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Price effects of a hospital merger: Heterogeneity across health insurers, hospital products, and hospital locations

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Abstract

In most studies on hospital merger effects, the unit of observation is the merged hospital, whereas the observed price is the weighted average across hospital products and across payers. However, little is known about whether price effects vary between hospital locations, products, and payers. We expand existing bargaining models to allow for heterogeneous price effects and use a difference-in-differences model in which price changes at the merging hospitals are compared with price changes at comparison hospitals. We find evidence of heterogeneous price effects across health insurers, hospital products and hospital locations. These findings have implications for ex ante merger scrutiny.

KEYWORDS

hospital merger, hospital–insurer bargaining, retrospective merger analysis

1 | INTRODUCTION

An increasing number of empirical studies have been conducted concerning the price effects of hospital mergers. In general, the aim of these studies is to test the effectiveness of antitrust policy. In competitive markets, the aim of preventive merger control is to prohibit anticompetitive consolidation. To determine whether a merger between two or more firms will result in anticompetitive price increases and/or quality decreases, antitrust authorities need to carry out a prospective review of the merger. However, merger reviews in the health-care sector encounter specific difficulties because there are unique factors that render the most commonly used tests for measuring geographic markets less reliable in health care than in other sectors (Elzinga & Swisher, 2011). Retrospective studies are aimed at providing a better understanding of the effects of mergers, which, in turn, may improve future antitrust policy.

The majority of the studies on retrospective merger analyses indicate a positive correlation between hospital mergers and prices (e.g., Gaynor & Town, 2012; Vogt & Town, 2006; Gaynor & Vogt, 2000 for reviews). In most of these studies, the unit of observation is the merged hospital, whereas the observed price is the weighted average across different hospital products and across different payers. However, little is known about whether price effects vary between different hospital locations, different products, and different payers. Because merged hospitals often continue to operate at different locations, produce multiple products, and negotiate prices with a range of payers, an interesting question is

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whether these differences matter. If it turns out that they do matter, this may have important implications for ex ante merger scrutiny by antitrust authorities.

This article considers the question of whether the price effects of a hospital merger vary between locations, products, and third-party payers. By means of a hospital–insurer bargaining model, we show that the price effects of a hospital merger may vary and that the differences between locations, products, and insurers may influence the outcome of hospital–insurer price setting differently. We show that the price effects differ between locations, products, and insurers depending on (a) the degree of substitution between the merging hospitals for different products, (b) the relative bargaining ability of hospitals and insurers, and (c) the premerger price–cost margins. We then use a unique national dataset on hospital–insurer negotiated contract prices for each hospital product in the Netherlands to investigate whether the price effects of a merger between a general acute care hospital (henceforth hospital M1) and a neighboring general acute care hospital that also provides tertiary hospital care (henceforth hospital M2) vary between different hospital locations, different products, and different insurers.

In the remainder, we outline our theoretical model (Section 2) and explain its applicability to the Dutch context and the merger considered (Sections 3–4). After this, we turn to our empirical analysis (Sections 5–7), concluding with a summary of the main findings (Section 8).

2 | THE MODEL

To explain the possibility of heterogeneous price effects of hospital mergers, we consider a game-theoretical model of hospital–insurer bargaining, following the lines suggested by Gaynor and Town (2012; hereafter: GT) and Gowrisankaran, Nevo, and Town (2015; hereafter: GNT). These papers build on earlier literature analyzing hospital–insurer bargaining, notably Gal-Or (1997), Town and Vistnes (2001), Capps, Dranove, and Satterthwaite (2003), and Gaynor and Vogt (2003).

To keep our model as simple as possible, we adopt a two-stage setup following the base model of GNT. In the first stage of this model, health insurers bargain and contract with hospitals on behalf of their insured, and in the second stage, each consumer receives a health draw and seeks treatment at the hospital that maximizes his utility. Because the consumer commits to a restricted network of hospitals when he buys health insurance, he has the option of visiting any of the contracted hospitals when he is in need of specific care.

To be able to explain heterogeneous price effects over products, we need to allow for flexibility in the price ratios between different products of the same hospital. Both the GT and the GNT models fix all product–price ratios at the level of the respective disease–weight ratios. In their models, hospitals are constrained to negotiate a single base price per hospital location and the prices for different products are computed as a product of the base price and the disease weight.[1] Our model (outlined in online appendix S1) deviates from this assumption by freeing the product–price ratios. It thus allows for the situation in which a hospital may be contracted only for a subset of treatments. This better matches practice where contracts between hospitals and insurers can be concluded for a subset of treatments and a price has to be determined for each care bundle (e.g., Chernew, Mechanic, Landon, & Gelb Safran, 2011; Delbanco, 2014; Song et al., 2014). In the United States, for example, we observe cases in which hospitals shifted resources and activities to central profitable services while reducing or eliminating some loss making services (i.e., the so-called specialty service lines; Berenson, Bodenheimer, & Pham, 2006). This is in line with the anticipated strategy change towards integrated care delivery systems (Porter, 2009) and further specialization of the health-care market because of quality considerations (Baicker & Levy, 2013; Ho, Town, & Heslin, 2007). Also in the Netherlands, which data we use when estimating the model parameters, hospitals may be contracted only for a subset of services. Interviews with health insurers and hospital representatives who were involved in contractual negotiations during our study period indicated that especially for high-revenue products insurers and hospitals bargain separate prices. In the Netherlands, it is usually the insurers that initiate selective contracting of procedures. For example, one insurer selectively contracts providers of breast cancer surgeries (CZ, 2015), whereas another selectively contracts 15 hospital products (VGZ, 2014). As a result of selective contracting or hospitals' choices, in practice, the full hospital or a subset of procedures in a hospital may be contracted.

[1]The disease–weights measure the mean resource usage by diagnosis. In the model, they reflect the resource intensity of treatment. Using the disease-weights with a base price does not allow for heterogeneous price effects of mergers.

2.1 | Heterogeneous price effects of hospital mergers

Following GT and GNT, we analyze hospital–insurer bargaining in a model with multiple hospitals and health insurers. On the basis of the theoretical model outlined in online appendix S1, we obtain the following expression for price change due to merger:

$$p_{mjd}^{(j+k)} - p_{mjd} = b_{m(s)}(p_{mkd} - mc_{mkd})d_{md}^{jk}, \tag{1}$$

where p_{mjd} and $p_{mjd}^{(j+k)}$ denote the prices that insurer m pays to hospital j for product d before and after merger, $b_{m(s)}$ is the bargaining weight of health insurer m, p_{mkd} denotes the prices that insurer m pays to hospital k for product d, mc_{mkd} is the marginal cost of providing product d in hospital k for health insurer m, and d_{md}^{jk} defines the disease-specific diversion share of patients of insurer m with illness d from hospital j to hospital k. A higher value of the diversion share suggests a higher degree of substitution between two hospitals in treating this illness.

There are a few important conclusions that can be drawn from Equation (1) with respect to the price effect of a hospital merger. The first important finding is that product d's price change after the merger in each hospital is increasing in the diversion share between these hospitals. This result tells us that a merger will increase the product's price more if the hospitals that partner in the merger are close substitutes with respect to that product. Therefore, if substitution between hospitals is stronger for one product than for another product,[2] the price increase after the merger will be higher for the first product and hence hospital mergers may lead to heterogeneous price effects across different products and different locations.

The second most important conclusion that follows from our model is that, according to Equation (1), the price change caused by merger is proportional to the difference between the price and the marginal cost of the other hospital. Merging with a hospital whose price of product d is higher, whereas the marginal cost are lower, would result in a greater price increase (*cp*).

Finally, we observe, perhaps at first sight somewhat contra-intuitively, that a price increase caused by merger is proportional to the bargaining ability $b_{m(s)}$ of the insurer. This result suggests that, although a greater relative bargaining ability of the insurer in comparison with hospitals provides the insurer with more leverage against these hospitals, this leverage advantage is reduced after the merger of the hospitals.

3 | THE DUTCH HOSPITAL MARKET

In this article, we estimate the price changes of a merger between two Dutch hospitals, and we use the theoretical result from Section 2 (and online appendix S1) to interpret our empirical findings. The current Dutch health-care system bears important similarities with the model set up: Consumers buy health insurance from health insurers and health insurers bargain and contract with hospitals on behalf of those that they insure. An insurer can also contract a hospital for a subset of products.

In recent decades, the Netherlands, like several other OECD countries, has embraced a market-oriented approach to healthcare. After decades of strict governmental supply-side regulation, the Dutch health-care system is undergoing a transition towards regulated competition (Schut & van de Ven, 2005).

Of particular importance are the introduction of the Health Insurance Act in 2006 and the introduction of hospital–insurer bargaining in 2005. Under the Health Insurance Act, all Dutch citizens are obliged to buy standardized individual basic health insurance from a private insurer. Having bought an insurance policy, the enrollee gets access to all hospitals of the contracted network without co-payments. As described in online appendix S1, there is an annual deductible per adult individual, although most hospital product prices are higher than the fixed amount that is set by the deductible[3] and hence the deductible does not play a role in patients' hospital choices. The insurers' market shares are relatively stable.

[2]The substitution rates may differ across products, for example, because for some hospital products patients' willingness to travel might be higher, there is more intense competition with nearby hospitals over those products or the transparency of different product markets differs.

[3]Just 11% of all patients received treatments that cost less than 165 euro in 2011. The prices of the products that we consider in our article all exceed the deductible during the study period.

Since 2005, the scope for free negotiations of prices between hospitals and health insurance companies has gradually increased from 10% of hospital revenue in 2005, to 20% in 2008, to 34% in 2009, and to 70% in 2012. For the remaining part, hospital prices are still regulated. For products and services included in the free-pricing segment, each hospital typically renegotiates the terms of its contracts with health insurers on an annual basis. Over the years, the number of health insurers offering contracts with restricted provider networks or policies that only cover a subset of treatments in hospitals has increased.

4 | THE MERGER

Dutch local and regional hospital markets are highly concentrated.[4] Between 2005 and 2012, 17 mergers involving 34 hospitals were cleared by the Dutch competition authority (Authority for Consumers and Markets [ACM]). All mergers took place between neighboring hospitals.

The merger that we study was consummated in year t (which was between 2005 and 2012).[5] The merger was notified to the ACM prior to taking place.[6] Following the notification, the ACM carried out a general review of the proposed merger in which they made inferences regarding the expected anticompetitive effects of the merger on the market. The merger was cleared after the first general review. The decision to clear the merger evoked criticism by health economists, however, who argued that the prospective merger analysis by the antitrust authority had been lacking and that it was likely that the merger had created a dominant position for the two hospitals involved (Varkevisser & Schut, 2008). Hence, this merger seems to be on the enforcement margin, making it an interesting case for further retrospective studies.

4.1 | The locations

The merger involved a general acute care hospital (hospital M1) and a neighboring general acute care hospital that also provides tertiary hospital care (hospital M2). Hospital M1 is located in an isolated geographical area, whereas hospital M2 is located in a more densely populated region with several other hospitals nearby. The distance between hospitals M1 and M2 is about 50 km. According to the ACM, the merging hospitals were subject to competition from five other hospitals before the merger took place. Prior to the merger, hospital M2 was the largest competitor to hospital M1, whereas hospital M2 had multiple competitors. After the merger, hospital M1 was expected to experience competitive pressure from only one rival hospital, whereas hospital M2 was expected to experience notable competitive pressure from five other hospitals.[7] The differences in competitive pressure in the markets of hospitals M1 and M2 may result in heterogeneous price effects of the merger (see Section 2).

4.2 | The products

In this article, we estimate the impact of the merger in three separate product markets that jointly make up 47.5% of the merged hospital's turnover in the segment for which Dutch insurers and hospitals were allowed to freely negotiate prices at the time of the merger. We looked at hip replacements, knee replacements, and cataract surgery. Most hospitals provide these services. At time of the merger, there were no independent treatment centers (ITCs) in the regional

[4]In 2006, the average HHI of Dutch hospitals equaled 2.350 (Halbersma et al., 2010), and since then, no hospitals entered or exited the hospital market. Only mergers have decreased the number of hospitals.

[5]For reasons of confidentiality, we only report those results that are of direct interest to this article. We anonymize the names of the merged hospitals, rival hospitals, and insurers. For the same reason, the merger year is reported as t (which was between 2005 and 2012), with the year preceding the merger as $t-1$ and the year following the merger as $t+1$.

[6]According to most antitrust laws, mergers must be reported to an antitrust authority prior to consummation (see 15 USC §18A for the US and the competition laws of the EU Member States or EC (European Commission), 2004 for the European Union's rules on prior merger notification). The Dutch antitrust law is no exception (Mededingingswet, section 37.2).

[7]None of these rivals provides tertiary hospital care.

TABLE 1 Descriptive statistics

Hospitals	Hip replacements		Knee replacements		Cataract surgery	
	$t-1$	$t+1$	$t-1$	$t+1$	$t-1$	$t+1$
Panel A. Hospital M1						
Volume	174	175	223	293	387	361
Gender (% male)	0.28	0.38	0.34	0.43	0.38	0.35
Patients' average age	68	68	64	56	72	73
Patients' average SES score	0.05	−0.14	0.15	0	0.09	−0.06
Panel B. Hospital M2						
Volume	390	511	271	299	2144	2113
Gender (% male)	0.34	0.35	0.34	0.32	0.41	0.40
Patients' average age	68	70	69	69	72	73
Patients' average SES score	0.31	0.42	0.39	0.48	0.35	0.42
Panel C. Rival 1						
Volume	165	154	164	135	1026	1045
Gender (% male)	0.27	0.36	0.27	0.29	0.41	0.37
Patients' average age	70	71	71	69	75	75
Patients' average SES score	−0.22	−0.05	−0.06	−0.09	−0.09	−0.02
Panel D. Rival 2						
Volume	237	195	162	162	881	1088
Gender (% male)	0.32	0.34	0.32	0.38	0.43	0.41
Patients' average age	70	68	68	68	73	72
Patients' average SES score	0.15	0.12	0.15	0.28	0.22	0.26
Panel E. Rival 3						
Volume	136	114	146	118	650	972
Gender (% male)	0.34	0.28	0.40	0.29	0.38	0.42
Patients' average age	70	62	70	70	75	74
Patients' average SES score	−0.83	−0.88	−0.76	−0.69	−1.01	−0.96
Panel F. Rival 4						
Volume	169	155	101	151	855	763
Gender (% male)	0.34	0.26	0.38	0.35	0.43	0.44
Patients' average age	69	73	70	71	75	75
Patients' average SES score	0.24	0.46	0.09	0.36	0.17	0.4
Panel G. Other hospitals						
Average volume	231 (14)	234 (15)	196 (12)	199 (12)	1590 (146)	1545 (137)
Gender (% male)	0.33	0.34	0.32	0.33	0.39	0.41
Patients' average age	69 (0.37)	69 (0.25)	69 (0.27)	69 (0.26)	73 (0.32)	73 (0.29)
Patients' average SES score	−0.04 (0.05)	−0.18 (0.08)	0 (0.05)	−0.11 (0.07)	0.01 (0.05)	−0.09 (0.07)

Note. The standard deviations are in parentheses. We excluded all hospitals that had more than 15% missing prices for either hip or knee replacements or cataract surgeries in the period $t-2$ to $t+2$. Panel G displays the descriptive statistics of the hospitals other than hospitals M1, M2, and the rival hospitals. Within panel G, 51 hospitals performed hip replacements, 56 hospitals performed knee replacements, and 57 hospitals performed cataract surgeries. The rows on volume only report cases that have a valid gender, age, and SES score.

market. Table 1 presents descriptive statistics on the patients for each product in hospitals M1 and M2 and four rivals[8] before and after the merger.

After merger, the hospitals had an opportunity to concentrate care in one of the two hospital locations. This does not seem to have occurred, however. Even though it follows from Table 1 that hospital M2 provided many more hip replacements in year $t+1$ than in $t-1$, the total number of hip replacements in the market barely changed, and the provision of hip replacements in hospital M1 also did not change significantly. The hospitals therefore do not seem to have concentrated care in hospital M2 after the merger. Rather, it seems that hospital M2 is, postmerger, better able to attract patients in need of hip replacements because the number of hip replacements performed in rival hospitals decreased slightly whereas the total number of patients in the market did not change significantly.

In hospital M1, the average age of patients undergoing knee replacements dropped between $t-1$ and $t+1$. Again, this does not seem to be an attempt to change patient flows in the merged hospitals, as, according to hospital M1's

[8]We excluded the fifth rival hospital from the analysis, because it had more than 15% missing prices in the period $t-2$ to $t+2$.

TABLE 2 Health insurers' market share per product per hospital in $t-1$ and $t+1$

	Market Share Insurer 1		Market Share Insurer 2		Market Share Insurer 3		Market Share Insurer 4		Market Share Insurer 5	
Hospitals	$t-1$	$t+1$	$t-1$	$t+1$	$t-1$	$t+1$	$t-1$	$t+1$	$t-1$	$t+1$
Panel A. Hospital M1										
Hip replacements	0.76	0.74	0.05	0.04	0.09	0.13	0.05	0.02	0.05	0.07
Knee replacements	0.69	0.61	0.05	0.06	0.16	0.20	0.06	0.08	0.05	0.06
Cataract surgery	0.84	0.77	0.01	0.03	0.09	0.09	0.04	0.05	0.02	0.06
Panel B. Hospital M2										
Hip replacements	0.62	0.62	0.08	0.06	0.19	0.17	0.04	0.06	0.07	0.08
Knee replacements	0.69	0.62	0.04	0.03	0.17	0.20	0.01	0.06	0.09	0.08
Cataract surgery	0.70	0.71	0.04	0.05	0.16	0.14	0.02	0.03	0.08	0.08

Note. The health insurers' market shares are based on the number of cases per hospital–insurer–product combination.

website, the hospital has been testing out an innovative procedure for knee replacements since year t for which only patients under 60 years old are eligible. This is likely unrelated to the merger but could explain the decrease in the patients' average age observed in the data.

4.3 | The health insurers

At the time of the merger, at least five health insurers were active in the region.[9] According to Table 1, the volume of patients has not changed significantly across hospitals, indicating that health insurers did not shift enrollees away from the merged hospitals to rival hospitals in $t+1$.

Table 2 shows the insurers' market share for each product and for each hospital in years $t-1$ and $t+1$. The market shares have not changed over the years.

5 | EMPIRICAL MODEL SPECIFICATION

We use data on hospital–insurer negotiated contract prices in the Netherlands for each of the three hospital products considered, to investigate whether the merger between hospitals M1 and M2 has led to price changes and if so, whether this effect varies between locations, payers, and products.

Because we wanted to control for price changes that would have occurred even if the merger had not taken place, we used a difference-in-differences (DID) model in which price changes at the merging hospitals are compared with price changes among a group of comparison hospitals that were unaffected by the merger (i.e., the control group). The identifying assumption of a DID estimation is that trends (price trends) would be the same in both groups in the absence of the event (merger). We visually investigated whether the common trend assumption applies (Figures 1–3). Although we only have 2 years of premerger data, the graphs suggest that the premerger price change in the merged hospital did not deviate substantially from the premerger price changes in Control Group 1.

To examine the effect of aggregating the merger price effect, we estimated DIDs models at various aggregation levels. As a benchmark, we started with the most aggregated model, which is the price effect for the merged hospital fully aggregated over hospital locations, products, and insurers. We then disaggregated this effect stepwise to ultimately arrive at the most differentiated model in which we fully differentiated the merger price effect across hospital locations, products, and insurers.

The most aggregated model:

$$\ln p_{jt} = \alpha + \lambda \cdot POST_t + \delta \cdot POST_t \cdot MERGED_j + \vartheta_j + \varepsilon_{jt}, \tag{2}$$

[9]In fact, there are six health insurers active in the region. However, for the sixth health insurer, we did not have valid prices in the post-merger year ($t+1$) for the merging hospitals M1 and M2. This health insurer was therefore not included in the DIDs estimates or in any other analysis. The effect of excluding this health insurer for hospital M1 and hospital M2 is most likely negligible, however, because the health insurer only accounts for less than 2% of all hip, knee, and cataract patients in hospitals M1 and M2.

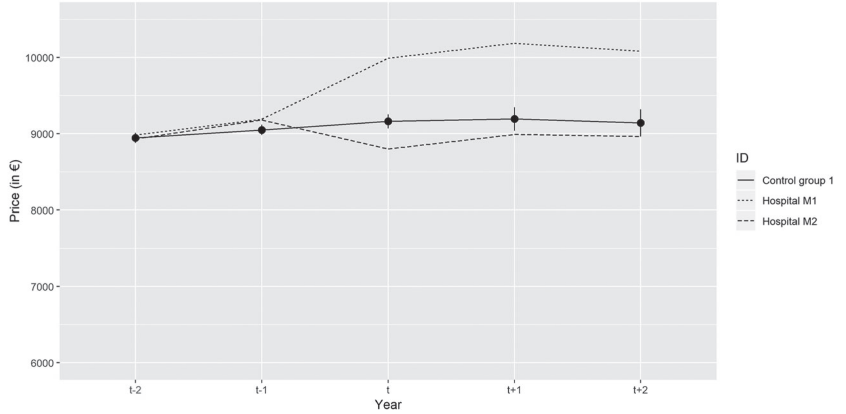

FIGURE 1 Average price development hip replacements in Hospitals M1, M2, and Control Group 1. *Notes*. The prices plotted for Control Group 1 are averaged over all hospitals in Control Group 1

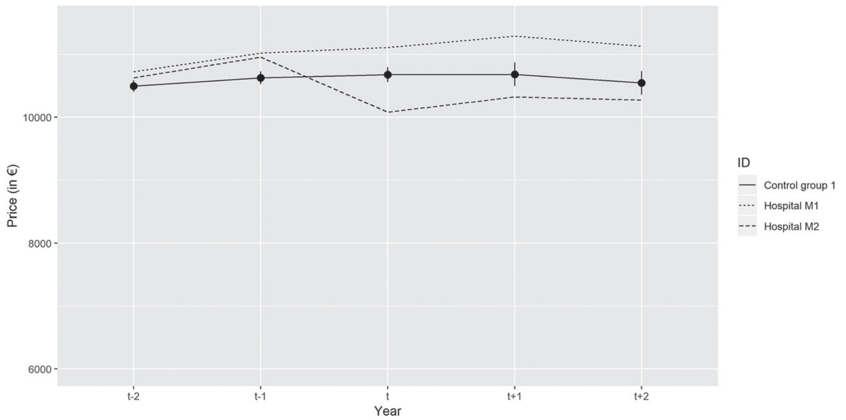

FIGURE 2 Average price development knee replacements in Hospitals M1, M2, and Control Group 1. *Notes*. The prices plotted for Control Group 1 are averaged over all hospitals in Control Group 1

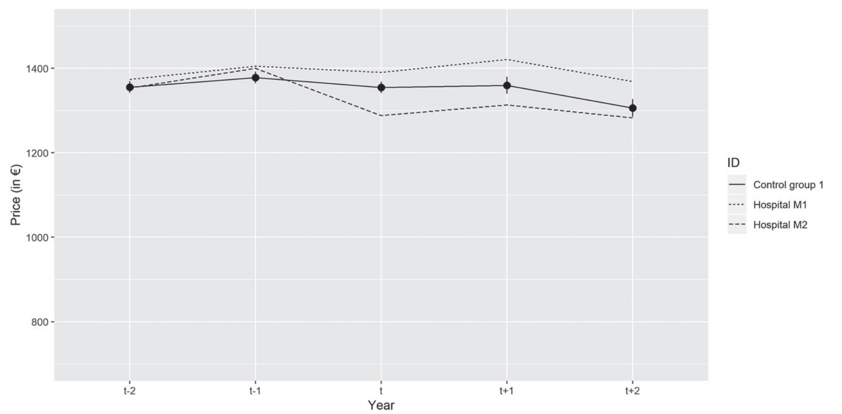

FIGURE 3 Average price development cataract surgery in Hospitals M1, M2, and Control Group 1. *Notes*. The prices plotted for Control Group 1 are averaged over all hospitals in Control Group 1

where p_{jt} was the weighted average hospital negotiated price,[10] $POST_{\mathrm{t}}$ is one in year $t + 1$ (the postmerger year) and zero in year $t - 1$ (the premerger year), $MERGED_{\mathrm{j}}$ is one for the merger hospitals and zero for the control group hospitals, $\lambda \cdot POST_t$ denotes the change in the average price in year $t + 1$ compared with year $t - 1$, δ is the DID estimator (i.e., the

[10]First, for the results presented in this paper we calculated an average price per product for each hospital–insurer pair. Second, we aggregated these prices over the insurers to an average price for each hospital-product combination, whereby we weighted the prices with the insurer's specific volume shares in year $t - 1$. Third, we aggregated over the products to an average price per hospital, whereby we weighted the hospital-product prices with the market-wide revenue shares for each product in $t - 1$. We calculated an average price for the merged entity M1 + M2, by weighting the prices for hospitals M1 and M2 with their corresponding revenue shares in year $t - 1$. In online appendix S2 we present the models using the per hospital-product revenue in $t - 1$ as a weighting factor for the aggregation over products (second step).

average treatment effect on the treated) and ϑ_j is a hospital fixed effect. To account for potential endogeneity of the merging policy, we matched a control group to the event group (i.e., hospitals M1 and M2). In this control group, we included all Dutch hospitals that provided the three products and excluded any other hospitals that also merged between years $t-2$ and $t+2$ and ITCs.

To estimate the most aggregated DID model, we aggregated the patient-level hospital data to an average price per hospital. In the Netherlands, negotiated prices differ between health insurers but not between patients with the same health insurer who are treated in the same hospital. Therefore, we can aggregate the data to hospital–insurer level without a loss of information. Furthermore, due to aggregation, we do not have to consider the correlation between prices within each hospital–insurer combination, which would otherwise lead to biased standard errors (see, e.g., Bertrand, Duflo, & Mullainathan, 2004; Donald & Lang, 2007; Thompson, 2011). We investigated whether our results from the disaggregated model were robust to changes in the control groups by using six different control groups[11]: (a) all Dutch hospitals that provide the product, excluding hospitals that also merged between years $t-2$ and $t+2$ and ITCs; (b) Control Group 1, excluding all university hospitals; (c) Control Group 2, excluding rivals of the merged hospitals; (d) Control Group 3, excluding the hospitals with low market power; (e) Control Group 3, excluding all hospitals with low health insurers concentration; and (f) Control Group 3, excluding hospitals of a different size to hospitals M1 and M2. We thus had 12 control groups, six for each hospital. Finally, we also tested whether our disaggregated model was robust to hospital-specific covariates.[12]

6 | DATA

We used a comprehensive nationwide patient-level dataset containing all inpatient and outpatient visits at all hospitals in the Netherlands. For each visit, the patient's zip code, age (year of birth), gender, health insurer, and DTC were observed, as well as the price negotiated for each hospital–insurer–product combination between years $t-2$ and $t+2$. For the DID analysis, we use data from $t-1$ to $t+1$. The patient-level data that we used came from the insurers' claims administration and hospital registries.

We focused on three products for which prices are freely negotiable: hip replacements,[13] knee replacements[14] (both orthopedics), and cataract surgery[15] (ophthalmology). In year $t-1$, these product markets jointly accounted for 47.5% of turnover in the free-pricing segment at the merging hospitals. All hospitals where more than 15% of prices were missing for 1 or more years between $t-2$ and $t+2$ were excluded from the dataset.[16]

The premerger price was based on data from the year preceding the merger ($t-1$), and the postmerger price was based on data from the year after the merger ($t+1$). Table 3 presents summary statistics on the volume and mean prices of the products within hospital M1, hospital M2, and Control Group 1.

Hospitals with limited market power are excluded from Control Group 4. The weighted average market share that was used to determine the hospitals' market power was based on the LOgit Competition Index (LOCI), developed by Akosa Antwi, Gaynor, and Vogt (2006, 2009). According to this model, the market share of hospital j for product d in zip code z is $s_{jd,z} = \frac{q_{jd,z}}{\sum_{j=1}^{J} q_{jd,z}}$, where $q_{jd,z}$ is the total number of patients at hospital j ($j = 1,..,J$) for product d

[11]The results presented in the main text relate to Control Group 1. The results for all six control groups are reported in online appendix S7.

[12]The following hospital-specific covariates were included in an additional DID model: the number of patients, the percentage of males, the average socioeconomic status score, the average age of the patients, and the weighted market share per hospital. The results using this model did not differ from the results by the other models. These are therefore not included in the main text but reported in online appendix S3.

[13]According to the Dutch hospital product classification system: "joint degeneration of pelvic/hip/upper leg; surgery with clinical admission and joint prosthesis."

[14]According to the Dutch hospital product classification system: "joint degeneration of knee; surgery with clinical admission and joint prosthesis."

[15]According to the Dutch hospital product classification system: "cataract; outpatient treatment with intervention."

[16]For hip replacements, 31 out of 90 hospitals had more than 15% missing prices in one or more years in the period $t-2$ and $t+2$. For knee replacements, 25 out of 89 hospitals had more than 15% missing prices in one or more years in the period $t-2$ to $t+2$. For cataract operations, 25 out of 89 hospitals had more than 15% missing prices in one or more years in the period $t-2$ to $t+2$. The threshold of 15% was arbitrary. As a sensitivity check, we therefore also used other thresholds for the disaggregated model. This had no effect on the overall results or the conclusions of the article. The results are available in online appendix S4.

TABLE 3 Volume and mean prices for hip and knee replacements and cataract surgery in hospitals M1, M2, and Control Group 1

	Hip replacements		Knee replacements		Cataract surgeries	
Hospitals	***t* − 1**	***t* + 1**	***t* − 1**	***t* + 1**	***t* − 1**	***t* + 1**
Panel A. Hospital M1						
Volume	172	173	222	282	381	355
Mean price in €	9,189.58 (348.00)	10,188.05 (559.08)	11,022.98 (494.94)	11,291.41 (651.32)	1,405.00 (40.78)	1,421.27 (45.08)
Panel B. Hospital M2						
Volume	389	503	271	295	2,140	2,077
Mean price in €	9,181.96 (144.25)	8,991.34 (109.09)	10,959.49 (185.30)	10,321.76 (245.90)	1,400.10 (20.34)	1,313.40 (29.83)
Panel C. Control Group 1						
Volume	224	227	189	194	1,520	1,498
Mean price in €	9,045.00 (338.64)	9,160.96 (620.08)	10,592.34 (473.51)	10,608.52 (786.32)	1,340.94 (72.83)	1,349.43 (104.12)

Notes. The hospitals' volume per product in this table slightly deviates from the hospitals' volume per product reported in Table 1. In this table, we only report the records with a valid price, whereas in Table 1 only records with a valid gender, age, and SES score per product per hospital are reported. The mean prices for each hospital are averaged over all patients. The mean price for Control Group 1 is the average over the mean prices of the hospitals within control group 1. The standard errors are in parentheses.

(d = 1,2,3) in zip code *z (z = 1,...,Z)*. Then, for each hospital and product, we calculated a weighted average market share $\bar{s}_{jd} = \sum_{z=1}^{Z} w_{jd,z} s_{jd,z}$, where we weighted each market share with the share of patients coming to hospital j from zip code z, that is, $w_{jd,z} = \frac{q_{jd,z}}{\sum_{z=1}^{Z} q_{jd,z}}$.

The insurer's HHI that was used to construct Control Group 5 is based on the insurer's market shares for each product and ranged from zero to one. The insurer's HHI for hospital j and product d: insurer's $\mathrm{HHI}_{jd} = \sum_{m=1}^{M} \left(\frac{q_{mjd}}{\sum_{m=1}^{M} q_{mjd}} \right)^2$, where q_{mjd} is the total number of patients of insurer m ($m = 1, \ldots$,M) in hospital j for product d.

7 | EMPIRICAL RESULTS

As expected, the weighted average market shares of the hospitals' products increased as a result of the merger. The increase is from 76.7% to 82.5% for hip replacements, from 78.2% to 85.7% for knee replacements, and from 83.5% to 86.6% for cataract surgeries. In Table 4, we present the diversion shares of hospitals M1 and M2 that follow from the bargaining model presented in Section 2 and online appendix S1. A higher value of the diversion share suggests a higher degree of substitution between two hospitals in treating the same disease.[17]

From Table 4, it follows that the diversion shares of hospital M1 to hospital M2 are much higher. Hospital M1 is located in a more isolated region with hospital M2 being its strongest competitor premerger. As expected, a large share of patients is diverted to hospital M2 once hospital M1 is not available. If the more centrally located hospital M2 would not be available, however, only few patients are expected to be diverted to hospital M1. When comparing the diversion shares over products, we find that the variation in diversion shares across products within each hospital is much smaller than the variation in diversion shares across hospital M1 and M2 for each product.

Table 5 presents the results of the DID model aggregated over locations, insurers, and products.

Table 5 shows that no significant merger effect was observed when the result was aggregated over locations, insurers, and products.

In Table 6, we disaggregate the merger effect by location, product, and insurer.[18]

We disaggregated the postmerger price change for each hospital location to see whether the merging hospital differentiated a potential price increase after merger across locations. When we used the DID approach, we found that the postmerger increase in prices for hip replacements in hospital M1 varied significantly from the control group, whereas the prices for hip replacements in hospital M2 were unaffected by the merger. Apparently, the merged hospital differentiated its prices across locations.

[17]Diversion ratios and market shares of rivals are reported in online appendix S5.

[18]The results of the stepwise disaggregation are presented in online appendix S6.

TABLE 4 Diversion shares to/from hospitals M1 and M2 (in $t-1$)

	Hip replacements		Knee replacements		Cataract surgery	
To\from	M1	M2	M1	M2	M1	M2
M1	—	0.105	—	0.158	—	0.034
M2	0.735	—	0.663	—	0.850	—

Notes. The diversion shares are calculated using a conditional logit model of hospital choice, following Capps et al. (2003). We used patient-level data from $t-1$ to estimate the model, which included the travel time between the patient's zip code and hospital location, a dummy indicating whether the patient is older or younger than 65 years old, a dummy for the patient's gender, and the socioeconomic status score for the patient's zip code.

TABLE 5 Merger effect aggregated over all three products, health insurers, and hospital locations[a]

Coefficients	Hospitals M1 and M2
(Intercept)	8.869*** (0.029)
Postmerger price change in the common trend (λ)	0.009 (0.009)
Postmerger price change	−0.017 (0.057)
Observations (number of hospitals)	54
R^2	0.719
Adjusted R^2	0.422

Notes. Models estimated by ordinary least squares with standard errors in parentheses. In this model, hospitals M1 and M2 together are compared with Control Group 1.

[a]For clarity reasons, we do not report the hospital dummies here.

***Significant at the 1 percent level. **Significant at the 5 percent level. *Significant at the 10 percent level.

TABLE 6 Merger effect for hip and knee replacements and cataract surgery per health insurer in hospitals M1 and M2[a]

Coefficients	Hip replacements	Knee replacements	Cataract surgeries
Panel A. Hospital M1			
(Intercept)	9.130*** (0.026)	9.311*** (0.031)	7.249*** (0.028)
Postmerger price change in the common trend (λ)	0.014* (0.007)	0.004 (0.008)	−0.015** (0.007)
Postmerger price change insurer 1	0.113** (0.053)	0.049 (0.062)	0.037 (0.057)
Postmerger price change insurer 2	0.099* (0.053)	0.024 (0.062)	−0.053 (0.057)
Postmerger price change insurer 3	−0.118** (0.053)	−0.153** (0.062)	−0.114** (0.057)
Postmerger price change insurer 4	0.157*** (0.053)	0.089 (0.062)	0.067 (0.057)
Postmerger price change insurer 5	0.147*** (0.053)	0.080 (0.062)	0.059 (0.057)
Observations (number of hospitals)	57	62	63
R^2	0.828	0.767	0.740
Adjusted R^2	0.617	0.487	0.429
Panel B. Hospital M2			
(Intercept)	9.130*** (0.026)	9.311*** (0.031)	7.249*** (0.028)
Postmerger price change in the common trend (λ)	0.014* (0.007)	0.004 (0.008)	−0.015** (0.007)
Postmerger price change insurer 1	−0.032 (0.053)	−0.066 (0.062)	−0.051 (0.057)
Postmerger price change insurer 2	−0.029 (0.053)	−0.035 (0.062)	−0.016 (0.057)
Postmerger price change insurer 3	−0.049 (0.053)	−0.084 (0.062)	−0.074 (0.057)
Postmerger price change insurer 4	−0.021 (0.053)	−0.016 (0.062)	−0.010 (0.057)
Postmerger price change insurer 5	−0.044 (0.053)	−0.049 (0.062)	−0.022 (0.057)
Observations (number of hospitals)	57	62	63
R^2	0.738	0.716	0.706
Adjusted R^2	0.417	0.375	0.354

Notes. Models estimated by ordinary least squares with standard errors in parentheses. In this model, hospitals M1 and M2 are compared with Control Group 1.

[a]For clarity reasons, we do not report the hospital dummies here.

***Significant at the 1 percent level. **Significant at the 5 percent level. *Significant at the 10 percent level.

We also disaggregated the effect of the merger for each product. We found that the price effects of the merger varied significantly between hospital products. Specifically, the merger resulted in higher prices for hip replacements in hospital M1, whereas the prices for knee replacements and cataract care in hospitals M1 and M2 remained unaffected.

Finally, we disaggregated the postmerger price changes for each hospital–insurer combination. For four out of five health insurers that negotiated prices with hospital M1, the postmerger price increases for hip replacements were on average 13 percentage points higher than for the control groups. The merger's price effect varied between health insurers from −12 to +16 percentage points relative to the control groups. Also, the largest health insurer—Insurer 1, which represented 76% of hospital M1's patients—was unable to negotiate lower prices: The prices it paid for hip replacements rose by 11 percentage points as a result of the merger. In contrast, one of the four other much smaller health insurers—Insurer 3, which represented only 11% of hospital M1's patients—was able to negotiate prices that were much lower than the control groups. These results were robust between the control groups. It is therefore less likely that the merger effect estimated was driven by unobserved characteristics in the control group.[19]

8 | DISCUSSION

The main finding of our study is that a merger between two hospitals in overlapping geographical markets generated heterogeneous prices effects at the two different hospital locations, for different hospital products, and for different health insurers. The theoretical model that was presented in Section 2 and online appendix S1 explains why this might be the case.

8.1 | Different price effects for different products

First, we find a significant increase in the postmerger price of hip replacements but not of the other two products. This result was robust across all control groups and model specifications.

This raises the question of why the price rise only occurred for hip replacements and not for knee replacements and cataract surgery. It followed from the theoretical framework that product *d*'s price change after the merger in each hospital is increasing in the diversion share between these hospitals and the price–cost margin of the partnering hospital. We found that the diversion shares in hospital M1 of hip replacements were no higher than the diversion shares of other products. Hence, the difference in product–price effects after merger must be explained by other factors, that is, the premerger price–cost margins of hospital M2. Unfortunately, we have no information on the product's price–cost margins of hospitals in this market. However, because the premerger prices for hip replacements in hospitals M1 and M2 were remarkably similar according to Table 3, the theory suggests that the premerger cost of hip replacements at hospital M2 were lower than the premerger cost of hip replacements at hospital M1.

Nevertheless, the finding that price effects *are* heterogeneous across hospitals' top-revenue products highlights the importance of using a more disaggregated approach rather than the more aggregated approach, when defining product markets. In practice, finding alternatives to highly debated traditional approaches to delineate geographic markets in health care have been the top priority of most antitrust authorities. With the emergence of promising alternatives, like merger simulation models, ex ante merger scrutiny could further improve by a better delineation of product markets. In antitrust cases, it is often assumed that the merger price effect will be the same for all hospital products because acute care, inpatient services can be considered as a single and thus homogeneous hospital product in cases of hospital mergers. According to antitrust laws, however, separate products or services need to be distinguished if they are not demand or supply substitutes.[20] Because the hospital market is highly complex due to the multiplicity of services offered and the heterogeneity of consumers, many different hospital products exist and the standard inpatient cluster may mask considerable variability in the concentration statistics across the inpatient categories that make up an overall cluster. Sacher and Silvia (1998) therefore argue that disaggregation can provide a better understanding of the potential

[19]These findings are reported in online appendix S7.

[20]According to the European Commission (1997) Commission Notice, “A relevant product market comprises all those products and/or services which are regarded as interchangeable or substitutable by the consumer, by reason of the products’ characteristics, their prices and their intended use.” According to the Federal Trade Commission (2010) Merger Guidelines: “Market definition focuses solely on demand substitution factors, i.e. on consumers' ability and willingness to substitute away from one product to another in response to a price increase or a corresponding non-price change such as a reduction in product quality or service.”

competition effects of a merger in a range of market configurations and that more attention to better product delineation in hospital markets is warranted. A similar point is made by Hentschker, Mennicken, and Schmid (2014).

Also from the theoretical model it followed that price effects after merger may differ between hospital products. As indicated in Section 2, freeing the product price ratios would more closely correspond to practices where contracts between hospitals and insurers can be concluded for a subset of treatments and a price has to be determined for each care bundle. For that reason, when we estimated the model parameters, we also disaggregated the effects of the merger by product markets. However, if the rules for product market definition were applied strictly, hundreds or maybe thousands of separate hospital product markets would have to be distinguished because many hospital products and services are not demand or supply substitutes. Clearly, this would not be a feasible strategy in cases of hospital mergers. Hence, only a certain level of disaggregation would be warranted. Although our theoretical model defines each product d as a treatment of one illness, d may also be understood as a product cluster combining several illnesses based on revenue or volume or specialism or otherwise. Hence, the model conclusions also hold for the situation in which some clustering (aggregation) is applied in order to reduce the number of product dimensions in the analysis or because this more closely corresponds with selective contracting in practice. Sacher and Silvia (1998) show that even a very limited disaggregation of the standard inpatient cluster can lead to a more accurate merger analysis. Zwanziger, Melnick, and Eyre (1994), too, propose a manageable disaggregation of the standard clusters. So far, in practice, antitrust authorities have only occasionally taken potential differences between products into account.[21] Recently, however, the Dutch competition authority concluded that the increasing trends towards more specialization and the development of integrated care networks necessitate a further and more formal disaggregated approach to define relevant hospital product markets. It announced that hospitals and independent treatment centers that wish to merge will now need to provide the Dutch competition authority with detailed information on the potential effect of the merger per patient group[22] (ACM, 2018). Because it is unclear how often antitrust outcomes would be affected by using a different level of aggregation (Sacher & Silvia, 1998), we suggest using both the clustered approach and a limited disaggregated approach when defining product markets in the case of hospital mergers. If the initial disaggregated approach yields different outcomes, the analysis can be further disaggregated.

The question then remains how an antitrust authority should deal with differences in merger outcomes between products. It is unlikely that the antitrust authority will block a merger if the prospective analysis indicates that the prices for one product will increase, whereas the prices of other products will not be affected. Rather, finding different effects across products may lead to interventions that are specifically addressed only to the product that is found to be affected by the merger. For example, antitrust authorities may impose remedies requiring the divestiture of a specific product, imposing the obligation to support new entrants (like ITCs) or introducing a price ceiling on particular products at one or more hospital locations.

8.2 | Different price effects at different locations

Second, the merged hospital raised its price for hip replacements significantly at one location (hospital M1) but not at the other (hospital M2). To establish whether the merging hospitals experienced different price changes after merger, we aggregated the postmerger price change according to hospital location. It followed from the theoretical model that price changes caused by merger are proportional to the merging hospitals' diversion shares and the initial price–cost margins of the merger partner. To date, however, most studies have not controlled for this potential source of heterogeneity. Only Tenn (2011) examines and finds evidence of differential pricing strategies after merger.

In our case study, the merging hospitals' diversion shares were different due to their geographic location. The differences in geographic locations manifest itself in higher diversion shares for hospital M1 than for hospital M2 before merger (Table 4). After the merger, the two hospitals were likely able to internalize this constraint, leading to higher prices at hospital M1. Our results are consistent with this line of reasoning: The price change after merger was higher for hospital M1 whose diversion shares to hospital M2 were much higher than the diversion shares from hospital M2 to hospital M1.

[21]For example, in one case the UK Competition Commission performed a detailed analysis of the appropriate product markets (Competition Commission, 2013) and in the *FTC v. ProMedica Health System* case, the U.S. antitrust authority paid special attention to the inpatient obstetrical services in addition to general acute-care inpatient services (Federal Trade Commission, 2012).

[22]There are 65 patient groups, which were developed by the Dutch Healthcare Authority. Each patient group is a cluster of patients having a similar diagnosis.

It needs to be recognized that a merger between a rather isolated hospital location and its closest substitute creates opportunities for postmerger price increases that may be overlooked when not taking the disaggregated approach. Our findings suggest that the competition intensity that merging locations experience before and after merger may differ considerably between locations even if the merger entails two neighboring hospitals. Because this difference may result in a heterogeneous merger effects across locations, antitrust agencies should take the difference between locations into account. However, then the question remains how antitrust authorities should deal with differences in merger outcomes between locations. We discussed product-specific remedies in the previous paragraph. Likewise, antitrust authorities may think about location-specific remedies in case they predict the merger effect to be differentiated across locations. Like product-specific remedies, location-specific remedies might entail structural remedies or behavioral remedies that are only aimed at the location(s) that is (are) affected by merger.[23]

8.3 | Different price effects for different insurers

Third, we showed that the price change caused by merger may differ between health insurers. For four out of five health insurers that negotiated prices with hospital M1, the postmerger price increases for hip replacements were on average 13 percentage points higher than the control group. The merger's price effect varied between health insurers from −12 to 16 percentage points relative to the control group. This finding corresponds to the results from an earlier retrospective study from the United States (Thompson, 2011).

The theoretical model suggests that the insurer-specific price differences may arise due to differences in the insurers' bargaining abilities. In particular, a health insurer with more bargaining weight or ability is confronted with a higher price increase after the merger. In our empirical analysis, we found some evidence for this somewhat counterintuitive theoretical finding: that is, the postmerger price of hip replacements in hospital M1 negotiated by the largest health insurer increased much more than the price negotiated by a much smaller insurer.

The source of bargaining ability of health insurers is the topic of many studies. The evidence suggests that idiosyncratic effects such as bargaining skills of the individuals at the negotiating table might have a sizeable impact on the market outcomes (Grennan, 2014; Halbersma, Mikkers, Motchenkova, & Seinen, 2010). Although the bargaining model gives us some ideas on the source of heterogeneity in the postmerger price effects across health insurers, it remains largely unclear why such large differences exist across insurers within markets and why some health insurers experience price increases whereas others experience price decreases after merger.

From a policy perspective, the fact that postmerger price effects are not homogeneous across insurers within markets is an interesting finding, however. It is furthermore interesting to note that the heterogeneities are large. In ex ante merger reviews in the Netherlands, the Authority for Consumers and Markets (ACM) asks representatives of large health insurers in the region about their expectations regarding competitive effects of the merger. Like in most other prospective merger cases, the largest health insurers in the relevant hospital market notified the competition authority that they did not anticipate negative competitive effects from the consolidation that we studied. Partly because of that reason the merger was cleared. However, the retrospective analysis indicates that the health insurers who believed to be able to counteract postmerger price increases were both not able to do that. We therefore suggest that a more critical assessment of health insurers' bargaining ability in merger cases is warranted.

9 | CONCLUSION

In this study, we expanded existing bargaining models to allow for heterogeneous product–price effects and used a DID model in which price changes at the merging hospitals are compared with price changes at a group of comparison hospitals. The main finding of our study is twofold. First, the merger led to heterogeneous prices effects for different health insurers, hospital products, and hospital locations. Second, these differences depend on (a) the degree of substitution between hospitals, which may also vary over products, (b) the relative bargaining ability of hospitals and insurers, and (c) the premerger price–cost margins of different products delivered by these hospitals.

[23]Occasionally, antitrust authorities have opted for imposing remedies at the entire location level. Divestitures of hospital locations were, for example, ordered by the U.S. antitrust authority in the *FTC v. ProMedica Health System* case (Federal Trade Commission, 2012) and by the German antitrust authority in the *Asklepios/LBK Hamburg* case (Bundeskartellamt, 2005), whereas in the *Evanston Northwestern/Highland Park Hospital* case the U.S. antitrust authority imposed a firewall so that the two merged hospital locations had to negotiate separately with insurers after merger (Federal Trade Commission, 2008). See Gowrisankaran et al. (2015) for a critical review of the latter remedy.

The theoretical model provided us with valuable insights on the sources of heterogeneity, whereas our detailed empirical analysis of a hospital merger improved our understanding of the magnitude of differences. The analysis, however, also gives rise to three areas for future research. First, it would be interesting to replicate this study for different hospital mergers to find out which of our findings persist. Second, more insight into the sources of insurers' bargaining ability would be valuable. Third, analysis of premerger price–cost margins will improve our understanding of heterogeneous postmerger price effects across products.

Nevertheless, the fact that price effects of a merger are heterogeneous across products, locations and insurers signals important conclusions for ex ante merger scrutiny. First, it highlights the importance of using a disaggregated approach rather than the current cluster approach when defining relevant hospital product markets. Second, it suggests that future prospective merger analyses should take potential differences across hospital locations into account. Finally, it asks for a critical assessment of health insurers' bargaining ability in merger cases.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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