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Price and volume effects of hospital mergers

Investigation into effects of hospital mergers 2007-2014

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Executive summary

In this study, we conduct an ex-post investigation into the price and volume effects of hospital mergers. The purpose of the investigation is to learn from mergers that have taken place. The findings of the investigation may thus have implications for ex-ante supervisory practices.

Reasons for the investigation

The investigation was prompted in part by criticism voiced in the field concerning ACM's merger practices. Health insurers state that mergers have led to a deterioration of their negotiating position. Hospitals, on the other hand, state that health insurers' negotiating power, stricter quality requirements, and increased competition between hospitals are key reasons why hospitals merge. In the assessments conducted hitherto, ACM has in most cases identified no ex-ante competition problems. ACM has prohibited one hospital merger in the last ten years. One merger has been authorized under certain conditions and three merger hospitals have committed to a voluntary price cap. The other mergers have been approved without conditions.

The most direct effect of a merger is a further concentration and possibly a reduction in competition. If there is insufficient remaining competition, there may be an incentive for hospitals to raise prices after the merger with an associated reduction in volume. If there is sufficient remaining competition, the merger may actually have a welfare-enhancing effect, such as greater efficiency, lower costs, and higher quality.

Results of price and volume effects of hospital mergers

In this study, we examine how the price and the volume have evolved after the merger. This has been investigated in the case of 12 hospital mergers. The results were obtained by means of Difference-in-Differences regression analyses of price and volume based on claims data from 62 of the 65 patient groups defined according to medical criteria by the Dutch Healthcare Authority (NZa). In the investigation, we have used claims data for the period 2007-2014. The 62 patient groups account for over 99% of the hospital turnover generated among patient groups.

The most important finding is an indication of a rise in prices of healthcare provided by merged hospitals compared to the prices of healthcare provided by non-merged hospitals. There are only very limited indications of a systematic difference in the development of volumes of merged hospitals as compared to non-merged hospitals. In the vast majority of patient groups there is an additional rise in turnover after the merger compared to the development of turnover in the control group of non-merged hospitals. See Figure 1. The results are in line with previous empirical investigations into the price and volume effects of hospital mergers.

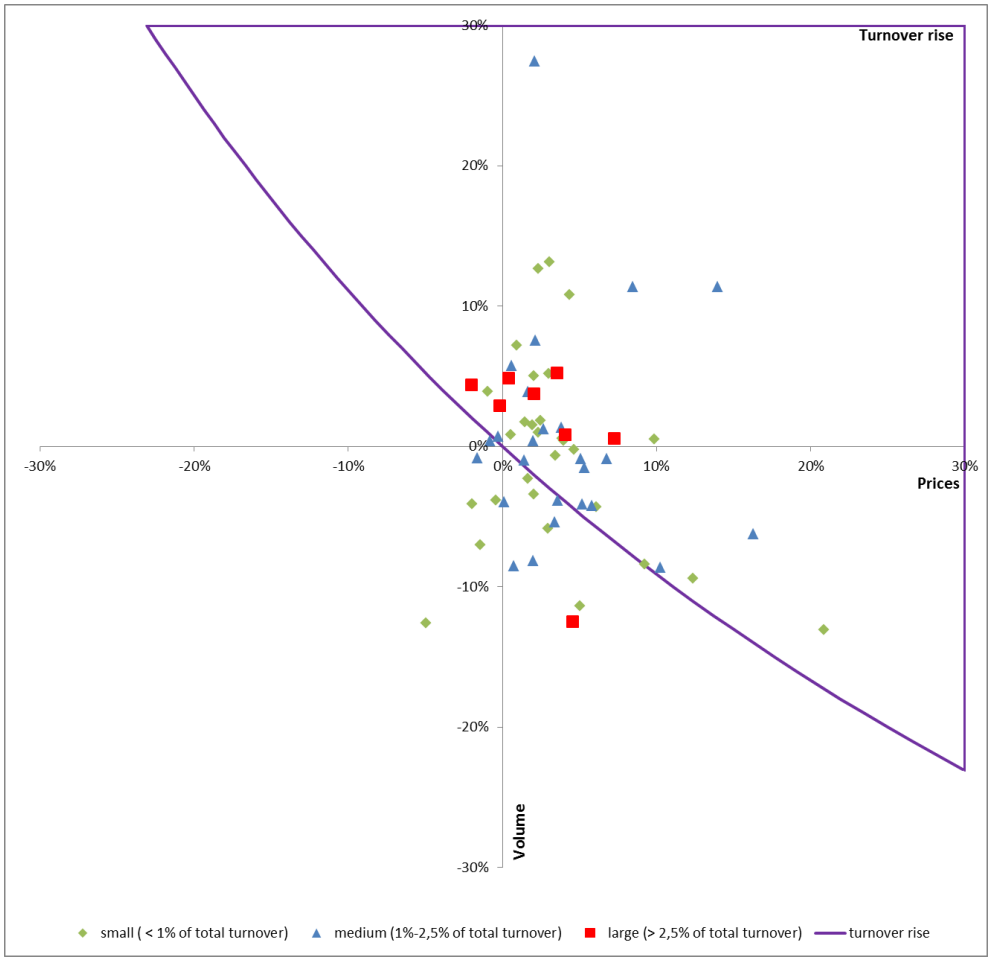

Figure 1 Correlation between price and volume effects of merged hospitals compared to non-merged hospitals, by patient group.

The price effects occur already in the first year after the merger, after which the number of patient groups experiencing a price rise decreases somewhat over time. If we examine individual mergers, we find that the merger that was approved with a remedy (Walcheren Hospital and Oosterschelde Hospitals) shows a relative fall in prices. The remedy may therefore have had an effect. The three hospital mergers involving a voluntary price commitment (Orbis - Atrium, TweeSteden - St Elisabeth and Spaarne - Kennemer Hospital) all show a relative rise in prices.

The volume effects of merged hospitals compared to non-merged hospitals are more evenly distributed and reasonably constant over time. Among the individual mergers, however, we see large differences in the relative volume developments. Some mergers show mainly increases in volume, there are mergers in which the number of patient groups with a rise in volume is similar to the number of patient groups with a fall in volume, and finally there are mergers mainly involving relative falls in volume.

Effects of concentration criteria

The investigation also provides insight into the relationship between various concentration criteria and price or volume. We find that a high Herfindahl-Hirschman Index (HHI) of a hospital is associated with a relatively higher price. This is consistent with previous empirical investigations that also found that a stronger concentration is associated with a higher price. If the insurers have uneven shares of purchasing in the hospital (resulting in a high HHI for the insurers), this is associated with a relatively lower price. However, given the insurers' HHI, a high market share of an insurer in a hospital is associated with a relatively higher price. In such cases the interdependence between the insurer and the hospital appears

to be detrimental to the insurer in terms of price.

Limitations of the investigation

It is important to note with regard to the investigation that only a limited proportion of the results obtained are statistically significant. However, the clear direction of the merger coefficients, the fact that we have investigated the entire population of hospital mergers, and the comparable results obtained in other empirical studies reinforce our conclusion that hospital mergers are usually associated with price rises. In the investigation, we were only able to make a limited assessment of the long-term effects of hospital mergers, mainly because many took place in the period from 2012. It is therefore almost impossible for us to draw a distinction between initial shock effects and long-term price and volume developments. We also have no knowledge of any cost developments.

Reflection

This investigation is complementary to the previous investigation by the Significant research firm (2016, conducted on behalf of ACM) into the effects of mergers on quality. That investigation produced no indication that hospital mergers have a strong effect on the quality of care.

Price rises were found in most patient groups, but there were no demonstrable quality gains. On average, therefore, the investigated hospital mergers lead to higher care costs without a demonstrable relative improvement in quality.

This study did not investigate whether ACM took the right decision on the basis of the information available at the time of the merger assessment. Judging by some simple characteristics such as whether or not there was a licensing requirement and the year of approval, there appears to be no systematic relationship between the observed price and volume effects and these characteristics. Further investigation is required to determine whether other indicators can provide insight into the estimated effects or whether the results obtained relate to statements that have not yet been acknowledged. Such indicators are necessary in order for the results of this investigation to be applicable in concrete terms to the ex-ante supervisory practices. The question then is which characteristics (of relevance to competition law) of an intended merger are a good predictor of subsequent price rises.

1. Introduction

Healthcare is a sector that receives a great deal of attention, and that is only logical. Around €95 billion was spent on healthcare in the Netherlands in 2015. A quarter of this expenditure was on specialist medical care, mostly in the hospital sector. The last few years have seen a steady increase in concentration in this sector, usually by means of mergers. Various developments have influenced this increase in concentration, such as selective healthcare procurement and the strong negotiating power of health insurers, increased competition between hospitals, and minimum volume standards of specialist associations and health insurers.

The most immediate effect of mergers is further concentration and hence possibly a reduction in competition. If there is insufficient remaining competition, hospitals have an incentive to raise prices after the merger. If there is sufficient remaining competition, however, a merger can also have welfare-enhancing effects, such as increased efficiency, lower costs and/or better quality. In a market with sufficient remaining competition, these benefits will accrue to consumers. The overall effect of a merger depends on the scale of the anti-competitive effects and efficiency benefits, as shown in Figure 2. If the anti-competitive effects are greater than the efficiency benefits, a merger is detrimental to consumers. If a merger delivers more efficiency benefits than anti-competitive disadvantages and sufficient competition remains, a merger will generate benefits for the consumer indirectly through lower health insurance premiums.

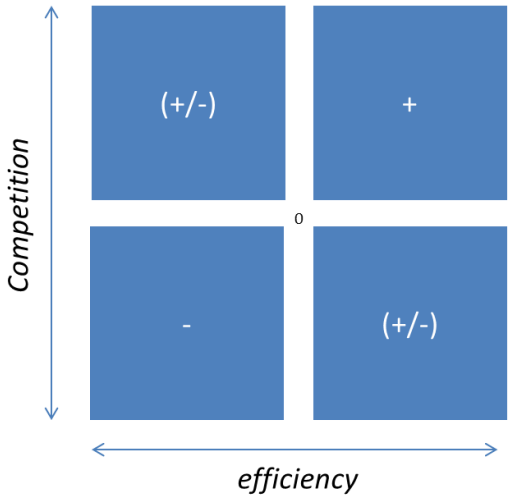

Figure 2 Effect of merger on consumers with change in competition and efficiency

ACM has the task of assessing whether mergers give rise to competition problems. ACM/NMa has conducted detailed assessments of more than 30 hospital mergers since 2004. In most cases, ACM found that the mergers had no substantial negative effect on competition. In the last few years, ACM has seen more competition risks in hospital mergers, partly due to the risks identified by health insurers. As a result of the large number of hospital mergers that have taken place, it is possible to gauge the effects of mergers. These effects of past mergers can help improve future merger assessments.

ACM conducted a previous investigation into the price effects of six hospital mergers (Kemp et al., 2012). This study investigated the price effects of mergers on the basis of a single treatment: hip replacements. Significant price rises were found in seven of the hospitals concerned, while three others saw significant price falls. This study also showed that price changes have no effect on patients' travel behavior. Roos

and Croes (2015) examined the price effects of a hospital merger for three treatments and also specifically assessed the effects for different insurers. They found that the effects differ depending on the insurer (in the case of one insurer they found significant price falls) and depending on the product (in the case of one product they found mainly significant price rises).

ACM recently published an investigation into the quality effects of hospital mergers (Significant, 2016). The main conclusion of this investigation was that there is “no indication that hospital mergers have a strong effect on the quality of care”. In the vast majority of the 97 indicators investigated there was no significant change after the merger compared to the control group of non-merged hospitals. Improvements or deteriorations were found in a limited number of indicators.

This investigation is complementary to the previous investigation by Significant. In this investigation, we assess the price and volume effects of hospital mergers. Compared to previous investigations into the price effects of hospital mergers, in this study we assess the effect of hospital mergers not on a selection of treatments, but on the basis of almost all treatments. The individual treatments are clustered into patient groups, i.e. groups of patients with similar diagnoses. The 62 of the 65 patient groups we cover in our investigation account for more than 99% of total turnover. These include the patient group that contains other healthcare, which accounts for around 9% of the total number of claims in 2014. We also look at volume developments resulting from mergers. On the basis of economic theory, the merging parties have an incentive to limit the volume and increase prices. In the merger assessments, insurers sometimes state that a merger makes it easier for them to enter into agreements to avoid supply-driven demand and unnecessary care. Finally, an examination of both price and volume effects provides insight into the development of turnover of the merger hospitals. This reflects the level at which most negotiations take place between hospitals and health insurers: the turnover of a hospital.

The report is structured as follows: First we describe the main findings of national and international investigations into the price, volume and quality effects of hospital mergers. We then explain the structure of the investigation and the main descriptive statistics in the research database. The subsequent section presents the results of the investigation. We close with a conclusion and a reflection on the results of the investigation.

2. Literature

There has been growing interest in assessments of interventions by competition authorities of late, both among researchers and among competition authorities themselves. These assessments are usually focused on merger decisions. In this section, we discuss the literature concerning these ex-post studies into the effects of mergers and then in particular hospital mergers.

Ex-post studies compare the effect of a merger (or the imposition of a remedy) with a counterfactual. This counterfactual is used to assess what the situation would have been if no merger had taken place. Insights gained from these retrospective studies of mergers can contribute in various ways to assessments by competition authorities. For example, they make it possible to test general assumptions, arguments and models used in terms of their significance and predictive power. Authorities can also 'calibrate' their policy against actual results, and thus identify potential system errors in the assessment. Kwoka (2013), for example, demonstrates in a meta-analysis that mergers approved subject to remedies often still have negative competition effects.

In the United States there is already extensive literature on merger effects, in various sectors and for different types of decision (Kwoka, 2013). Increasing attention has been paid to ex-post studies in Europe in recent years, although the number of mergers investigated is still limited (Mariuzzo et al., 2016). The Organisation for Economic Co-operation and Development (OECD) has also focused attention on ex-post studies. It has recently written a manual and held two meetings including presentations on various ex-post studies (see http://www.oecd.org/competition/evaluationofcompetitioninterventions.htm and OECD, 2016). ACM has also published various ex-post studies in the past (Kemp et al., 2012; Lear, 2015; Aguzzoni et al., 2016). The present study is in line with these.

In the literature review, we will consider the effects of hospital mergers on key competition parameters: price, volume and quality of care. Most ex-post studies look at the price effects of hospital mergers. The availability of more quality information has resulted in an increase in the number of studies examining quality effects. The volume effects of hospital mergers have so far been investigated only to a very limited extent. Table 1 shows the main conclusions of the studies conducted.

Table 1 Overview of main results in literature on effects of competition parameters

Competition parameter	Main conclusions in literature
Price	Many studies have investigated the price effect of hospital mergers, principally those carried out in the United States. In 10 of the 14 studies, there are indications that hospital mergers lead to price rises.
Volume	Few studies have investigated the volume effect of hospital mergers. Their results have not been conclusive; both relative rises and falls in volume have been found, and in some cases no effects at all.
Quality	Many studies show hospital mergers having no effect on quality; in some cases a merger results in a deterioration in quality.

We also provide a more detailed commentary on the developments in the literature concerning the Difference-in-Differences approach. Most of the ex-post studies of merger effects adopt a Difference-in-

Differences approach, as does this study. This method is still being developed, with attention focused particularly on the statistical effect of the relatively small number of cases in which an intervention takes place. Since we also deal with a relatively small number of mergers in our investigative setting (the intervention), we also briefly devote attention to developments in this field.

2.1 Investigation into price effects of hospital mergers

The investigation demonstrates that prices often rise after a merger. Table 2 summarizes the main conclusions concerning the price of healthcare after a merger. Many studies of the price effects of hospital mergers look at the United States, since competition was introduced into the US healthcare sector some time ago.

Table 2 Overview of main results in literature on effects of merger on price

Author	Merger country	Years	Did merger increase prices?	Main conclusions
Connor et al. (1998)	US	1986-1994	No	Cost reductions due to merger are passed on to the consumer. Both costs and prices of 122 merger hospitals fall by around 5%. The price fall is smaller in less competitive markets.
Krishnan (2001)	US	1994-1995	Yes	Effect of price rise is greater in product markets with a high HHI. On the basis of 122 hospitals in Ohio (22 mergers) and 108 in California (15 mergers).
Vita & Sacher (2001)	US	1986-1996	Yes	The prices of merged hospitals rise by 23%, compared to 17% for nearby competitors.
Krishnan & Krishnan (2003)	US	1995-1996	Yes	Investigation into 113 hospitals, including 20 mergers. Merger hospitals have 23% higher turnover, a 9% higher contribution margin, no reduction in costs/expenditure, and higher prices.
Capps & Dranove (2004)	US	1997-2001	Yes	Price rise based on Difference-in-Differences analysis covering 12 merger hospitals.
Dafny (2009)	US	1989-1996	Yes	Prices of nearby non-merging hospitals rise after merger. Conclusions based on 97 mergers.
Sprang et al. (2009)	US	1988-1997	Partly	Cost benefits of merger are only passed on to consumers in competitive market (HHI < 1600). This is based on a study of 4,160 hospitals, of which 125 were merged. It covers a period of 10 years.
Haas-Wilson & Garmon (2011)	US	1999-2002	Yes	Total price rise of mergers 2-4%. Price rises in one merger. In the second merger, part of the insurers show a rise in prices and part show a fall.
Tenn (2011)	US	1997-2002	Yes	After the merger, prices tend to move towards the level of the merger hospital with the highest price.
Thompson (2011)	US	1997-2002	Partly	Three insurers show price rises up to 50% and one shows a fall of 30%. This makes it difficult to draw a general conclusion on the price effect of the merger.

Author	Merger country	Years	Did merger increase prices?	Main conclusions
Kemp et al. (2012)	NL	2005-2010	Partly	Ex-post Difference-in-Differences price rise 2-16% in six merging hospitals. Price falls of 2-4% for hip replacements in three hospitals.
Roos & Croes (2015)	NL	-	Yes	Most insurers pay a higher price for cataract operations and hip and knee replacements after a merger. The results differ depending on the insurer.
Dauda (2017)	US	2005-2008	Yes	Price rise of 3-11% in a market contracting from five to four hospitals. Further concentration leads to a higher price.
Lewis & Pflum (2017)	US	2000-2010	Yes	The authors investigate the price effects of hospital mergers outside each other's geographic market. They find a price rise of 17%. Hospitals close to the acquired hospital show a price rise of 8%.

Since 2000, more studies have been conducted looking directly at the effects of individual mergers or a series of mergers (usually a DiD approach). These studies compare the price changes in the merging hospitals and the price changes in the control group of non-merged hospitals. This investigation adopts the same approach.

Connor et al. 1998) study the changes in turnover for 122 merger hospitals in the period 1986-1994. They find that both costs and prices fall by around 5% and conclude that cost reductions are therefore evidently being passed on. The price fall is smaller, however, in less competitive markets.

Krishnan (2001) studies 22 hospital mergers in Ohio and 15 in California. She compares the price development of treatments where the merger hospital has a high HHI[1] with treatments in a low HHI market at the same merger hospital. The high HHI market shows a substantially higher price rise than the low HHI market. The advantage of this approach is that it is not necessary to construct a good control group. This conduct is totally consistent with a Ramsey pricing strategy in which the highest margin is achieved with the least elastic demand.

Vita and Sacher (2001) investigate a merger of two hospitals in California. They find that prices in the merger hospitals rise by around 23% and that prices of nearby competitors rise by around 17% compared to the control group. They therefore find support for the theoretical assumption that nearby competitors also benefit from a merger. They also show that the price rises cannot be explained by a change in costs and that the merger hospitals' market share decreases. A relative quality improvement therefore also appears not to be a factor, since it would then be expected that more people would go to the merged hospitals.

Krishnan and Krishnan (2003) study 20 mergers and conclude that the merger hospitals have 23% higher turnover per patient than non-merged hospitals, a 9% higher contribution margin (margin remaining per product to cover constant costs and possibly to generate profit), and no decrease in expenditure. They conclude that the acquired hospitals therefore raise their prices. Capps and Dranove (2004) study 12

[1] Herfindahl Hirschman Index, which is calculated by summing the squares of the market shares of the providers in a market. A high value indicates a concentrated market.

mergers and they too find that hospital mergers cause substantial price effects compared to the control group.

Dafny (2009) measures the effect of hospital mergers by looking not at the price changes of the merged hospitals themselves, but at the price changes of nearby competing hospitals and finds substantial price effects of around 40%. The idea behind the structure of this study is that when merger hospitals increase their market power and raise prices, nearby competitors also raise their prices. The advantage of this approach is that there is no longer any selection bias and endogeneity (for example, it is always poor-quality hospitals that merge).

Sprang et al. (2009) study a large number of hospital mergers and acquisitions over a period of 10 years. They find that the merger hospitals have lower costs after the merger. However, this benefit is not passed on to the end-users in the form of lower prices. This result is caused particularly by for-profit hospitals. In these for-profit hospitals, the efficiency advantage of the merger turns into a market power disadvantage if the HHI in the market exceeds a level of around 1,600. In other words, the cost benefits are only passed on in a competitive market (HHI < 1,600)

Some years ago, the US Federal Trade Commission carried out various ex-post studies of the price effects of hospital mergers. Tenn (2011) looks at a merger in which one merging party charged relatively low prices before the merger and the other merging party charged relatively high prices. After the merger, prices tended to move to the highest level. Haas-Wilson and Garmon (2011) study two mergers. The results they obtained differed greatly depending on the insurer. In one merger, most insurers faced steep price rises. In the other, there were both price rises and price falls. The overall price rise was 4% in the period 1999-2002. Finally, the study by Thompson (2011) shows a mixed picture. Three insurers had to contend with price rises potentially exceeding 50%. Another saw a 29% fall in prices.

Dauda (2017) studies the effects of the continuing concentration of hospitals and insurers in the US in the period 2005-2008. She finds that a higher concentration of hospitals leads to higher prices, whereas a higher concentration of insurers leads to lower prices. In a market with five hospitals ranking equally in terms of turnover, a five-to-four merger leads to a price rise of between 3% and 11%.

Ex-post studies have also been conducted in the Netherlands over the last few years. Kemp et al. (2012) study the price effects of six hospital mergers in the case of a specific treatment, namely hip replacements. In six of the 12 merger hospitals, they find a significant price rise of between 2.3% and 16.4%. In three hospitals they find a significant price fall of 2.0% to 4.2%. The price effects differ somewhat from year to year. The price changes appear to have no effect on patient flows, so it is not plausible that the merger resulted in quality effects.

Roos and Croes (2015) study a Dutch hospital merger with reference to three treatments, namely cataract operations and hip and knee replacements. They also examine the effect of the merger on the various health insurers. They find that most insurers pay a significantly higher price for hip replacements in a merger hospital. In the other two treatments, the effects are mostly insignificant. In all three treatments, however, an insurer was able to obtain a significantly lower price. Hence, after the merger there is continuing price differentiation in terms of location, treatment and insurer.

Up until early 2000, the studies examined particularly the relationship between the degree of concentration (a result of mergers) and the price level (Dranove et al., 1993; Pautler and Vita, 1994; Robinson, 2011). Most studies show that markets with a high concentration generally also have higher prices. More recent studies look more at price growth. Melnick and Keeler (2007) find a positive correlation between the price rise and concentration. Akosa Antwi et al. (2009) find that prices rise fastest in monopoly markets. A change in concentration is not accompanied by a change in price growth. Finally, Dranove et al. (2008) also find a relationship between concentration and price, but the strength of the relationship diminishes over time. In the Netherlands, too, a positive relationship is found between a higher market share of a hospital and the price-cost margin (Halbersma et al., 2011). These concentration price studies do not, however, provide a direct estimate of the effect of (individual) mergers on prices.

They are also highly dependent on the operationalization of the variables used and the market definition and any checks for differences in marginal costs, which are often very difficult (Vogt & Town, 2006; Varkevisser et al., 2008).

2.2 Investigation into volume effects of hospital mergers

In addition to price, it is also important to examine the development in the number of claims. It is often stated that healthcare is characterized by supply-driven demand. The mere fact that certain treatments are possible means patients will want to undergo them. More competition would further strengthen this relationship. As a result of increasing competitive pressure, hospitals would expand their capacity and then provide more treatments to fill that capacity. New technologies and expensive equipment can be also purchased and then used for treatments that could be performed just as well using easier and cheaper methods (medical arms race). On the other hand, competition may also lead to a rationalization of the available capacity. After all, in a competitive market it is expensive to have excess capacity.

In merger processes, health insurers sometimes argue that a merger makes it easier to reduce capacity in region. A merger is naturally an opportunity for health insurers to talk to hospitals and negotiate on the volume of care to be provided in the region. It is easier to limit volume when there is one party than if two independent care providers are involved.

The ex-post investigations already conducted include relatively little analysis of the effect of mergers on volumes (see Table 3). If it has been investigated, it is mostly in relation to productivity and/or scale effects.

Table 3 Overview of main results in literature on effects of merger on volume

Author	Merger country	Years	Has merger reduced volumes?	Main conclusions
Alexander et al. (1996)	US	1980-1990	No	Mergers can contribute to an acceleration or slowing of general developments. The number of patients decreases more slowly after the merger than in the control group.
Gupta Stategists (2010)	NL	2009	-	Competition intensity has no perceptible volume-raising effect.
Gaynor et al. (2012)	UK	1997-2006	Yes	Mergers led to a decrease of around 10% in the number of activities.
Hayford (2012)	US	1990-2006	No	Mergers have no effect on the market share (and associated volume effects), but do lead to more intensive treatments.
Blank and van Hulst (2013)	NL	1979-2010	-	Hospitals are susceptible to diseconomies of scale. Mergers do not appear sensible from an economic perspective.
Krabbe et al. (2017)	NL	2006-2008	-	The introduction of the competitive B segment has led to slightly lower volumes. The effect differs depending on the specialism and type of care.

Alexander et al. (1996) look at the effect of hospital mergers on scale and staffing. It is often claimed that a merger can bring about efficiency in the form of a consolidation of scale (such as a change in working methods, a decrease in the number of beds, reduced duplication), more efficient use of personnel, and improvements in operational efficiency (such as bed occupancy). They find that the investigated indicators already revealed a trend in the sector and that a merger influences the development of this trend. For example, the number of patients decreases after the merger, but less quickly than in the control group. They therefore state that mergers may have provided an impetus for change.

In a study of the performance of Dutch hospitals, Gupta Stategists (2010) looks at the relationship between competition and volume. They find no evidence for the assertion that more competition leads to higher care volumes. In areas with a higher concentration intensity, the consumption of healthcare is below the national average. It is only in The Hague and Rotterdam that researchers find a relatively high level of care consumption. Gutpa Strategists concludes that the competition intensity has had no perceptible volume-raising effect.

Gaynor et al. (2012) study the mergers in the UK between 1997 and 2006. The wave of mergers in this period was prompted by changing political views, a more free-market outlook, and more prospects for collaboration. Of the 223 hospitals in 1997, 112 merged in the period 1997-2006. They find that the mergers led to a decrease of around 10% per year in the number of activities. The number of employees and the number of beds have also decreased by around 10% per year. Productivity thus remains unchanged. The financial position of many merged hospitals deteriorated in the period of the investigation.

Hayford (2012) studies the effect of a merger on treatment intensity and volume among patients who suffered a heart attack. The merger hospitals retain their market share after the merger, indicating that no volume effects occur. The treatment intensity increases, hospitals carry out relatively more bypass and angioplasty operations after the merger and the patient undergoes more procedures during the hospital stay. The mortality figure and the length of stay increase somewhat after the merger.

Blank and van Hulst (2013) have investigated the efficient scale of hospitals. They demonstrate empirically that in the hospitals in the Netherlands are susceptible to diseconomies of scale. If production increases further (for example as a result of a merger), the costs will rise faster than production. The benefits, such as more efficient use of capital goods, better division of labor or purchasing advantages, do not offset any diseconomies of scale such as extensive bureaucratization, communication problems and reduced social cohesion. A hospital would thus operate more efficiently on a smaller scale. They therefore argue that a merger of hospitals does not appear economically sensible in the Netherlands.

Krabbe et al. (2017) examine the volume effects of gradual transition from a budget system to the managed care system. The results are therefore slightly further from the effects of a merger. The introduction of products in the B segment has led to a slight decrease in volume compared to somewhat similar products in the A segment. The effects differ, however, depending on the type of care (clinical, non-clinical and day care: volume decrease in day treatments) and specialism (in cardiology, a lower share in the case of clinical treatments and an increased share in the case of day treatments; in orthopedics, an increase in the case of clinical and non-clinical patients and a decrease in the case of day treatments).

There has so far been little investigation of the volume effect of hospital mergers. The results do not lead to a clear conclusion. There are indications of relative decreases in volume after mergers, but also of relative increases in volume.

2.3 Investigation into the quality effects of hospital mergers

In 2016, ACM commissioned the research firm Significant to investigate the quality effects of hospital

mergers. This investigation was launched because hospital directors often use the argument that the merger will be good for patients because it will improve the quality of care. This assertion is not borne out, however, by the results of Significant's investigation. Up to five years afterwards, hospital mergers are not found to have contributed demonstrably to an improvement in the quality of care. This result is consistent with the picture presented in the literature (see Table 4). Below we discuss the main studies.

Table 4 Overview of main results in literature on effects of merger on quality

Author	Merger country	Years	Did merger improve quality?	Main conclusions
Vogt and Town (2006)	various	-	Not on the whole	Review article. The authors conclude that there are indications that hospital mergers lead to lower quality.
Mutter et al. (2011)	US	1997-2002	No	The researchers find no connection between hospital mergers and quality.
Romano and Balan (2011)	US	1998-2003	No	The quality improvements claimed in the merger process have not been realized. In fact, there are indications of quality reductions.
Gaynor and Town (2012)	various	-	Not on the whole	Review article. More competition leads to better quality of care, particularly in countries where prices are regulated.
Gaynor et al. (2012)	UK	1997-2006	No	Most quality indicators show no change. Waiting times increase, however.
Hayford (2012)	US	1990-2006	No	The mortality risk increases slightly.
Zuiderent-Jerak et al. (2012)	NL	-	-	Increased concentration can contribute to better quality, particularly in low-volume, highly complex healthcare. In other healthcare, the relationship is often not demonstrated.
Feng et al. (2015)	UK	2011-2012	No	A higher concentration leads to a lower quality score, but this effect is not significant.
Cooper et al. (2016)	UK	2002-2013	-	The entry of a private hospital changes a hospital's patient mix. NHS hospitals receive relatively more burdensome patients with a longer average stay.
Moscelli et al. (2016)	UK	2002-2011	Yes/No	The relationship between concentration and quality shows a mixed picture. Sometimes quality increases with more concentration, but sometimes it decreases. The relationship may have to do with the ratio of costs to regulated prices.
Significant (2016)	NL	2008-2016	No	96 indicators were investigated. There are no indications that mergers led to better quality.
Skellern (2017)	UK	2002-2013	No	A negative relationship is found between concentration and quality (PROMs) in this investigation. This is in contrast to previous investigations.

Most studies of the relationship between hospital mergers and quality have been carried out in the United States. Vogt and Town wrote a review article in 2006. The reviewed studies show a mixed picture: there are negative, zero and positive effects. Taking all studies into account, the authors conclude that there are indications that a hospital concentration leads to lower quality.

Gaynor and Town (2012) conclude that more recent studies confirm the conclusions of Vogt and Town: greater concentration leads to better quality of care. This applies particularly to countries in which prices are regulated by the government. If the regulated price exceeds the marginal costs, greater concentration will lead to better quality. In countries in which prices are determined by the market, the results are mixed. In these countries, participants compete on two parameters: price and quality. If the purchasers respond more strongly to price than to quality, price competition will be at the expense of quality.

Romano and Balan (2011) have conducted an ex-post investigation into the acquisition of the Highland Park hospital by Evanston Northwestern Healthcare. In the assessment procedure at the FTC, the merging hospitals argued that the quality of care would improve as a result of the merger. In their study, Romano and Balan investigate whether this assertion was borne out and they find no evidence for it. Their point estimates tend more to indicate a limited deterioration in quality, but the standard errors are large.

Mutter et al. (2011) study the effects of 42 hospital mergers in 16 states of the United States, looking also at whether a hospital's role in a merger affected the relationship. They conclude that the average effect of a merger on the quality of care is statistically insignificant (no change in 21 indicators, two improvements and two deteriorations). In the case of hospitals that acquire another hospital, quality rises in three of the 25 indicators; in the case of acquired hospitals, four indicators deteriorate and one improves. Finally, in a merger between equals, three indicators deteriorate and one improves.

Hayford (2012) has investigated the effects of 40 hospital mergers in California and concludes that the mortality rate increases in merger hospitals. Mergers also lead to greater treatment intensity, in terms of both the type of treatment (more complex) and the number of treatments during a hospital stay.

Research into the quality effect of hospital mergers has also been conducted in the United Kingdom in recent years. Gaynor et al. (2012) investigated the effects of the hospital mergers in the period 1997-2006. They find that a single quality indicator shows an improvement, but waiting times increase.

Feng et al. (2015) investigate the relationship between concentration and the health gains reported by the patient after a hip replacement (PROMs). They find a positive but insignificant relationship between competition (measured in HHI) and quality. There is no difference between average and more serious patients.

There are also a number of recent working papers. Moscelli et al. (2016) demonstrate that the relationship between competition and quality depends on the chosen indicator and type of treatment. For example, they find a positive relationship between competition and the quality of emergency care in the case of a hip fracture, but a negative relationship in the case of a stroke. In the case of plannable care, they find a negative relationship for hip or knee replacements, but no relationship at all for a bypass operation. This may have to do with the regulated price. If this price is lower than the cost of treatment or if marginal treatment costs are higher in the case of a quality improvement, the quality will fall as a result of greater competition.

Skellern (2017) also uses PROMs as a quality indicator instead of mortality rates or readmissions. He finds a negative relationship between competition and quality in the treatments for knee and hip replacements, hernia and varicose veins. This is in contrast to previous studies using mortality rates. This difference can possibly be explained by the availability and openness of quality data. The mortality rates are readily available to patients; PROM data are not available. It is possible that hospital management concentrates on data that are available to patients, in this case mortality rates, in order to improve these figures.

Cooper et al. (2016) look at the effect of opening a private hospital alongside an NHS hospital on the quality of healthcare and the length of stay for hip and knee replacements. The entry of a private hospital

shortens the admission period for the operation. The new independent treatment centers attract healthier patients, leaving NHS hospitals with relatively more demanding patients, so the average post-operative stay is longer. If fixed prices are charged, as in the UK, the NHS hospital receives sicker patients without being sufficiently compensated.

From a competition perspective, Perry and Cunningham (2013) argue that the empirical literature does not bear out the assertion that hospitals always or at least generally deliver better quality after a merger. The evidence is mixed, with some studies even showing that hospital mergers lead to a fall in quality. They conclude that the quality claims hospitals make in competition procedures must therefore be substantiated with case-specific facts and evidence.

From a different perspective, Bloom et al. (2015) find that more competition leads to better management of hospitals. Competition also leads to lower mortality rates, better productivity and employee satisfaction.

Finally, apart from the investigation by Significant (2016), no investigation has been conducted into the relationship between hospital mergers and quality of care in the Netherlands. Zuiderent-Jerak et al. (2012) have nevertheless investigated the relationship between volume standards and quality of care. They state that this relationship between volume and quality of care is sometimes positive, but that in many cases the relationship has not been demonstrated or has not been investigated at all. The relationship differs depending on the treatment, with a positive relationship occurring more frequently in highly complex healthcare. They also argue that in the volume-quality discussion and the further concentration that results from it, the examination is conducted particularly from the perspective of the professionals and care providers. There is often insufficient focus on the perspective of the patient (greater travel distances, receipt of care at multiple locations with less choice). The researchers also conclude that the results of volume initiatives fail to deliver on the promise that concentration of care will make an important contribution to the public interests of quality, accessibility and financeability.

In summary, this literature review shows that there is no strong empirical evidence for the claim that a merger will contribute to the quality of care. It is important to state, however, that the identified relationship is affected by the choices and the potential to operationalize quality.

2.4 Literature on the Difference-in-Differences method

In this section, we deal with the developments in methods used to conduct evaluation research, particularly the Difference-in-Differences method. This approach is frequently used in program evaluations where the effect of a particular intervention or policy intervention is investigated. This could include the introduction of a subsidy, a new law or different teaching methods. This approach is also appropriate for our investigation. This method is used in several studies of the effects of mergers, including studies of the effects of hospital mergers (Kwoka, 2015). However, the method itself is still being developed, with particular attention being devoted to the consequences of a low number of observations and/or a limited number of groups in the intervention group. In this section, we will briefly discuss the recent developments in this literature.

The idea behind the Difference-in-Differences method is that price and volume changes in the control group are a good indicator of what the price and volume developments would have been in the intervention group if the intervention had not occurred. This is made clear in Figure 3. A particular development takes place in the control group, shown here with a rising blue line. This may have to do with developments that are imperceptible to the researcher, such as technological developments, common cost developments such as changes in collectively agreed pay, changes in the product structure, the transition from the DBC (Diagnosis Treatment Combination) system to the more transparent DOT system, and other unobserved effects. We assume that the merged hospitals and the intervention group will develop in the same way as the control group if the merger hospitals in the intervention group are not merged. This is shown by the dotted red line. In fact, the intervention group shows a different development: the red line. The difference between the actual result (red line) and the forecast result (dotted red line) is the effect that can be attributed to the intervention, in this case the merger.

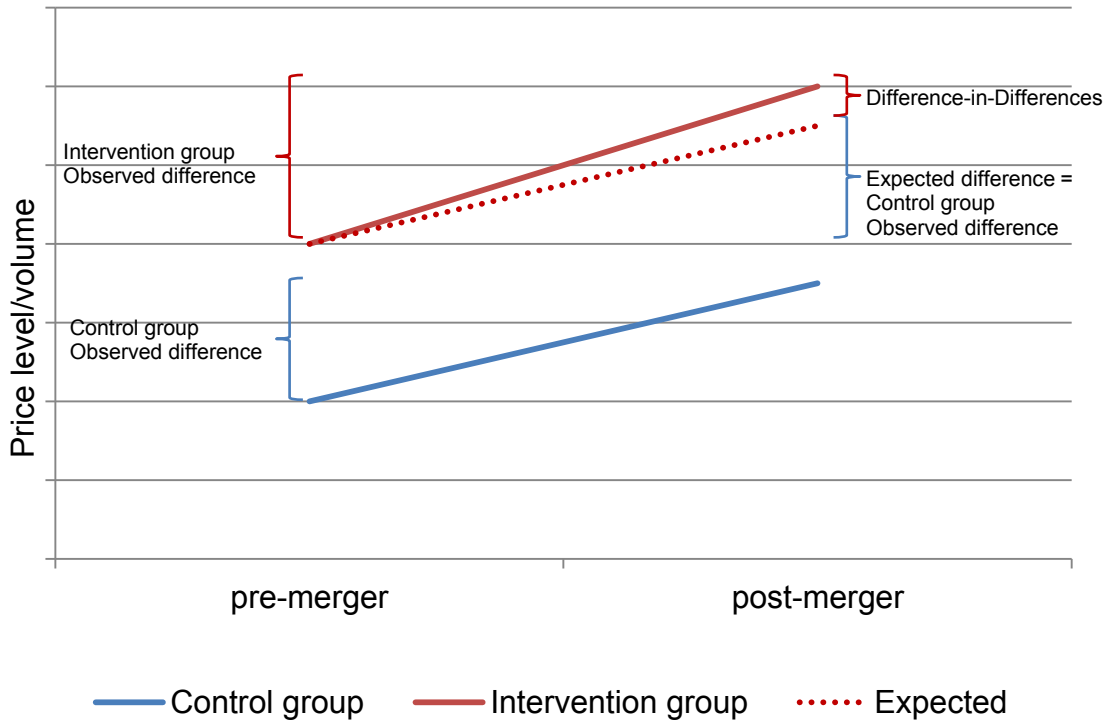

Figure 3 Schematic representation of the Difference-in-Differences method

Parallel trend assumption

An important assumption in the Difference-in-Differences method is that the unobserved effects have the same influence on the control and intervention groups. In other words, the development of the variable to be investigated is influenced to the same extent in the control and intervention groups by a common trend (the parallel trend assumption). If this is the case, the estimates are unbiased. In addition, the control group must not be influenced by the intervention, i.e. the merger[2].

The parallel trend assumption must apply to the entire investigation period. However, only the pre-intervention period can be used for the comparison, because in the post-intervention period the development of the variable to be investigated is also affected by the intervention. The intervention may have a different effect on the intervention group than on the control group. This is investigated in particular. The parallel trend assumption is therefore investigated in the pre-intervention period. There are various ways to assess the parallel trend assumption. First of all, a visual inspection can cast light on this assumption (Hastings, 2004). The price and volume development of the control and intervention groups must show a similar development in the pre-intervention period. After the intervention, the developments may diverge, possibility indicating an effect of the intervention. The prices and volumes may be on a different level (as also stated in Figure 3).

[2] This condition was not entirely fulfilled in this investigation. Various control hospitals are located in the vicinity of the merger hospitals. If we exclude these control hospitals from the analysis, the number of control hospitals decreases sharply, with the result that is no longer possible to make reliable estimates. Dafny (2009), among others, has demonstrated that nearby hospitals also raise their prices in response to the merger. If this effect also occurs in our investigation, we will find relatively weaker price rises.

In addition to the visual inspection, the parallel trend assumption can also be assessed. Different approaches are applied for this purpose. Ashenfelter et al. (2013) use a model with a dummy for each time period with a value of 1 for the intervention observations. The coefficients of these dummies are then used in the period before the intervention (the pre-merger period) as explained variables in a regression with time as the explanatory variable. If this coefficient (the slope) does not differ from zero, it is assumed that the pre-merger trend is the same for the control and intervention groups. Author (2003) adopts a similar approach (leads and lags), assessing whether, taken together, the coefficients of the dummies in the periods before the intervention differ significantly from zero. Here too, if the coefficients, taken together, do not differ from zero, it is assumed that the control and intervention groups are following a joint trend.

If the parallel trend assumption is not fulfilled, any specific trends in each group can be estimated and are included in the regression (Wolfers, 2006). Estimating a group-specific trend can be difficult, however, if the different trends are not very clear, particularly if there are few observations or a limited number of data points for the intervention. In this case, the inclusion of a group-specific trend can lead to the introduction of an additional error (O'Neill et al., 2016).

Underestimation of standard errors

A second point that must be taken into account is the possible underestimation of the standard errors. Bertrand et al. (2004) have demonstrated that due to the existence of autocorrelation (residues that are correlated over time) the standard errors are too small and will tend more to show significant results. This has to do with two types of correlation: *Moulton correlation* and *autocorrelation.*

The Moulton correlation arises because certain observations have the same values or are influenced by a common factor. This causes a clustering of the residues. In our investigation, the prices of the various insurers for a particular hospital will be interrelated, because the hospital is a common factor in the negotiations with the various insurers. The two merged hospitals will also be managed jointly after the merger and may charge the same prices. In addition, the price in one year will often be closely related to the price in the following year. This gives rise to possible autocorrelation. A final factor is that the variable reflecting the intervention shows little variation over time. Before the intervention, this variable has a value of zero, whereas afterwards it has a value of 1. This reinforces the problem of the autocorrelation.[3]

Bertrand et al. propose different solutions. First of all, the standard errors can be calculated by means of a block bootstrap. In this approach, the group, in our study the hospital, is fully included as a group in the random sampling (with replacement). Secondly, the values in the pre- and post-intervention periods can be aggregated to produce pre- and post-values. This solves the problem of the serial correlation. If the interventions take place at different times, however, this solution is more difficult to implement. Finally, the standard errors can be corrected by means of clustering (cluster-robust standard errors in Stata, for example). Here too, the cluster is the hospital. This correction assumes a large number of clusters and a similar number of observations per cluster. In reality, the number of clusters is often limited, so the cluster-robust standard error correction is less efficient. This correction can also lead to an overestimation of the standard errors (MacKinnon and Webb, 2016). Cameron et al. (2008) suggest using a 'wild bootstrap' method in this situation. However, this approach is again sensitive to the relationship between the number of control and intervention groups.

If the number of control groups differs greatly from the number of intervention groups, this results in an underestimation of the significance level (Brewer et al., 2013; MacKinnon and Webb, 2014).

Donald and Lang (2007) argue that the cluster-robust approach works reasonably well with a cluster size

[3] This problem is less significant in our investigation, because we have a number of interventions starting at different times over a period (the merger year).

of 40-50 clusters. Conley and Taber (2011) add that the number of intervention clusters must be 10 or more. They propose a different approach for studies with fewer than 10 intervention clusters. They use the residues from the control group to obtain a distribution with which they can compare the Difference-in-Differences estimate of the intervention. In this way, it is possible to determine a reliability interval around the coefficient of the intervention. This approach is conditional, however, on the number of groups in the control group being reasonably large (> 40 groups).

A disadvantage of the above corrections is that the statistical strength of the test usually decreases, with a diminution in distinctive capability. This means the statistical test fails to reveal an effect that is present in the population. The likelihood of a type 2 error increases.

Antecedent probability of statistically significant results

In our analyses, we assess the effects of hospital mergers on price and volume in 62 patient groups. Carrying out tests in all these groups proportionately increases the antecedent probability of finding statistically significant connections. With a significance level of 5% it is already possible to expect five 'significant' connections in 100 tests based on coincidence, without this necessarily being an actual result. This effect is known as the multiple comparisons problem. This can be corrected by defining a sharper significance level, thereby reducing the number of flukes. In our study, we present not only the normal significance levels, but also the significant levels after a Sidák correction for the multiple comparisons problem.

Finally, it is important to note that we conduct the analysis among the entire population of hospital mergers in the Netherlands and that the results are therefore not based on a sample. Discussions on reliability intervals and significance are therefore less relevant. When assessing the results, it is therefore necessary to look not only at the significant effects, but also at the direction of the effects.

The use of the entire population precludes the 'sample selection' problem as described by Carlton (2009). If the examination is limited to only a few mergers, the focus will be particularly on the 'interesting' ones, i.e. those that were touch and go. These are the very mergers in which price rises are more likely. Such a selection can therefore not be used as a basis on which to make statements on any systematic error in the merger assessments. Such a systematic error can only be investigated by studying all hospital mergers.

Conclusion on literature on the Difference-in-Differences method

In conclusion, the Difference-in-Differences method is often used in all kinds of program evaluations as well as in studies of the effects of mergers, including between hospitals. This method is still being developed, with particular attention being devoted on the effect of the context of the investigation (number of intervention groups, total number of groups) on the sensitivity of the standard errors. Given the context of our investigation, we will study all hospital mergers collectively on the basis of cluster-robust standard errors. When assessing individual mergers, we use the approach adopted by Conley and Taber (2011). It is also important to look closely at the parallel trend assumption.

In the next section, we will deal in greater detail with the structure of the investigation and present descriptive statistics.

3. Structure of investigation and descriptive statistics

3.1 Structure of investigation

We investigate the impact of a merger on price and volume by means of the Difference-in-Differences (DiD) method. We compare the pre-merger period with the post-merger period and assume that the merged hospitals would have developed in the same way as the non-merged hospitals had the merger not taken place. The difference between the expected and actual development is the DiD, and is therefore related to the occurrence of the merger. In methodological terms, however, we cannot demonstrate a causal link between price and volume developments.

In order to assess the merger effects as well as possible, it is preferable if the merged and non-merged hospitals share the same characteristics as far as possible (apart from the occurrence of the merger). For this reason, only Dutch hospitals are included in the analysis, and ZBCs (independent treatment centers), mono-disciplinary hospitals and academic centers do not form part of the analysis.

Since healthcare prices are set at the health insurer and hospital level, we also show the price and volume effects of the merger on this level.

The merger may lead to a change in the material focus of a hospital, with certain treatments being continued or discontinued. The hospital may also start treating more complex patients. These material developments may affect the development of the volume and average price of specific treatments in the hospital. We cannot dissociate the assessment of these price and volume effects in a patient group from other price and volume effects of the merger, but since we want to correct these effects as well as possible, we assess the price and volume effects at the level of 62 individual medically defined patient groups.

Using the available data, we can show the price and volume effects of a selection of mergers for the period 2007-2014.

In the sections below, we provide a more detailed explanation of the:

- data
- model variants
- control variables
- patient groups in the analysis
- mergers in the analysis
- parallel trend assumption
- standard errors
- effects of individual mergers
- correction for multiple comparisons problem

Data

The database was designed on the basis of more than 150 million claims for healthcare products made in the period 2007-2014[4]. The data are from Vektis. For each insured person we know what price an insurer paid for the healthcare product concerned. The average price and the volume were calculated per patient group, hospital and insurer group.

Before carrying out the analyses, the data were checked and a number of corrections were made. First,

[4] In 2014, the total claims amounted to 85% of the permitted amount.

duplicate observations were eliminated. Observations with missing values for crucial variables were then eliminated (postcode, price, specialism code, etc.). Patients living abroad and the so-called 'other healthcare products' were also eliminated.

After the Vektis claim data, we used the area address density in five categories at municipality level supplied by Statistics Netherlands. On the basis of these data, we determine an indicator for the population density of the hospitals' operating areas.

Patient groups

We base the classification into patient groups on a medically defined clustering of diagnoses from the ICD-9, initially developed by the Dutch National Institute for Public Health and the Environment (RIVM) and converted by the NZa. RIVM developed this method in the context of 'Costs of diseases' and the NZa uses this classification to monitor price developments within diagnosis groups. The NZa has amended the classification to bring it more into line with the product structure and to increase the reliability of the patient groups over the years. The classification into patient groups is carried out at claim level (a specialism and a diagnosis are linked to each claim).

We base the final analyses on 62[5] patient groups that can be clustered on a medical basis into 16 main groups. An insured person may fall into several patient groups over the year. In addition, around 8% of turnover cannot be allocated to a specific diagnosis. Figure 4 shows the 10 patient groups with the highest turnover (in 2014).

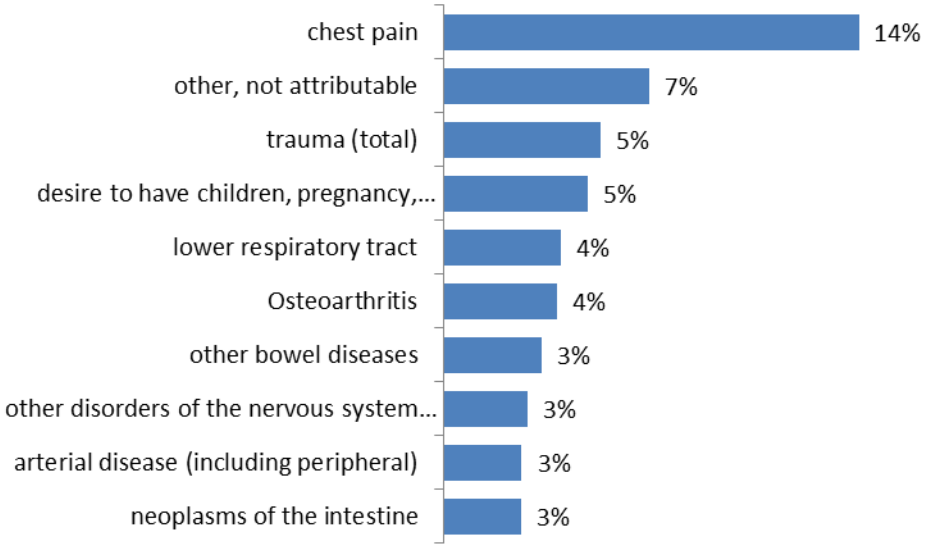

Figure 4 Patient group turnover as a proportion of total turnover in 2014 [percentage]

[5] The original classification consists of 65 patient groups. A number of groups turned out to be too small to include in the analyses.

Mergers in the analysis

We include the mergers of general hospitals that took place in the period 2007-2013. The academic hospitals, monodisciplinary hospitals and independent treatment centers do not form part of the control and intervention groups. Table 5 includes the mergers that are part of this investigation. In annex 1, we provide a full overview of the merger decisions made during this period. Most mergers were approved unconditionally; remedies were imposed in one merger and voluntary price commitments were given in three mergers. One merger was prohibited and therefore no longer counts as a merger.

Table 5 Mergers section of investigation

Names of merged hospitals
MCA - Gemini
St. Lucas Hospital - Delfzicht Hospital
Walcheren Hospital - Oosterschelde Hospitals
Bethesda Hospital - Scheper Hospital
Noorderbreedte Care Group - De Tjongerschans Hospital
Vlietland Hospital - St. Franciscus Hospital
St. Lucas Andreas Hospital - Onze Lieve Vrouwe Hospital
Orbis - Atrium Hospital Parkstad
TweeSteden Hospital - St. Elisabeth Hospital
Spaarne Hospital - Kennemer Hospital
Haga Hospital - Reinier de Graaf Group
Lievensberg - Franciscus

We have not included the merger of Leveste Middenveld Care Group and the Refaja Hospital owing to the previous merger of one of these hospitals. The post-merger period of the first merger overlaps with the pre-merger period of the second merger. This can lead to distortions. We have not included the intended merger of Nij Smellinghe Hospital and Pasana Care Group owing to a bankruptcy. The other general hospitals fall within the control group. Ideally, these hospitals will not be affected by the merger. This cannot be ruled out in our investigation, however, since in the case of every hospital in the control group a nearby hospital merged during the investigation period. If we were to remove these nearby hospitals from the control group, we would be left with too few hospitals in the control group to conduct reliable analyses. Dafny (2009) and Lewis and Pflum (2017) have demonstrated that a merger between two hospitals can also lead to a price rise in other nearby hospitals. In our investigation, this would mean that a price-raising effect would already occur in the control group and that we would therefore measure only the additional rise in prices of the merged hospitals and not the total effect. Finally, we note that in the case of the mergers that took place in 2007 and 2008, it is not possible to test the parallel trend assumption (due to a lack of data in the pre-merger period). However, we see no reason for any difference in the development of prices at these hospitals before the merger as compared to mergers in subsequent years.

Figure 5 shows the locations of the individual mergers included in the analysis (except the locations of external polyclinics). The orange dots are locations of merged hospitals. The blue dots are non-merged

general hospitals. There are relatively more mergers in the west of the country, although mergers are spread across urban and less urban areas.

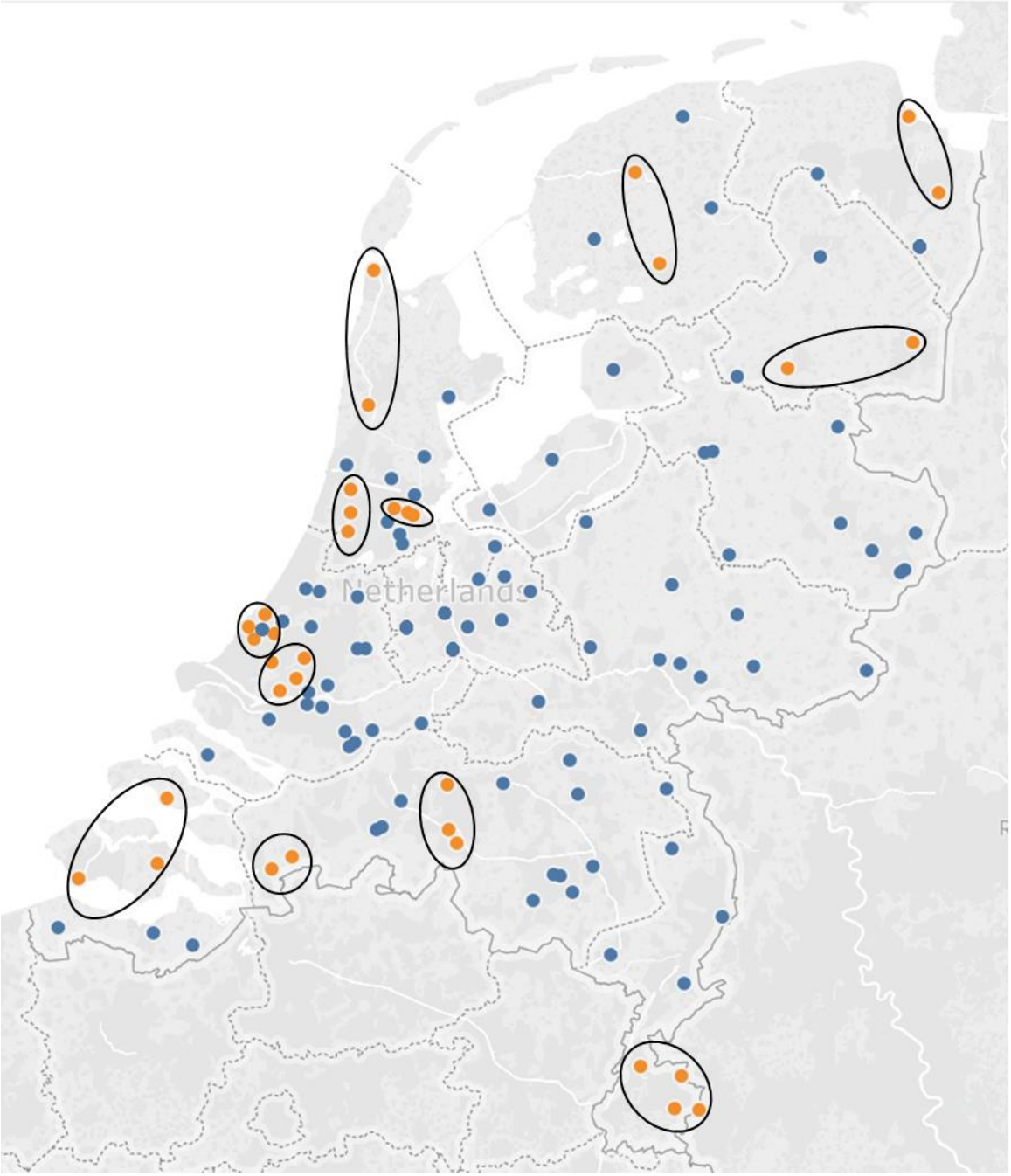

Figure 5 Locations (based on RIVM) of mergers of general hospitals in analysis

Annual effects of individual mergers

The various mergers take place in different years. This makes it difficult to calculate the DiD estimate, but also to attribute the effects to the years. Table 6 presents the annual effects that we show by means of the estimates. When assessing the annual effects, it is important to note the mergers selected in the

analysis. For all mergers, we can show the effects for at least one year after the merger. In the case of 10 mergers, we can assess the effects for two or more years. In the case of four mergers, this is possible for five or more years.

Table 6 Years before and after merger

Name of merged hospital	2007	2008	2009	2010	2011	2012	2013	2014
MCA - Gemini	pre-1	post-1	post-2	post-3	post-4	post-5	post-6	post-7
St. Lucas Hospital - Delfzicht Hospital	pre-2	pre-1	post-1	post-2	post-3	post-4	post-5	post-6
Walcheren Hospital - Oosterschelde Hospitals	pre-3	pre-2	pre-1	post-1	post-2	post-3	post-4	post-5
Bethesda Hospital - Scheper Hospital	pre-3	pre-2	pre-1	post-1	post-2	post-3	post-4	post-5
Noorderbreedte Care Group - De Tjongerschans Hospital			pre-3	pre-2	pre-1	post-1	post-2	post-3
Vlietland Hospital - St. Franciscus Hospital				pre-3	pre-2	pre-1	post-1	post-2
St. Lucas Andreas Hospital - Onze Lieve Vrouwe Hospital				pre-3	pre-2	pre-1	post-1	post-2
Orbis - Atrium Hospital Parkstad				pre-3	pre-2	pre-1	post-1	post-2
TweeSteden Hospital - St. Elisabeth Hospital				pre-3	pre-2	pre-1	post-1	post-2
Spaarne Hospital - Kennemer Hospital				pre-3	pre-2	pre-1	post-1	post-2
Haga Hospital - Reinier de Graaf Group					pre-3	pre-2	pre-1	post-1
Lievensberg - Franciscus					pre-3	pre-2	pre-1	Post-1

Model variants

We show the price and volume effects in various ways. For this purpose, we use the model variants shown in Figure 6. For both the average price and the volume, we investigate the average effect of mergers over the years, the year-specific effects of the mergers, and the average effects of individual mergers. We are mainly interested in the merger coefficient(s).

In addition to the merger, characteristics of the local market can also affect the price and volume development. In all individual models, we apply a correction for the impact of these market-specific characteristics, such as the position of the insurer in the local market, the degree of urbanization, etc.

We show the merger effects for all individual patient groups.

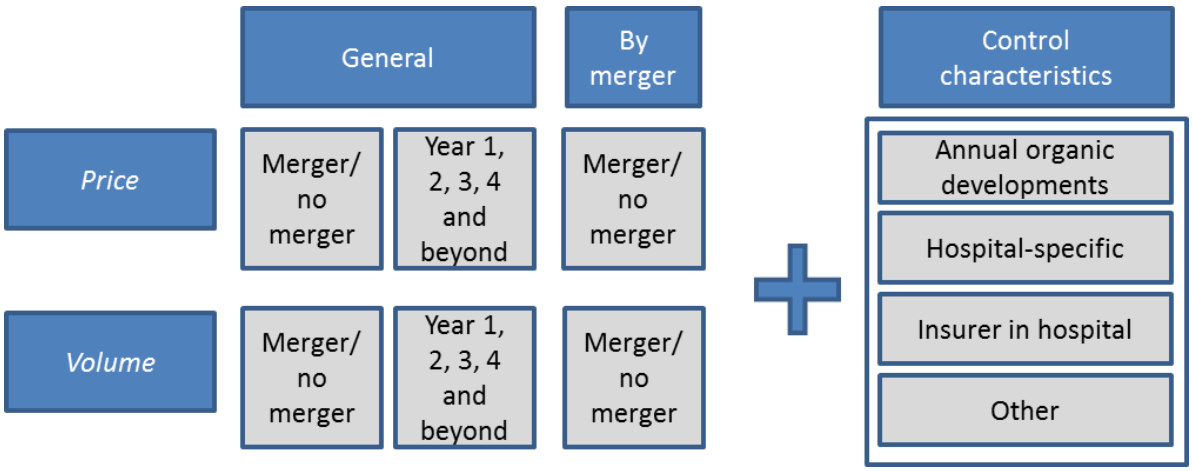

Figure 6 Model variants regression analysis

Control variables

We add a number of control variables to the regressions. These relate to the hospital level, the insurer level and the market context. The control variables have been produced specifically at the level of the patient group, except for the size of a hospital. All control variables are based on information that is available from the claims data. The degree of urbanization was also determined using data from Statistics Netherlands (*omgevingsadressendichtheid* - address density of the surrounding area). A brief explanation of each of the control variables is given below:

- *Size of hospital:* The size of the hospital refers to the volume of the hospital. This characteristic applies a correction for the format of the hospital and any associated economies of scale. The size was measured as the number of treatments carried out by a hospital as a proportion of all treatments in the Netherlands.
- *Hospital's concentration index based on the Herfindahl-Hirschman index (HHI)*: The hospital's HHI is based on its turnover in the patient group. This variable applies a correction for the hospital's degree of concentration within the patient group in that hospital's geographic market. We have calculated the HHI on the basis of a hospital's turnover in a postcode area in a geographic market from which 90% of the hospital's inflow originates.
- *Insurer's market share in the hospital's turnover:* The insurer's market share is its turnover as a proportion of the total turnover for the patient group in the hospital. This characteristic applies a correction for the insurer's influence and possible negotiating power within the hospital.
- *Degree of concentration of insurers in hospital (HHI, measured in turnover)*: The insurer HHI is the sum of the squares of the insurers' market shares (in terms of turnover) in the hospital per patient group. The insurer HHI applies a correction for the degree of concentration of insurers in the hospital.
- *Urbanization:* This variable is an average of the address density category in the hospital's catchment area. This variable is based on the categorization of the area's address density provided by Statistics Netherlands (CBS). This variable has been operationalized on the basis of the hospital's relevant market (origin of 90% of the hospital's total turnover). A low value indicates a very urban area; a high-value indicates a non-urban area.
- *Number of ZBCs in the province within the patient group:* This characteristic applies a correction for the supply of other healthcare within the patient group and reflects any shifts in the degree of specialization of healthcare providers. The number of ZBCs is based on ZBCs that claim from insurers at the level of the patient group in the province in which the hospital is located.
- *Annual organic developments in price and volume:* In all individual models, we apply a correction

for annual organic developments. By organic we mean price and volume developments that are unconnected with the merger and the other control variables (in models with a dependent variable of price, we apply a correction for the annual effects of price, while in models with a dependent variable of volume, we apply a correction for the annual effects of volume).

Conditions of Difference-in-Differences estimate

An important precondition for a DiD estimate is an identical development in prices and volumes of the control and intervention groups prior to the merger. In this investigation, we have carried out both a visual and a formal assessment of the trend. The visual inspection is difficult, because hospital mergers take place at different times. We have therefore also estimated a regression in which we assess whether there are any significant differences in the volume and price at patient group level 1, 2 or 3 years before the merger. In this estimate, we also include year-specific dummies, to check for 'organic' price and volume developments and to check for market-specific factors, which must be viewed as unrelated to the merger (see Angrist & Pischke, 2008; Autor, 2003). The findings have been included in the results section.

Since we carry out analyses at group rather than individual level (hospital - insurer) and examine the effects over time, we are very likely to observe distorted effects (Bertrand et al., 2004; Cameron & Miller, 2010). In this investigation, we apply a correction for these forms of correlation by clustering the standard errors at the level of the 'group' (the merged hospitals collectively). This clustering is sufficient in our context, because we have between 69 and 72 clusters, depending on the patient group, including 12 mergers. Since not all hospitals offer all forms of healthcare, the analysis does not always include all hospitals. According to Angrist and Pischke (2008), 42 clusters are sufficient for a reliable correction. The number of intervention clusters (12 mergers) is also large enough to obtain good standard errors (Conley and Taber, 2011).

Additional steps are required in order to carry out a proper assessment of the statistical relevance of the individual merger effects for consistency. We have corrected the reliability intervals in accordance with the Conley & Taber method.

Finally, in addition to calculating the significance level of all individual regressions, we have applied a correction for the significance levels. This is because the large number of coefficients to be estimated means there is also a chance that we will record flukes and thus erroneously identify an effect. In this investigation, we apply a correction for the multiple comparisons problem by adjusting the significance level in accordance with the Sidák method[6].

3.2 Descriptive statistics

In this section, we show the main volume and price developments over time. We show the price developments of the individual patient groups. We also indicate the years for which we can show the price and volume effects of the individual mergers. Finally, we describe the key development of the control characteristics over time.

Developments in price and volume over time

In Figure 7, we show the price and volume development over the 2007-2014 period for the hospitals that form part of the analysis. The number of claims in 2007 amounted to €12.9 million, with an average price of €940. We see that the average price of a healthcare product falls relatively more sharply in 2012 than

[6] $\alpha_{sidak} = 1 - (1 - \alpha)^{\frac{1}{k}}$ where K is the number of coefficients to be assessed and α has the usual value of 5%.

in the preceding years and that the volume rises faster. This change may have to do with the uncertainty associated with a change in the product structure (transition from DBC to DOT).

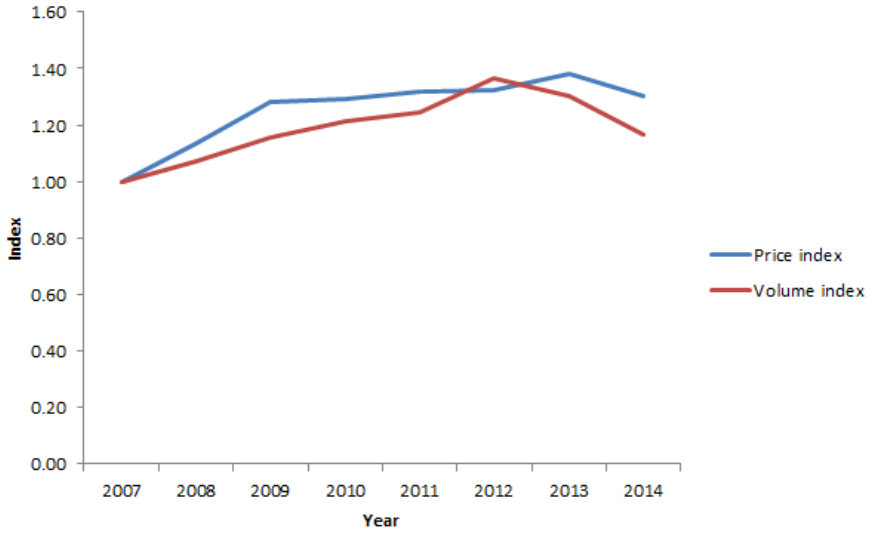

Figure 7 Price and volume development 2007-2014 (index 2007=100)

The development of prices of merged and non-merged hospitals is shown in Figure 8. The average price of merged hospitals is lower than the average price of the non-merged hospitals. Up to 2012, the price development appears to follow a similar trend. In 2013, the control group price rises somewhat faster, after which the development is again similar in 2014.

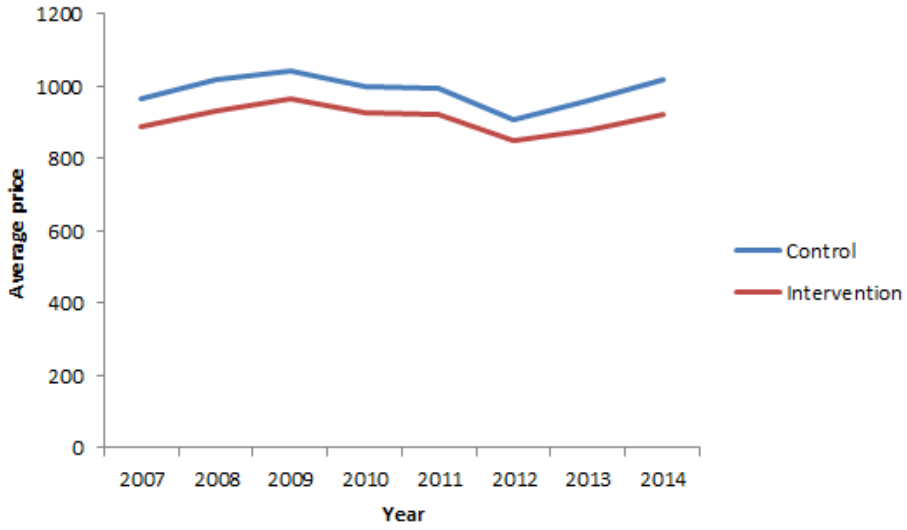

Figure 8 Development of average price of intervention and control groups 2007-2014 [euro]

The development of the volume of merged and non-merged hospitals is shown in Figure 9. The number of claims in the case of merged hospitals is higher on average than in the case of non-merged hospitals.

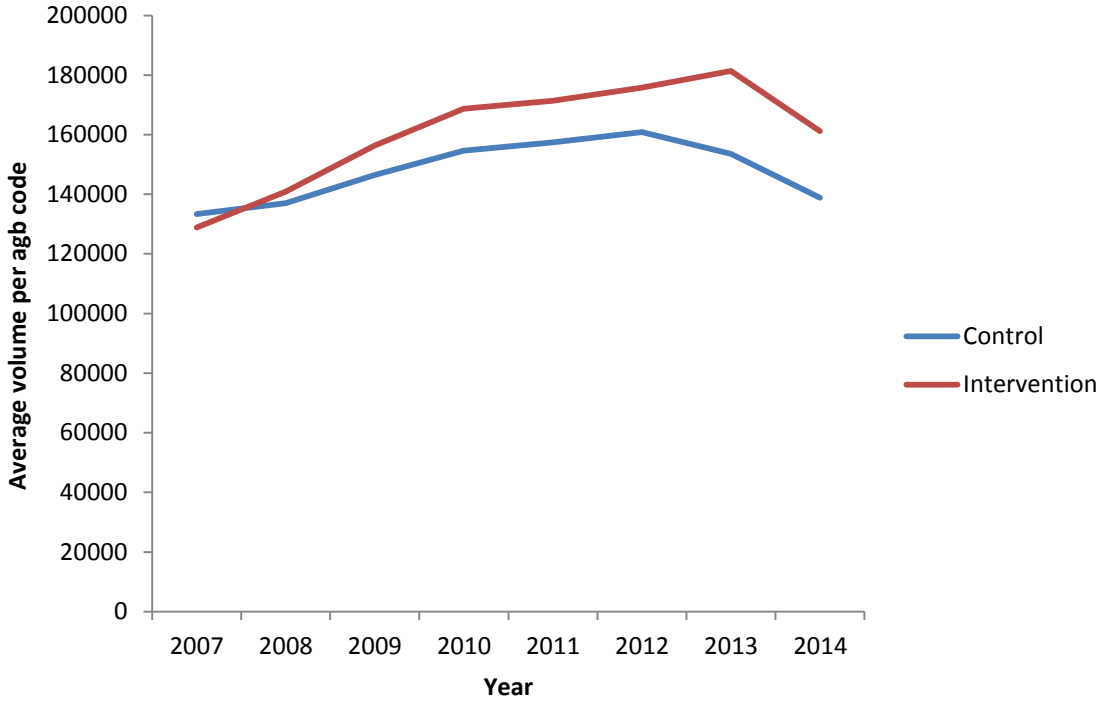

Figure 9 Development of average volume per healthcare provider in intervention and control groups 2007-2014 [number of claims]

Patient groups in analysis

The turnover of the ten largest patient groups in 2014 was shown above in Figure 4. These 10 patient groups collectively determine almost 50% of the hospital care turnover. The 62 patient groups included in the analysis account for over 99% of hospitals' turnover. The number of claims per patient group varies over time.

Development of control variables

Table 7 shows the development of the control variables. The analysis includes factors associated with the position of both the hospital and the health insurer. We also wish to check the extent of urbanization and the presence of ZBCs. The average size of the hospitals is around 1% and is reasonably stable over time. The average HHI of the hospitals is between 2,963 in 2008 and 2,380 in 2014. The average concentration appears to decrease slightly. This may have to do with a larger share of ZBCs or a more even distribution among hospitals. The market share of insurers in a hospital is stable over the years. We do see, however, that the HHI of insurers in a hospital decreases over the years. The dominance of one or more insurers in a hospital decreases over time. This may be because the regional distribution of insured persons has widened since the Dutch Health Insurance Act was introduced, leading to declining dominance of a single insurer in a regional area. We have not investigated this in greater detail, however. Urbanization is increasing somewhat. That means the relative share of the volume in hospitals in urban areas increases slightly in 2013.

The number of independent treatment centers (ZBCs) fluctuates over time. One reason for this is that part of the ZBCs are not active/have not claimed in every year. Another possible cause is that not all claims on insurers from ZBCs were entered in the analysis database. This must be borne in mind when

interpreting the results.

Table 7 Development of control variables (at national level)

	2007	2008	2009	2010	2011	2012	2013	2014
Hospital								
Size	0.0099	0.0099	0.0099	0.0101	0.0100	0.0094	0.0096	0.0096
HHI	2,947	2,963	2,853	2,838	2,781	2,683	2,394	2,380
Insurer								
Insurer's market share in hospital*								
-Achmea	35%	31%	30%	30%	30%	33%	33%	32%
-CZ	16%	21%	20%	20%	21%	20%	20%	20%
-Menzis	14%	13%	13%	13%	13%	13%	13%	13%
-Multizorg	7%	9%	9%	9%	9%	7%	7%	7%
-VGZ	25%	23%	25%	25%	25%	25%	24%	26%
-DSW**	3%	2%	3%	3%	3%	3%	3%	3%
HHI of insurer turnover in a hospital*	4,422	4,147	3,997	3,951	3,904	3,877	3,835	3,721
Other								
Urbanization (median)***	2.6	2.6	2.6	2.6	2.6	2.6	2.7	2.7
Number of ZBCs****	171	209	237	260	298	291	247	248

***Weighted by turnover of hospital in year in question**
****DSW was included from the beginning as being demerged from Multizorg**
*****Urbanization based on Statistics Netherlands address density categories 1 to 5**
******Number of ZBCs is difficult to ascertain: according to the Dutch Hospital Association (NVZ), over 300 ZBCs have obtained approval under the Care Institutions (Accreditation) Act. We have excluded small ZBCs from the analysis (fewer than one claim per month and/or less than €1,000 turnover per month).**

In the regression models at patient group level, the various control variables were produced at the level of the patient group.

4. Results

The results of the analyses of the price and volume effects of hospital mergers are shown below. Since we carry out the analyses at patient group level, for the sake of clarity we only show the direction of the coefficients and/or whether the coefficient is significant. Annexes 2 and 3 show the coefficients of the individual models. Here we show the coefficients with the effect of all years after the merger combined, as well the year-specific effects.

The results of the regressions give a strong indication that the price rises in relative terms after the merger and that the volume development hardly differs at all from that of non-merged hospitals. We draw these conclusions on the basis of Difference-in-Differences regressions of 62 medically defined patient groups with dependent variables of price and volume.

In addition to the general effect of the merger on price and volume, it is important to analyze year-specific effects in depth. A merger may result only in a temporary price shock, followed soon after by reconvergence with developments at non-merged hospitals (Mariuzzo et al., 2016). The results of the analyses provide some indication that the initial price effect of the merger diminishes somewhat, but that the majority of the price rises remain in place.

We can also learn from individual mergers. At the level of the specific merger, we see few statistically significant effects. Some mergers show mainly price rises and some show mainly price falls. The mergers with a price rise cannot be explained by indicators such as first-phase versus second-phase matters, for example, or the year of approval.

4.1 Price development after merger

General

Mergers help bring about a more concentrated market and a change in the negotiating positions between the hospital and the insurer. If the relative negotiating position of a hospital strengthens, this can lead to higher prices. A merger also leads to higher prices in the theoretical oligopoly models (Cournot, differentiated Bertrand).

The results of the regressions give a strong indication that the average price of merged hospitals has risen more strongly than the price of non-merged hospitals. We see price rises in 52 of the 62 patient groups. It should be noted here that the effects of mergers on price are usually not statistically significant (see Table 8). After correction for the multiple comparisons problem, there are no longer any patient groups showing a statistically significant effect. The patient groups with a significant positive effect on price before the correction for the multiple comparisons problem are: lung and intrathoracic neoplasms, Diabetes mellitus, diseases of the blood and blood-forming organs, dementia, other disorders of the nervous system and senses, perinatal and congenital. There are no significant price falls.

Table 8 Direction of coefficients and significance level of price effect

	Negative coefficient	Positive coefficient	Grand total
Before correction for multiple comparisons problem			
Not significant	10	46	56
Significant (5%)	0	6	6

Grand total	10	52	62

Year-specific

In the first three years after the merger, we mainly see price rises at merged hospitals compared to non-merged hospitals.

Figure 10 shows the year-specific merger effects for the patient groups, broken down into significant/insignificant price falls and significant/insignificant price rises. The number of mergers for which we can show the year-specific effect decreases over time, because we only have information available up to the end of 2014. One year after the merger, the price of merged hospitals rose more sharply than the price of non-merged hospitals in 50 of the 62 patient groups. In 11 of these patient groups, the effect was statistically significant. In 39 patient groups, the estimated price rise is not significantly higher than zero. The number of positive price effects increases somewhat in the second year after the merger (52 of the 62), but the number of significant effects decreases (9). In the third year after the merger, the number of positive price effects decreases slightly to 44 of the 62 patient groups. The number of significant effects decreases to four. On the one hand, this may be because the number of hospitals with information decreases from three or more years after the merger. On the other hand, the price effect may be a short-term shock effect.

The price effects for the patient groups show no consistent pattern over the years: a patient group with a positive price effect three years after the merger does not necessarily also show a positive price effect one year after the merger (see Figure 10).

Figure 10 Price effects - Direction of year-specific coefficients and significance level [number of patient groups]

In conclusion, we see mainly price rises in hospital mergers compared to the control group of hospitals that have not merged[7]. The effect appears to diminish somewhat over time, possibly due to the effect of time itself or because of a decrease in the number of mergers included in the estimate of the annual effects. Despite this shift, the relative price rises remain dominant.

[7] The hospital sector is characterized by contracts that include capping and budget agreements. If the agreed caps or budgets are exceeded (as a result of excessively high prices and/or higher volume), new negotiations must take place or repayments must be made. These adjustments concern overall figures and are not made to the claims. We cannot therefore take any such adjustments into account.

By merger

Figure 11 shows the merger-specific price effects for the different patient groups. In six hospital mergers we mainly see a positive effect on the price and in six hospitals we see a price fall. The mergers with mainly price rises cannot be explained by indicators such as whether the merger was approved in the first or second phase or the year of the approval. For confidentiality reasons, we have labelled the mergers A to L.

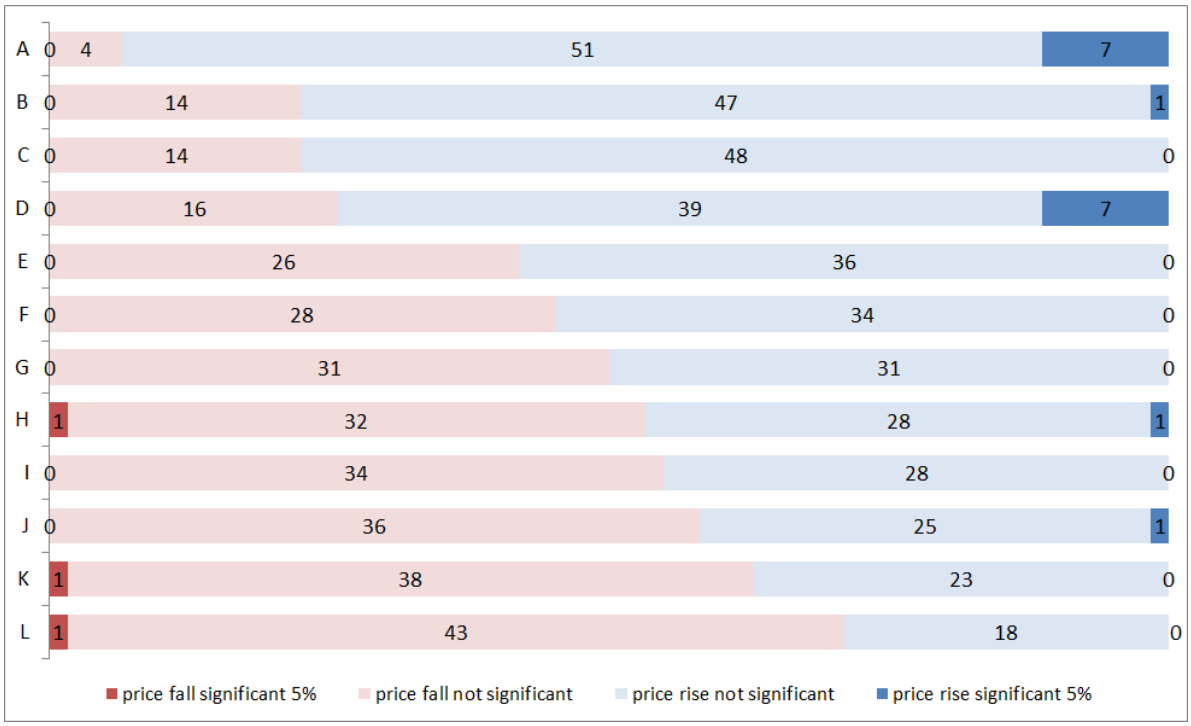

Figure 11 Price effects of mergers - Merger-specific effects by direction and significance [number of patient groups]

4.2 Volume developments after merger

General

Before a merger takes place, its effect on the volume of a hospital is less clear than the price effect. An increase in the relative negotiating power of the merger hospital may mean that a higher volume is negotiated with the insurer. Total turnover could rise in such a case. From a more theoretical perspective (Cournot, differentiated Bertrand), a merger could lead to a lower volume and a higher price. This could lead to a fall in turnover, but profitability could be improved.

The volume developments after the merger differ depending on the patient group[8]. In almost half of the patient groups we see a relative volume rise and in the other half a relative volume fall. Here too, it should be noted that the coefficients are usually not statistically significant (see Table 9). After correction for the multiple comparisons problem, none of the coefficients show a statistically significant effect.

Table 9 Direction of coefficients and significance level of volume effect

	Negative coefficient	Positive coefficient	Grand total
Before correction for multiple comparisons problem			
Not significant	27	29	56
Significant (5%)	2	4	6
Grand total	29	33	62

The groups with a significant effect fulfil the parallel trend assumption on the basis of the lincom test[9]. A total of six of the 62 investigated patient groups do not fulfil the parallel trend assumption, slightly more than in the case of the price effect.

Year-specific

In the first years after the merger, there is more or less the same number of patient groups with a volume rise as a volume fall after the merger (see Figure 12). In the first year after the merger, however, there are more patient groups in which volume rises significantly after the merger. The number of mergers for which we can show the subsequent year-specific effect decreases over time, however, because we only have information available up to the end of 2014.

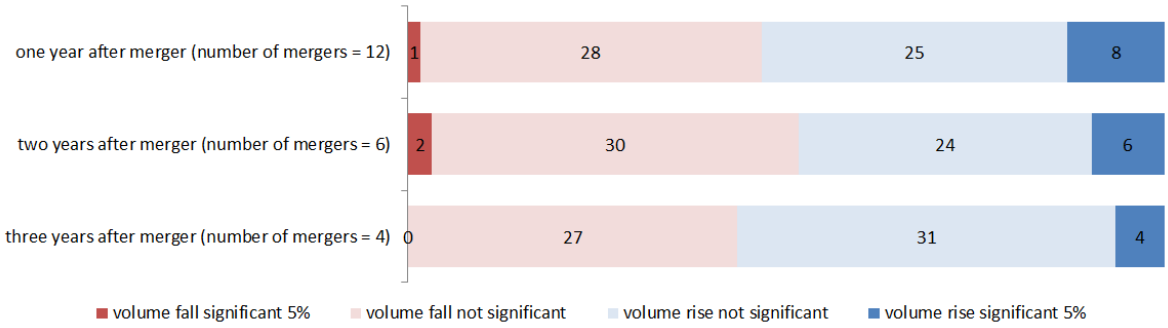

Figure 12 Volume effects – Year-specific merger effects by direction and significance [number of patient groups]

In conclusion, the volume effect of hospital mergers is much more diverse than the price effect. There are both rises and falls in volume. This pattern does not change greatly over time.

[8] In the analysis, the volumes of the merging parties and the pre- and post-periods are considered together.

[9] Linear combination of the individual year coefficients three years before the merger does not differ significantly.

By merger

In five hospitals we mainly see volume falls and in seven we mainly see volume rises. The volume rises are more often significant. There is no clear relationship between merger hospitals with mainly volume rises or falls and variables such as approval in the first versus the second phase or the year of approval. The letters denoting the merger correspond to the letters in Figure 11.

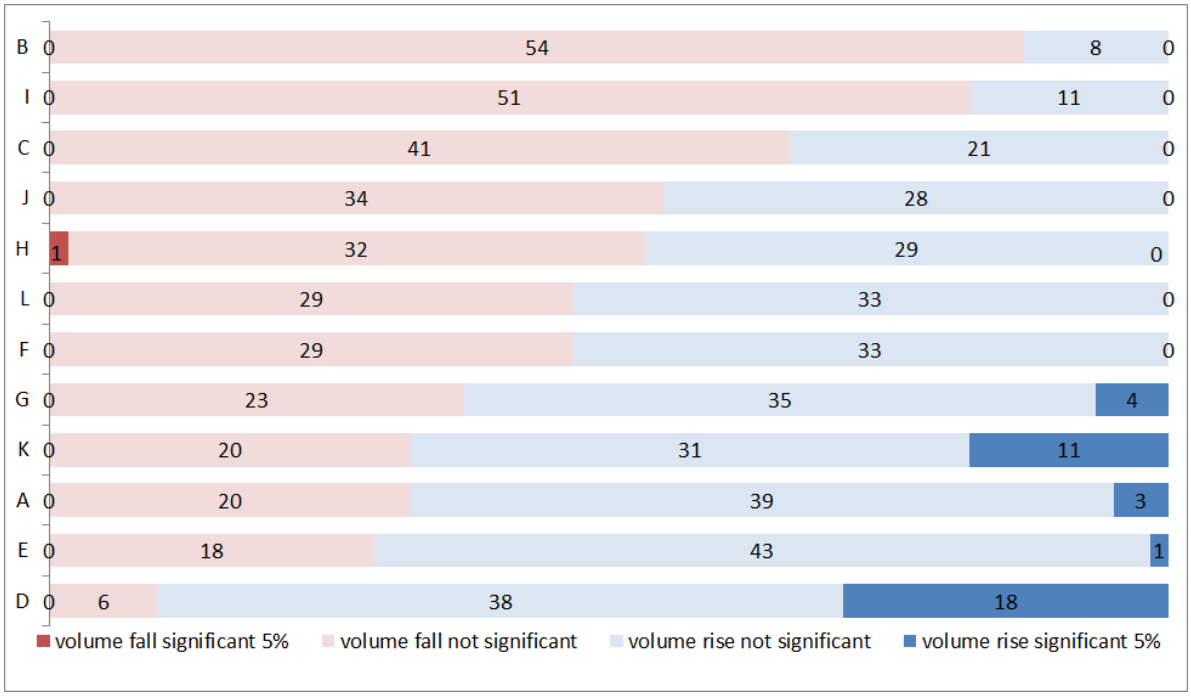

Figure 13 Volume effects of mergers - effects by direction and significance [number of patient groups]

4.3 Relationship between price and volume developments

Price and volume development by patient group

At patient group level, there is no connection between the price and volume developments. Figure 14 shows the regression coefficients of the intervention coefficients. The color of the dot shows the size of the patient group: green up to 1% of total turnover; blue between 1% and 2.5%; and red more than 2.5% of total turnover. The figure indicates that there is only a very limited connection between the price and volume developments after a merger. The area to the right of the convex line shows where the multiplication of the price and volume effect is positive, i.e. where there is a rise in turnover. We see a rise in turnover in most patient groups.

In the quadrant with the price rise and volume fall (bottom right) and the part where there is no increase in turnover (the area outside the transparent blue triangle), the absolute price change is smaller than the absolute volume change. This leads to lower turnover. However, under certain conditions (price exceeding the costs based on constant costs, no economies or diseconomies of scale), the price rise (and the associated lower volume) can nevertheless lead to a higher profit. This will be the case particularly for the patient groups in which the absolute difference between the price rise and the volume fall will not be very large or if the difference between the price and costs is small (small margin). Since we have no cost information (including at patient group level), we cannot determine for which patient groups

in this area the merger will nevertheless be profitable. The patient groups for which the merger is profitable will therefore be somewhat larger than the group for which the merger leads to a rise in turnover.

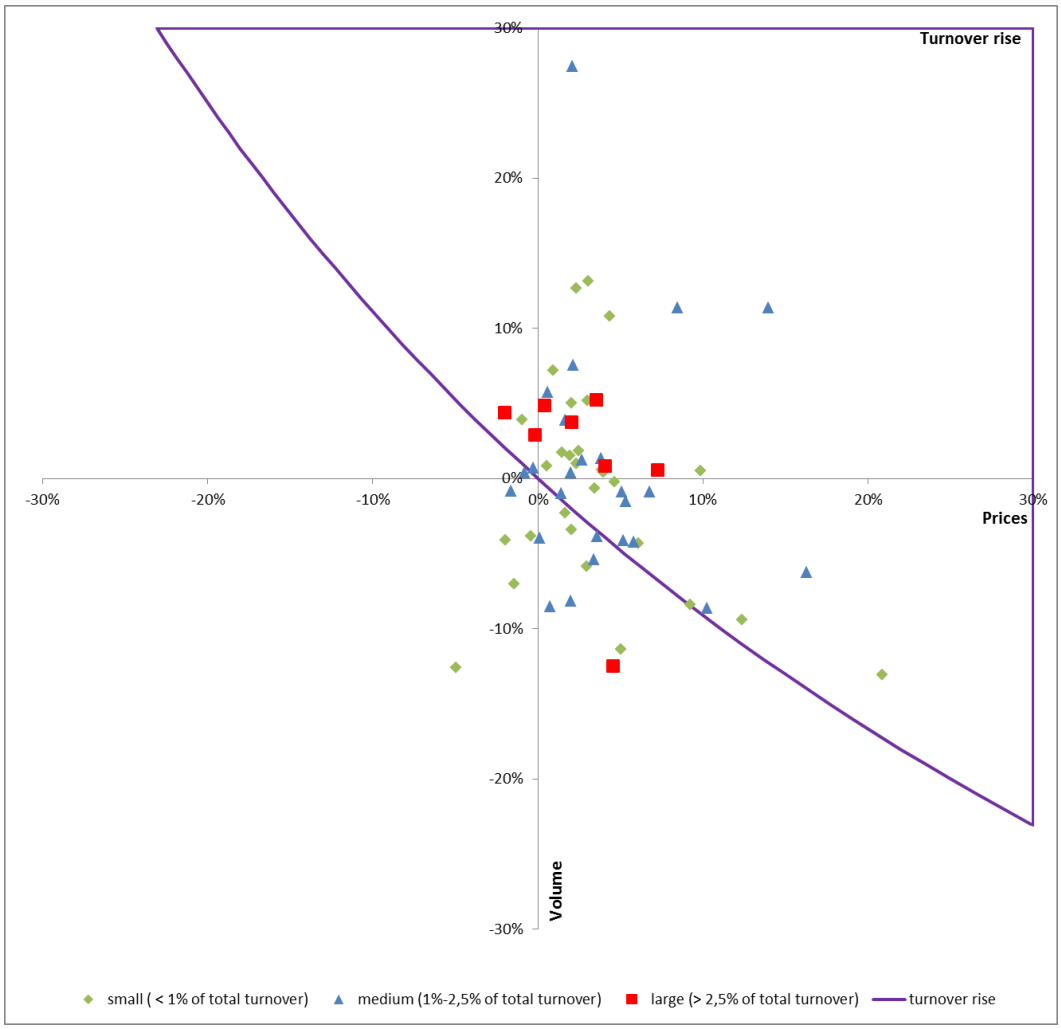

Figure 14 Correlation between price and volume impact of regression results by patient group. The color of the dot reflects the size of the patient group

Price and volume development by merger

At merger level too, there appears to be hardly any relationship between the price development and the volume development (see Figure 15). This figure shows a weighted average of the merger coefficient. The weighting is based on the number of claims in the patient group in 2013. In five hospital mergers we see a rise in turnover. In four of these hospital mergers both the price and the volume rise; in one merger the price rises, but the volume falls slightly. In seven hospitals we see a fall in turnover. In three of these hospitals there is a price fall and, given the volume development, both turnover and profit will fall with costs remaining unchanged. From the hospital's perspective, these mergers can only be profitable if cost savings are made. The other four mergers with a fall in turnover are found in the quadrant with price rises and volume falls. The price rises in three hospitals are very limited. The turnover in these hospitals falls, but the profit can increase if they achieve a very small margin or if the costs fall, for example due to efficiency improvements. In the merger where the volume falls are more or less equal to the price

increases, the slight fall in turnover will be profitable, however. With a margin of 35% or less this merger is profitable. The results must be viewed with caution, however, because only a very small proportion of the coefficients are actually significant.

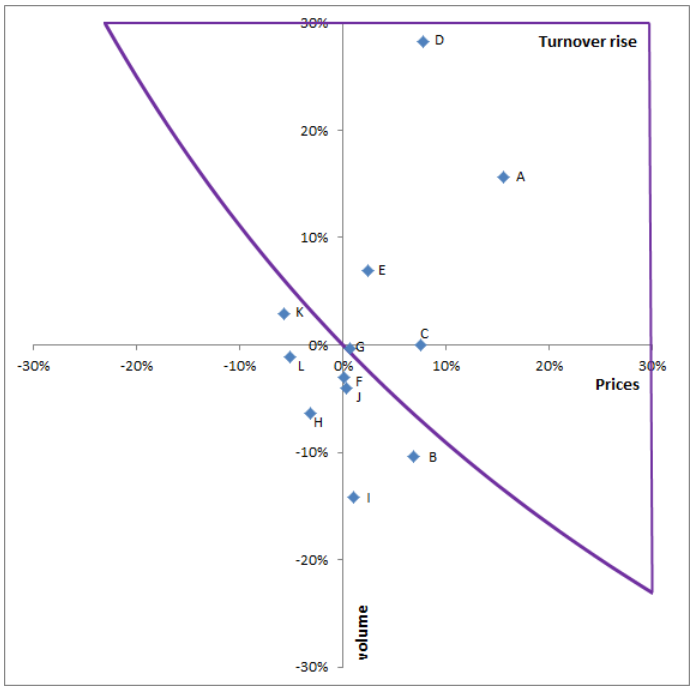

Figure 15 Correlation between price and volume by merger [weighted coefficient based on patient groups' share of turnover in merger hospital]

It is also interesting to note that, in the case of a merger that has been approved with a remedy (Walcheren-Oosterschelde), a relative price drop has been observed. The remedy may thus have had an effect.

The three mergers that have committed voluntarily to apply a price cap (Orbis-Atrium, TweeSteden-Elisabeth and Kennemer-Spaarne), all show a price rise, i.e. despite the commitment not to allow prices to rise above average, and whereas ACM had previously established that the hospitals did comply with the price commitment. The basis of the commitment and our investigation thus differ in several ways such as the dataset used, and the control group. In addition, the price commitment related only to the B segment. In our analysis, we have included both the regulated A and the free B segments.[10]

4.4 Control variables

Annexes 4 and 5 include the coefficients of the control variables. Here we discuss the main points. The size of the hospital appears to show no clear picture with regard to price. There are both significant positive and negative effects. In the case of volume, however, there is a clear direction: larger hospitals have larger volume developments.

[10] Since the A segment is regulated and changes among the merger hospitals and the control group are therefore expected to be smaller, this means that the price effect in the B segment will be slightly greater than the price effect shown in the figure.

The HHI of a hospital can be seen as an indication of the power of a hospital. A higher HHI value means more concentration. In 56 of the 62 patient groups, a higher value for the hospital's HHI is accompanied by a higher price, and in 35 patient groups, this coefficient is significantly positive. This is consistent with the relationship found in the literature between the HHI of a hospital and the price. In the case of volume, the picture is somewhat less clear; there are 47 positive effects, of which 24 are significantly positive, and 15 negative effects, of which two are significantly negative. It therefore appears that more powerful hospitals (higher HHI) can achieve a higher price and volume. Furthermore, there is generally a relationship between the level of a hospital's HHI and the degree of urbanization: hospitals in non-urban areas generally have a higher HHI.

The size of the insurer in the hospital (insurer's market share) acts as a 'countervailing power'. A larger insurer would be able to achieve a lower price and/or volume. We do not see this reflected in the results, however. With regard to price, we see a higher price in 47 of the 62 patient groups, including 18 significantly, and a lower price in 15 patient groups, including 7 significantly. Large insurers may depend on the hospitals, so they probably have to accept a higher price more often; the small insurers more often obtain a relatively low price. In the case of volume, we find only positive coefficients. This is an expected effect; a large insurer is more likely to have a large volume in a hospital. Almost all coefficients are also significant.

The insurers' HHI is an indicator of the interrelationship between the insurers in a hospital, at patient group level. The higher this value, the more uneven the distribution of the insurers' market shares. A high HHI is therefore associated with a high market share of an insurer. The relationship with the price and the volume is generally negative (59 patient groups have a lower price, including 50 significantly – and all patient groups have a negative volume coefficient, including 61 significantly). Hence, the more uneven the market shares of the insurers in a hospital (larger HHI), the lower the price and the volume. Here too, there is a relationship between the HHI and the degree of urbanization: in non-urban areas, the insurers' market shares are more often unevenly distributed.

The number of ZBCs in the province shows a mixed picture; 43 of the 62 patient groups show a higher price if the number of ZBCs increases, including three significant coefficients. In three patient groups, the price decreases significantly when the number of ZBCs rises. Hence, if there are many ZBCs operating in a province, this leads to relatively higher prices. This could indicate that ZBCs are cherry picking the 'easy' cases, leaving the hospitals with the more difficult cases (see also Cooper et al., 2016). However, in the case of volumes, we see that when the number of ZBCs in a province rises, the volume also rises. In 45 of the 62 patient groups, we see a positive effect, significantly so in five cases. There are also five patient groups in which there are lower volumes when the number of ZBCs rises. The more frequent positive relationship between the volume and the number of ZBCs is then inconsistent with 'cherry picking' by ZBCs. In the case of urbanization, there are slightly more negative (significant) coefficients in price and positive (significant) coefficients in volume. In a non-urban area, the price therefore appears slightly more often to be lower, but the volume, by contrast, is higher.

4.5 Fulfilling conditions

Parallel trend assumption

From the assessment of the parallel trend before the merger we conclude that the intervention and the control group before the merger generally match. We have examined this in two ways. We have assessed the individual years and the linear combination of the three individual years. Only in very few patient groups do we find that the price and the volume before the merger differ significantly from those of the non-merged hospitals. Table 10 shows the summarized results of the parallel trend assumption for the estimated models. On the basis of the linear combination of the year coefficients, the trend in price differs in two patient groups. In the case of volume, we do not meet the condition for the parallel trend

assumption in 6 of the 62 patient groups. Looking at the individual years, we see that in the price section there is one patient group for which the price in year 2 and year 3 before the merger differs significantly. In the volume section there is one patient group (other neoplasms of female genital organs patient group) that differs in all years from that of the non-merged hospitals. There are two patient groups that differ in two years and 13 patient groups that differ in one year.

We conclude that in the price component before the merger there is no difference in the average price between merged and non-merged hospitals. More caution is required when interpreting the volume effects.

Table 10 Number of patient groups in which the price and volume of merged hospitals before the merger differs significantly on average from the control group

	t-1	t-2	t-3	lincom
Price	1	3	6	2
Volume	12	4	4	6

5. Conclusion and reflection

In this study, we have investigated which price and volume effects occur in hospital mergers. We have investigated this for the 12 hospital mergers approved by ACM/NMa in the period 2007-2014. The price and volume effects were studied in 62 of the 65 patient groups, jointly accounting for more than 99% of the hospital turnover generated with patient groups.

The main conclusion is that in most patient groups there is a relative price rise after the merger. In some cases this effect exceeds 20%. The relatively higher price is not accompanied by a demonstrable improvement in the quality, as evidenced by the study by Significant (2016). For a limited number of patient groups there is a price fall of up to 5%. These results largely correspond to the findings in previous empirical studies. These studies, too, mostly find price rises as a result of hospital mergers. The strength of the effects of the Dutch hospital mergers differs depending on the time and the merger. The price effects occur already in the first year after approval, and there is a slight indication that this price effect diminishes somewhat over time. However, price rises are also evident in most patient groups in the third year after the year of approval. Some mergers are characterized by price rises in most patient groups, while other mergers mainly show price falls. The only merger approved with a remedy (Walcheren Hospital – Oosterschelde Hospitals) shows a relative price fall, in line with the remedy. The three hospital mergers involving a voluntary price commitment (Orbis - Atrium, TweeSteden - St Elisabeth and Spaarne - Kennemer Hospital) all show a relative rise in prices.

The volume developments as a result of the mergers are less clear. The effects vary from a volume fall of around 12% to a volume rise of more than 25%. This less clear picture also matches the empirical literature. No clear development is observable over time. There are strong differences between mergers, however, ranging from mergers with a very large number of patient groups with a fall in volume to mergers in which most patient groups show a rise in volume.

A volume fall may have different backgrounds. First, as is usual in the standard economic literature, a price rise can be accompanied by a fall in volume. Certain users refrain from purchasing because the product is too expensive; there is a drop in demand. Since the reimbursement of costs for most hospital care is covered by health insurance, meaning that patients have low if any price sensitivity, this mechanism does not seem very likely, unless the health insurer stops purchasing or capping agreements are in place. A volume decrease can also be caused by longer waiting times due to the fact that a health insurer has purchased a limited volume. The study by Significant (2016) shows that waiting times often worsen as a result of mergers. Patients will then be more likely to choose another hospital, causing the volumes of the merger hospital to decrease. Both mechanisms (fall in demand or switching) may be the result of a merger.

The volume fall may also have to do with less supply-driven demand. A merger may enable hospitals to plan and make better use of their capacity. In consultation with insurers, a merger may contribute to a reduction in capacity in a region. This may lead to less unnecessary care being provided, as the capacity removed from the market no longer has to be ‘filled’. The question, however, is whether the capacity can be reduced so quickly that the effects will become visible immediately in the first year after the merger. Furthermore, we see both volume falls and rises in individual mergers and across all hospital mergers, which means the capacity argument does not appear to hold true in the period of the investigation. Capacity reductions may only be possible if the supply of care is redistributed among the various locations. This is a process that requires a longer period, as discussed in the investigation by Significant (2016). Less supply-driven demand therefore appears less likely, particularly in the first years after approval of the merger.

The combined price and volume effects give rise to a development in turnover. In most patient groups turnover rises or, put another way, the healthcare costs for these patient groups rise. At merger level, we see a rise in turnover in five mergers. These mergers therefore lead to higher care costs (unless patients are attracted from elsewhere) and if the quality has not improved they are harmful to the consumer. The other seven mergers show a fall in turnover. The fall in turnover may be a profitable strategy, even if costs remain unchanged. This hold true particularly if the price and volume developments are approximately equivalent in absolute terms. In the case of mergers where the price and volume developments diverge, cost falls are usually necessary for the merger to be a profitable strategy. These are socially 'desirable' mergers.

The role of the insurer must also be involved in the discussion of the turnover development after the merger. An insurer will try to reduce the burden of claims, which means a decrease in the turnover of a hospital. This aim can have a positive, but also a negative effect. As stated above, a fall in turnover as a result of decrease in supply-driven demand is positive from a social perspective. Unnecessary care is avoided. However, an undesirable drop in demand is also positive for an insurer, because this also leads to a drop in total care costs. This is undesirable from a social perspective. People who need care do not receive it. In the case of mergers in which a fall in turnover is accompanied by a shift in demand, it is important to know where the patients go. If they go to cheaper hospitals, it may be an advantageous merger (total care costs fall). However, if they go to a more expensive hospital, the total care costs will rise. Finally, rises in turnover are undesirable from the health insurer and social perspective; after all, the total care costs rise as a result of these mergers.
Therefore, in order to distinguish the various situations properly and assess the desirability of the merger, health insurers must, when determining their position on the benefits of merger, substantiate why and by what mechanisms the merger limits supply-driven demand and show that any fall in turnover does not result from an (undesirable) drop or shift in demand.

In addition to a direct relationship between the merger and the price and volume, it is also useful to examine the control variables. For example, a higher HHI of a hospital is associated with a relatively higher price. This relationship corresponds to the relationship found between both variables in the literature. Therefore, in addition to the merger effect, the higher degree of concentration (a higher HHI) after a merger already leads to a higher price. The higher HHI is also accompanied by a larger volume.

In addition to the degree of concentration of the hospital, there is the position of the insurer. If the insurers' shares of a hospital's purchasing differ greatly (high HHI), this leads to a lower price. On the other hand, subject to a check for the HHI at insurer level, a larger market share for an insurer within a hospital/patient group is associated with a higher price. Large insurers may depend on the hospitals, so they probably have to accept a higher price more often. The small insurers more often obtain a relatively low price. This is the opposite of what would be expected; after all, a large insurer would have more power and thus be able to achieve a better negotiating result than a small insurer. We find a similar relationship with regard to the volume. Here too, a large insurer could be expected to exert more pressure on the development of volume (stringent purchasing) than a small insurer. In the case of volumes too, however, we see the opposite.

Some caution is necessary when interpreting the effects, because many coefficients are not statistically significant. However, the clear direction of the merger coefficients, the fact that we have investigated not a selection of hospital mergers but the entire population of hospital mergers, and the comparable results in other empirical studies reinforce our conclusion that hospital mergers are usually associated with price rises. The control variables such as the HHI also correspond to findings in the literature.

Caution is also called for with regard to the desirability of mergers, because we have no information on the costs and cost development after the merger. How costs will develop after a merger is naturally a crucial question; whether there will be cost advantages or inefficiencies and higher costs. Earlier studies focusing specifically on hospital costs show higher costs in the case of larger hospitals. The price rises found in this study in 9 of the 12 mergers also give no cause for optimism. After all, if any cost advantages have been realized they are insufficient to offset the disadvantages of the merger (increase in

market power and hence higher prices).

This investigation has not addressed the predictive power of various competition law indicators. Looking at a number of simple characteristics of merger control, there appears to be a relationship between the mergers in which a license is or is not required and the price and volume effects (rises and falls in both categories). There appears to be no relationship between the effect and the year of approval. For market shares and the position of the insurer a check has already been made in the analysis, so there appears to be no connection. Looking at the location of the mergers with a price rise, the extent of urbanization (rural versus urban) could have an effect, with the price rises occurring particularly in more rural areas.

This will have to be investigated in greater detail. For instance, it is possible to investigate whether the level of price forecasts, as the NZa usually includes in its opinions, has a predictive force.

Since the available budget of a hospital is determined in negotiations with insurers, it is obvious to look for indicators that provide insight into the negotiating power of both parties and any changes in them. The HHIs and the size (absolute or market share) as proxies for the negotiating power are already included as control variables. Another perspective for indicators is to look at what happens if the available budget is exceeded, for example as a result of a higher volume than the hospital was estimating. This provides a view of the power relationships between a hospital and the insurer. Of course, in this case it is necessary to apply a correction for logical explanations for exceeding a volume rise, for example, because more insured persons were customers of an insurer than were previously forecast. If relevant (competition law) indicators are found that can accurately predict the price and volume effects, they can play a role in the future ex-ante assessment of hospital mergers.

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Annex 1 Hospital mergers (2004-2016)

	Merger	ACM approval date	Particular circumstances	Analysis section
1	Juliana Children's Hospital - RKZ-Leyenburg	1-28-2004		
2	Erasmus MC - Haven Hospital	6-8-2005		
3	Hilversum Hospital - Gooi Noord Hospital	6-8-2005		
4	Laurentius Hospital - St. Jans Hospital	2-19-2007	Not implemented	
5	Vlietland Hospital - Rijnmond Zuid Hospital	7-19-2007	Not implemented	
6	MCA - Gemini	9-13-2007		Yes
7	St. Lucas Hospital - Delfzicht Hospital	4-29-2008		Yes
8	Walcheren Hospital - Oosterschelde Hospitals	3-25-2009	Remedies	Yes
9	Bethesda Hospital - Scheper Hospital	8-21-2009		Yes
10	Noorderbreedte Care Group - De Tjongerschans Hospital	9-28-2011		Yes
11	Vlietland Hospital - St. Franciscus Hospital	6-29-2012		Yes
12	Nij Smellinghe Hospital - Pasana Care Group	7-5-2012	Bankruptcy	
13	St. Lucas Andreas Hospital - Onze Lieve Vrouwe Hospital	9-11-2012		Yes
14	Orbis - Atrium Hospital Parkstad	11-2-2012	Price commitment	Yes
15	TweeSteden Hospital - St. Elisabeth Hospital	11-2-2012	Price commitment	Yes
16	Spaarne Hospital - Kennemer Hospital	11-2-2012	Price commitment	Yes
17	Leveste Middenveld Care Group - Refaja Hospital	12-23-2012		
18	Haga Hospital - Reinier de Graaf Group	1-21-2013		Yes
19	NPM Healthcare - Orthopedium	2-8-2013	Only active in orthopedics	
20	Lievensberg Hospital - Franciscus Hospital	9-30-2013		Yes
21	Zuwe Hofpoort Hospital - St. Antonius Hospital	12-3-2013		

	Merger	ACM approval date	Particular circumstances	Analysis section
22	Bronovo - Haaglanden Hospital	12-6-2013		
23	Isala Clinics - Zorgcombinatie Noorderboog	2-13-2014		
24	Rijnland Care Group - Diaconessenhuis Leiden	2-27-2014		
25	Kwadrant Group - Antonius Care Group - Nij Smellinghe Hospital/Pasana Care Group	10-14-2014	Not implemented	
26	Reinier Haga Group - 't Lange Land Hospital	3-19-2015		
27	UMCG - Ommelander Hospital	4-24-2015		
28	Albert Schweitzer Hospital - Rivas Care Group	7-22-2015	Prohibited	
29	Waterland Hospital - Westfries Hospital	11-22-2016		
30	Slingeland Hospital - Queen Beatrix District Hospital	12-6-2016		

Annex 2 Results of price coefficients

Patient group	Description	Merger dummy and significance level	t1 and significance level	t2 and significance level	t3 and significance level
1	infectious diseases	0.04	0.12 **	0.00	0.00
2	other neoplasms of the digestive system	0.10	0.04	0.16 **	0.10
3	neoplasms of the intestine	0.02	0.01	0.01	0.04
4	lung and intrathoracic neoplasms	0.14 **	0.18 **	0.18 ***	0.05
5	breast neoplasms	0.06	0.06 **	0.07	0.08
6	cervical neoplasms	0.01	0.05 **	0.01	-0.01
7	prostate neoplasms	0.01	0.00	-0.02	0.09
9	other neoplasms of female genital organs	0.04	0.04	0.13 **	0.00
10	bladder and kidney neoplasms	0.02	0.00	0.05 *	0.01
11	neoplasms of lymphatic and blood-forming tissue	0.03	-0.02	0.13 *	0.04
12	skin neoplasms	-0.01	0.01	-0.03	0.00
13	other neoplasms	0.05	0.07 *	0.07	0.03
14	Diabetes mellitus including diabetic complications	0.16 **	0.17 ***	0.19 ***	0.09
15	nutritional disorders	0.10	0.05	0.06	0.27 **
16	Other endocrine disorders	0.02	0.03	0.04	-0.02
17	Other metabolic disorders and immunodeficiencies	-0.01	0.01	-0.06	0.03
18	diseases of the blood and blood-forming organs	0.06 **	0.13 ***	0.02	0.06 *
19	dementia	0.12 **	0.09	0.18 **	0.11
20	mental illnesses	0.09 *	0.04	0.18 **	0.11 **

Patient group	Description	Merger dummy and significance level	t1 and significance level	t2 and significance level	t3 and significance level
21	Parkinson's disease	0.02	-0.04	0.06	0.13
22	Multiple sclerosis	0.04	-0.02	0.02	0.17 **
23	Epilepsy	0.02	0.06	-0.03	0.05
24	disorders of the lens of the eye (cataract)	0.02	0.00	0.02	0.02
25	refraction and squint	0.00	-0.02	0.03	-0.05
26	eyelid and 'red' eye	-0.02	-0.01	-0.03	-0.04
27	posterior eye chamber/retina	0.01	0.02	0.02	0.00
28	other eye	0.05	0.02	0.06	0.04
29	Hearing disorders/inner ear	0.03	0.05	0.02	0.02
30	Other disorders of the nervous system and senses	0.07 ***	0.07 ***	0.09 **	0.09 ***
31	Hypertension	0.03	0.05 *	0.03	0.02
32	chest pain	0.04	0.05	0.05	0.08
33	stroke	0.02	0.06	0.01	0.00
34	arterial disease (including peripheral)	0.07	0.14 ***	0.11	-0.04
35	varices	0.05	0.02	0.03	0.05
36	Other disorders of the vascular system	0.03	0.03	0.08 *	0.04
37	Upper respiratory tract and middle ear	0.00	0.01	0.02	-0.03
38	Lower respiratory tract	0.04	0.03	0.05	0.04
39	mouth, esophagus, stomach and duodenum (ulcers)	0.02	0.04	0.03	-0.01
40	acute abdominal (appendicitis)	0.21 *	0.00	0.25 *	0.19 *
41	abdominal wall ruptures (acquired)	-0.01	-0.02	-0.03	0.01
42	inflammatory bowel diseases	0.03	-0.02	0.08	0.09

Patient group	Description	Merger dummy and significance level	t1 and significance level	t2 and significance level	t3 and significance level
43	other bowel diseases	0.00	0.03	-0.01	-0.02
45	diseases of the bile ducts, gall bladder and pancreas	0.05	0.01	0.07 **	0.06
46	kidney diseases (including dialysis)	0.03	0.04	0.03	0.04
47	diseases of the urinary tract	0.01	0.01	0.05 **	0.00
48	urinary tract stones	0.02	0.06 **	0.01	0.03
49	disorders of the male genital organs	0.02	0.03	0.03	-0.02
50	disorders of the female genital organs	-0.02	-0.01	-0.02	-0.02
51	desire to have children, pregnancy, childbirth and postnatal care	0.02	0.04	0.04	-0.06
52	eczema	0.04	0.07 *	0.02	0.02
54	other skin disorders	0.02	0.02	0.04	0.01
55	Inflammatory polyarthropathies (rheumatism)	0.03	0.02	0.04	0.11 *
56	Osteoarthritis	0.05	0.04	0.06	0.07
57	degenerative disorders of the spine (hernia)	0.00	0.01	0.01	0.01
58	Osteoporosis	-0.05	-0.03	-0.01	-0.06
59	Internal derangement of the knee	0.01	0.01	0.01	0.03
60	Soft tissue rheumatism	0.05	0.06 **	0.06 *	0.02
61	Other disorders of the locomotor apparatus	0.04 *	0.03	0.06 *	0.05
62	allergies	0.01	0.03	0.02	0.02
63	trauma (total)	0.00	0.02	0.04	-0.03
64	other, not attributable	-0.02	0.02	-0.03	-0.03
65	perinatal and congenital	0.08 **	0.09 **	0.09 *	0.11 *

Annex 3 Results of volume coefficients

Patient group	Description	Merger dummy and significance level	t1 and significance level	t2 and significance level	t3 and significance level
1	infectious diseases	0.04	0.07 *	0.04	-0.03
2	other neoplasms of the digestive system	0.06	-0.08	-0.01	-0.07
3	neoplasms of the intestine	0.06	-0.01	0.00	0.07
4	lung and intrathoracic neoplasms	0.06	0.08	0.15 **	0.20 **
5	breast neoplasms	0.05	-0.03	-0.03	-0.03
6	cervical neoplasms	0.05	0.05	0.10 *	0.14 *
7	prostate neoplasms	0.05	0.03	0.01	0.14 *
9	other neoplasms of female genital organs	0.05 *	0.13 ***	0.13 **	0.11
10	bladder and kidney neoplasms	0.13 *	0.33 ***	0.29	0.27 ***
11	neoplasms of lymphatic and blood-forming tissue	0.06	0.04	0.04	-0.01
12	skin neoplasms	0.05	0.02	0.00	0.03
13	other neoplasms	0.05	0.03	-0.01	0.01
14	Diabetes mellitus including diabetic complications	0.05	-0.06	-0.07	-0.06
15	nutritional disorders	0.11	-0.02	0.03	0.15
16	Other endocrine disorders	0.06	0.05	0.06	0.06
17	Other metabolic disorders and immunodeficiencies	0.04	0.05	0.05	0.09
18	diseases of the blood and blood-forming organs	0.07	-0.04	-0.01	-0.05
19	dementia	0.10	-0.05	-0.14	-0.02
20	mental illnesses	0.06	-0.09 *	-0.06	-0.05

Patient group	Description	Merger dummy and significance level	t1 and significance level	t2 and significance level	t3 and significance level
21	Parkinson's disease	0.04	0.06	-0.03	0.08
22	Multiple sclerosis	0.06	-0.03	-0.03	0.16
23	Epilepsy	0.05	0.05	0.02	0.01
24	disorders of the lens of the eye (cataract)	0.05	0.00	0.05	0.06
25	refraction and squint	0.11	-0.07	-0.06	0.06
26	eyelid and 'red' eye	0.08	-0.02	-0.02	-0.03
27	posterior eye chamber/retina	0.05	0.03	0.04	0.00
28	other eye	0.09	-0.03	-0.01	0.11
29	Hearing disorders/inner ear	0.05	0.05	-0.01	0.04
30	Other disorders of the nervous system and senses	0.03	0.02	0.03	0.01
31	Hypertension	0.06	0.09 **	0.02	0.07
32	chest pain	0.06	0.06	0.08 *	0.06
33	stroke	0.04	0.11 **	0.14 ***	0.01
34	arterial disease (including peripheral)	0.04	0.02	-0.02	-0.05
35	varices	0.07	-0.05	-0.05	0.02
36	Other disorders of the vascular system	0.05 *	0.09 *	0.14 ***	0.24 ***
37	Upper respiratory tract and middle ear	0.04	0.02	-0.01	0.10
38	Lower respiratory tract	0.05	0.03	-0.01	0.04
39	mouth, esophagus, stomach and duodenum (ulcers)	0.06	-0.06	-0.02	-0.03
40	acute abdominal (appendicitis)	0.09	0.00	-0.16 **	-0.11
41	abdominal wall ruptures (acquired)	0.03 *	-0.03	-0.10 **	-0.12
42	inflammatory bowel diseases	0.06	-0.01	-0.03	0.06

Patient group	Description	Merger dummy and significance level	t1 and significance level	t2 and significance level	t3 and significance level
43	other bowel diseases	0.04	0.05	0.06	0.08
45	diseases of the bile ducts, gall bladder and pancreas	0.05	-0.03	-0.01	0.05
46	kidney diseases (including dialysis)	0.05	-0.02	-0.04	-0.07
47	diseases of the urinary tract	0.05	-0.01	0.00	0.05
48	urinary tract stones	0.05 *	0.18 **	0.08 *	0.14 **
49	disorders of the male genital organs	0.05	-0.05	-0.05	0.09
50	disorders of the female genital organs	0.03	-0.02	-0.01	0.03
51	desire to have children, pregnancy, childbirth and postnatal care	0.06	0.11 **	0.11 **	-0.14
52	eczema	0.06	0.03	0.01	-0.04
54	other skin disorders	0.05	-0.01	-0.02	-0.13
55	Inflammatory polyarthropathies (rheumatism)	0.06	-0.01	-0.08	-0.03
56	Osteoarthritis	0.15	-0.11	-0.10	-0.17
57	degenerative disorders of the spine (hernia)	0.05	0.01	0.00	-0.06
58	Osteoporosis	0.09	-0.06	-0.11	-0.08
59	Internal derangement of the knee	0.04 *	-0.11 **	-0.02	-0.02
60	Soft tissue rheumatism	0.07	0.00	-0.02	-0.04
61	Other disorders of the locomotor apparatus	0.06	0.01	-0.01	-0.07
62	allergies	0.05	-0.02	0.04	-0.01
63	trauma (total)	0.06	0.03	0.05	0.00
64	other, not attributable	0.05	0.08 ***	0.09 **	-0.15
65	perinatal and congenital	0.06	0.10 **	0.09 *	0.11

Annex 4 Results of price market variables

Patient group	description	HHI of hospital		HHI of insurer		market share of insurer		Number of ZBCs in province		Size of hospital		Urbanization	
1	infectious diseases	0.74	***	-0.62	**	0.58		-0.01		14.8	*	-0.03	
2	other neoplasms of the digestive system	0.22		-1.32	***	0.21		-0.01		-7.5		0.15	
3	neoplasms of the intestine	0.56	***	-0.48	**	0.50		-0.01		-0.8		0.01	
4	lung and intrathoracic neoplasms	0.85	***	-0.75	***	-0.07		-0.01		-3.2		-0.10	
5	breast neoplasms	0.58	***	-0.76	***	0.27		0.00		15.6	*	0.05	
6	cervical neoplasms	0.69	***	-0.64	***	0.58	*	-0.01		-13.6	**	0.01	
7	prostate neoplasms	0.52		-0.36		0.91	***	-0.02		28.9	***	0.08	
9	other neoplasms of female genital organs	0.88	***	-1.47	***	1.47	**	-0.04	**	-3.2		-0.19	**
10	bladder and kidney neoplasms	0.19		-1.46	***	1.34	**	-0.02		5.0		-0.17	**
11	neoplasms of lymphatic and blood-forming tissue	0.42	*	-1.29	***	0.41		0.02		1.8		-0.35	***
12	skin neoplasms	0.11		-0.21		0.60	***	0.00		7.9		-0.03	
13	other neoplasms	-0.52		-0.64	***	0.14		-0.01	*	25.1	***	-0.10	
14	Diabetes mellitus including diabetic complications	0.29		-0.78	***	0.37		0.00		-15.3		-0.24	
15	nutritional disorders	-0.05		-1.90	***	-0.40		0.00		-13.3		-0.33	**
16	Other endocrine disorders	0.22		-0.43	***	0.69	**	-0.01		9.6	**	-0.02	
17	Other metabolic disorders and immunodeficiencies	0.18		-0.58	***	0.03		0.01		14.7	**	-0.20	
18	diseases of the blood and blood-forming organs	0.44	***	-0.85	***	0.84	*	0.00		-1.6		-0.13	***
19	dementia	0.76	***	-0.53	**	0.50		0.03		-27.8	***	-0.03	
20	mental illnesses	0.21		-0.98	***	0.97	***	0.00		4.0		-0.06	
21	Parkinson's disease	0.72	***	-0.87	***	1.00	**	0.01		1.2		0.08	

Patient group	description	HHI of hospital		HHI of insurer		market share of insurer		Number of ZBCs in province		Size of hospital		Urbanization	
22	Multiple sclerosis	0.44	**	-1.41	***	-0.51		-0.02		-19.7		-0.04	
23	Epilepsy	1.24	***	-0.92	***	0.60		0.01		10.2		0.07	
24	disorders of the lens of the eye (cataract)	0.88	***	-0.79	***	0.30	*	0.01		3.0		0.01	
25	refraction and squint	0.42	**	0.03		0.14		0.01		13.9		0.19	**
26	eyelid and ‘red’ eye	0.44	**	0.00		0.30		0.00		-7.4		0.00	
27	posterior eye chamber/retina	0.16		-0.49	*	-0.23		0.00		19.8	*	-0.06	
28	other eye	0.28	**	-0.58	**	0.11		-0.01		-7.9		0.09	
29	Hearing disorders/inner ear	-0.18		-0.19		0.22		0.02	***	8.0		-0.01	
30	Other disorders of the nervous system and senses	0.21		-0.72	***	-0.02		0.00		2.7		-0.03	
31	Hypertension	0.27	**	-0.45	**	0.21		0.01	*	12.4	***	-0.04	
32	chest pain	0.00		-0.93	**	0.54	***	0.01		41.9	***	-0.24	
33	stroke	-0.33		-0.68	***	0.22		0.00		6.7		-0.10	
34	arterial disease (including peripheral)	0.25		-1.21	***	1.01	*	0.00		45.3	***	-0.08	
35	varices	0.60	***	0.08		0.42	*	0.00		-15.1	***	-0.05	
36	Other disorders of the vascular system	0.41	***	-0.94	***	0.16		0.00		-6.2		-0.33	***
37	Upper respiratory tract and middle ear	0.47	***	-0.56	**	0.02		-0.01		-7.0		0.08	
38	Lower respiratory tract	0.21		-0.33	*	0.57	***	0.00		2.5		-0.10	
39	mouth, esophagus, stomach and duodenum (ulcers)	0.16		-0.48	***	0.00		-0.01		11.8	**	-0.07	
40	acute abdominal (appendicitis)	0.55		-1.62	**	-0.94	**	0.00		16.3		0.00	
41	abdominal wall ruptures (acquired)	0.68	***	-0.68	**	-0.37	*	-0.01		-10.5	**	0.00	
42	inflammatory bowel diseases	0.92	***	-1.07	***	0.82		0.00		-16.2	***	-0.01	
43	other bowel diseases	0.35	***	-0.41	**	0.17		0.00		-7.4	**	-0.10	**
45	diseases of the bile ducts, gall bladder and pancreas	0.29	***	-0.24		0.05		0.00		-8.1	**	0.00	

Patient group	description	HHI of hospital		HHI of insurer		market share of insurer		Number of ZBCs in province		Size of hospital		Urbanization	
46	kidney diseases (including dialysis)	0.16		-0.52	***	1.28	***	-0.01		27.3	***	-0.13	
47	diseases of the urinary tract	0.19	*	-0.63	***	0.25		0.00		-2.6		-0.11	
48	urinary tract stones	0.12		-0.62	**	1.13	**	-0.05	**	11.1		0.17	*
49	disorders of the male genital organs	0.34	***	-0.86	***	0.48	*	0.00		-4.1		-0.07	*
50	disorders of the female genital organs	0.25	*	-0.35	**	-0.22		0.00		-12.8	**	0.07	
51	desire to have children, pregnancy, childbirth and postnatal care	0.52	**	-0.30	*	-0.09		0.00		-4.4		0.01	
52	eczema	0.56	***	-0.38	*	0.14		-0.01		5.0		0.06	
54	other skin disorders	0.27		-0.36		0.44		0.00		14.1	**	-0.20	***
55	Inflammatory polyarthropathies (rheumatism)	0.56	***	-1.29	***	0.06		0.00		4.9		-0.18	*
56	Osteoarthritis	-0.03		-0.96	***	0.23		0.00		-10.3		0.11	
57	degenerative disorders of the spine (hernia)	-0.32		-0.46		-0.46	**	0.01		7.9		-0.02	
58	Osteoporosis	0.40	***	-0.60	***	0.31		0.02	*	8.4		-0.07	
59	Internal derangement of the knee	0.31	*	-0.56	**	-0.44	***	-0.01		-10.4		-0.13	
60	Soft tissue rheumatism	0.49	***	-0.45	**	-0.56	***	0.00		-14.7	***	-0.06	
61	Other disorders of the locomotor apparatus	0.21		-0.50	*	-0.66	***	0.00		5.6		0.04	
62	allergies	0.38		-0.69	***	0.11		0.00		6.7		0.12	
63	trauma (total)	0.04		-0.02		-1.16	***	0.00		0.9		0.11	
64	other, not attributable	0.54	***	-0.24		-0.05		0.00		-6.0		-0.12	**
65	perinatal and congenital	0.26	*	-0.24		1.09	***	0.00		8.5		0.02	

Annex 5: Results of volume market variables

Patient group	description	HHI of hospital		HHI of insurer		market share of insurer		Number of ZBCs in province		Size of hospital		Urbanization	
1	infectious diseases	0.03		-1.35	***	4.59	***	0.00		132.4	***	-0.02	
2	other neoplasms of the digestive system	-0.05		-1.28	***	4.96	***	0.01		118.6	***	0.19	
3	neoplasms of the intestine	-0.11		-1.61	***	5.29	***	0.02	***	98.3	***	-0.10	
4	lung and intrathoracic neoplasms	-0.14		-1.42	***	1.97		-0.02		125.0	***	0.08	
5	breast neoplasms	0.27		-1.39	***	4.81	**	0.01		87.1	***	0.26	*
6	cervical neoplasms	0.06		-1.26	***	6.03	***	0.01		95.7	***	0.30	**
7	prostate neoplasms	0.28		-2.33	***	6.25	***	0.01		94.3	***	0.31	*
9	other neoplasms of female genital organs	-0.11		-1.09	***	6.56	***	0.01		86.1	***	0.32	**
10	bladder and kidney neoplasms	0.02		-1.40	***	5.21	***	-0.03	**	72.5	***	0.04	
11	neoplasms of lymphatic and blood-forming tissue	-0.15		-1.35	***	5.98	**	0.00		100.7	***	0.04	
12	skin neoplasms	0.84	***	-1.64	***	6.86	***	-0.01	***	89.1	***	0.26	
13	other neoplasms	-1.08	*	-1.38	***	6.30	***	-0.01	*	142.8	***	0.35	***
14	Diabetes mellitus including diabetic complications	0.82	***	-1.26	***	6.65	***	-0.01		99.0	***	0.29	***
15	nutritional disorders	-0.52	**	-1.71	***	2.16	***	0.01		100.0	***	-0.02	
16	Other endocrine disorders	0.52		-1.29	***	5.07	**	0.00		96.7	***	0.25	*
17	Other metabolic disorders and immunodeficiencies	0.37		-1.39	***	4.71	***	0.01		104.9	***	0.39	*
18	diseases of the blood and blood-forming organs	0.11		-1.33	***	5.10	***	0.02		77.9	***	-0.18	*
19	dementia	1.95	***	-1.17	***	2.24	**	0.07	*	94.1	***	-0.38	
20	mental illnesses	0.42	*	-1.19	***	4.45	***	-0.01		78.1	***	-0.17	
21	Parkinson's disease	0.08		-0.96	***	4.66	***	-0.01		105.3	***	-0.22	*

Patient group	description	HHI of hospital		HHI of insurer		market share of insurer		Number of ZBCs in province		Size of hospital		Urbanization	
22	Multiple sclerosis	0.11		-1.55	**	1.93		-0.06	***	60.8	**	0.08	
23	Epilepsy	0.16		-0.62	***	5.24	***	-0.01		81.4	***	-0.07	
24	disorders of the lens of the eye (cataract)	1.37	***	-2.22	***	3.96	***	0.01		83.7	***	0.21	*
25	refraction and squint	2.23	***	-3.86	***	3.23	***	0.01		84.0	***	0.08	
26	eyelid and ‘red’ eye	0.38		-1.15	**	5.45	***	0.02	**	131.3	***	0.06	
27	posterior eye chamber/retina	0.75	***	-1.34	**	4.17	***	0.01	**	102.8	***	0.20	
28	other eye	2.02	***	-1.99	**	5.25	***	0.02		123.6	***	0.11	
29	Hearing disorders/inner ear	0.87	**	-1.00	***	6.82	***	0.01		94.4	***	0.01	
30	Other disorders of the nervous system and senses	0.08		-1.41	***	6.50	***	0.00		82.0	***	0.03	
31	Hypertension	1.07	***	-1.66	***	7.05	***	-0.01		75.1	***	0.38	***
32	chest pain	-0.37		-1.77	***	6.31	***	0.01		108.8	***	-0.06	
33	stroke	-0.29		-1.11	***	6.79	***	-0.01		95.7	***	0.13	
34	arterial disease (including peripheral)	-0.27		-0.79	***	5.74	***	0.00		103.2	***	0.16	
35	varices	1.26	***	-2.65	***	4.59	***	-0.01		94.1	***	0.66	***
36	Other disorders of the vascular system	0.70	***	-1.98	***	3.61	***	0.00		79.8	***	0.36	**
37	Upper respiratory tract and middle ear	0.86	***	-1.70	**	6.27	***	0.00		82.5	***	0.04	
38	Lower respiratory tract	0.46		-1.53	***	6.53	***	0.00		83.8	***	0.29	
39	mouth, esophagus, stomach and duodenum (ulcers)	0.82	***	-1.53	***	4.91	***	-0.01		83.9	***	0.05	
40	acute abdominal (appendicitis)	0.27		-2.48	***	5.87	***	0.00		77.2	***	0.03	
41	abdominal wall ruptures (acquired)	-0.08		-2.03	***	4.64	***	0.01		93.5	***	0.06	
42	inflammatory bowel diseases	0.33		-0.90	***	5.96	***	0.02	*	101.8	***	0.15	
43	other bowel diseases	0.45	*	-2.04	***	5.72	***	0.00		88.7	***	0.13	
45	diseases of the bile ducts, gall bladder and pancreas	-0.09		-1.84	***	6.14	***	0.00		88.2	***	0.07	

Patient group	description	HHI of hospital		HHI of insurer		market share of insurer		Number of ZBCs in province		Size of hospital		Urbanization	
46	kidney diseases (including dialysis)	0.66	**	-1.04	***	3.48	***	0.01		111.5	***	0.21	
47	diseases of the urinary tract	0.56	***	-1.87	***	6.91	***	-0.01		92.3	***	0.12	
48	urinary tract stones	-0.13		-1.70	***	5.73	***	0.02		68.7	***	0.24	*
49	disorders of the male genital organs	0.59	***	-1.89	***	4.83	***	0.00		82.7	***	0.09	
50	disorders of the female genital organs	0.69	***	-1.62	***	6.66	***	0.00		79.9	***	0.59	***
51	desire to have children, pregnancy, childbirth and postnatal care	0.00		-0.94		5.85	***	0.01		116.3	***	0.44	***
52	eczema	0.79	***	-2.24	***	3.42	***	-0.01		69.1	***	0.15	
54	other skin disorders	0.49	*	-1.53	***	6.66	***	-0.01	**	99.7	***	0.20	*
55	Inflammatory polyarthropathies (rheumatism)	-0.11		-1.02	***	3.13	**	0.01		87.4	***	-0.08	
56	Osteoarthritis	0.22		-1.79	***	6.26	***	0.00		105.7	***	0.41	**
57	degenerative disorders of the spine (hernia)	-0.12		-1.31	**	6.22	***	0.00		97.8	***	0.42	**
58	Osteoporosis	1.29	***	-1.42	***	5.61	***	-0.01		60.6	***	0.19	
59	Internal derangement of the knee	0.50	**	-2.18	***	4.99	***	0.00		91.2	***	0.11	
60	Soft tissue rheumatism	0.36	***	-1.94	***	5.14	***	0.00		104.2	***	0.15	
61	Other disorders of the locomotor apparatus	0.00		-1.77	***	7.76	***	0.00		111.0	***	0.18	
62	allergies	0.07		-1.34	***	5.89	***	0.00		109.2	***	0.27	
63	trauma (total)	0.26		-1.45	***	7.22	***	0.00		108.2	***	-0.14	
64	other, not attributable	0.13		-1.10	*	3.91	***	0.00		120.6	***	0.34	**
65	perinatal and congenital	0.15		-1.24	***	5.61	***	0.00		108.3	***	0.20	***