.

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