A retrospective evaluation of the GDF/Suez merger: Effects on gas hub prices

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MSI_1705

A retrospective evaluation of the GDF/Suez merger: Effects on gas hub prices

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May 2017

Abstract:
We present an ex-post analysis of the effects of GDF's acquisition of Suez in 2006 created one of the world's largest energy companies. We perform an econometric analysis, based on Difference-in-Difference techniques on the market for trading on the Zeebrugge gas hub in Belgium. Removing barriers to entry and facilitating access to the hub through ownership unbundling were an important part of the objectives of the remedies imposed by the European Commission. Our analysis shows a price decline after the merger. This decline suggests the remedies were effective in limiting the potential anti-competitive effects of the merger. Moreover, it suggests that ownership unbundling has generated improved access to the hub. Therefore, the remedies may have done more than simply mitigate the potential anti-competitive effects of the merger; they may have effectively created competition.

Keywords: Mergers, Ex-post Evaluation, Gas sector, Hub prices
JEL classification: L4, Q4

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This paper is partially based on a project we undertook for the European Commission, Directorate-General for Competition (European Commission, DG Competition, 2015). The opinions expressed here, however, are the sole responsibility of the authors of this paper. We wish to thank Luca Aguzzoni, Benno Bühler, Adriaan Dierx, Tomaso Duso, Fabienne Ilzkowitz, Sebastian Schwenen, Cristiana Vitale, Christian von Hirschhausen and seminar participants at Ofgem for insightful comments and suggestions. Jo Seldeslachts gratefully acknowledges the financial support from the Flemish Science Foundation (FWO) and Albert Banal-Estañol from the Ministerio de Economía y Competitividad and Feder (ECO2013-43011-P and ECO2016-76998-P).

1. Introduction

Competition policy enforcement activity in the EU energy sectors has increased significantly over the last fifteen years, especially with regards to merger cases. Between 2000 and 2014, the European Commission (EC) has handled over 270 merger cases in the energy sectors, as opposed to 20 in the five years prior to year 2000 (European Commission, DG Competition, 2015). Moreover, since 2003, a significantly higher share of the merger cases in gas and electricity have received in-depth investigations, suggesting an increased level of merger scrutiny. As a result of these investigations, the EC has prohibited some mergers, while others have been abandoned.[1]

Some commentators argue that the EC is effectively shaping the overall development of the EU gas and electricity markets through its merger policy decisions. It has been said that the energy sector has been taken "out of the domain of (national) sector-specific regulation and put under the auspices of (EU) competition policy" (Hellwig, 2009). These developments have also been seen as "overcoming significant obstacles to Europeanization endemic to the energy sector" (Eberlein, 2012), where the EC is using "windows of opportunities" created by large European cross border merger proposals (Pakalkaite, 2014).

This is in line with the EC's view that the EU liberalization directives in energy markets have not been wholly effective. Member States have forced a number of compromises to defend their national energy champions, which often limited or delayed EU directives' effectiveness. Difficulties securing third party access to transportation capacity, and discrimination in favor of vertically integrated businesses, were especially problematic (Harrison and Mordaunt,

[1] For example, in 2004 the Commission prohibited the proposed acquisition of joint control over Gás de Portugal (GDP), the incumbent gas company in Portugal, by Energias de Portugal (EDP), the incumbent electricity company in Portugal, and ENI, an Italian energy company. In 2008, the proposed acquisition of the Hungarian oil and gas company, MOL, by the Austrian oil and gas group, OMV, was abandoned following the Commission's concerns relating to the combined market share of the companies in several energy markets.

2012). Moreover, several Member States failed to fully implement the energy package requirements by the deadline. These collective failings - of regulation and of its implementation - meant that mergers were more likely to have harmful effects in comparison to scenarios where barriers to entry and expansion had been successfully dismantled. As a result, merging parties could be required to offer remedies to address the resulting regulatory gaps. In reality, some of the EC remedies put in place, in principle to mitigate the potential anti-competitive effects of mergers, may have effectively been used to promote market liberalisation and to achieve effective unbundling of network and supply activities.

Despite the importance of merger policy in energy markets, we are not aware of any retrospective study that provides an ex-post evaluation of the EC's merger decisions in the energy sector. This may be because of complex market structures, where several layers of the market coexist (production, wholesale, transmission, distribution, retail), or due to specific technical features of energy markets. Notwithstanding these difficulties, retrospective studies are essential tools to assess past decisions and improve decision-making for future cases.[2]

This paper provides, to the best of our knowledge, the first analysis of the direct effects of a merger and its associated remedies in the energy sectors. Our case study deals with one of the most important mergers in the energy sector of recent decades. The Gaz de France's (GDF) acquisition of Suez in 2006 created one of the world's largest energy companies and affected the electricity and gas markets at several stages in the supply chain in both Belgium and France. We focus on the effects in the market for trading on the Belgian gas hub. It is this market in which it is most feasible to isolate and quantify the effects of a policy intervention. It also is an important part of the imposed remedies by the EC and one of the key dimensions of the

[2] A growing number of retrospective studies analyse the effects of mergers in a large variety of other industries. See Ashenfelter, Hosken and Weiberg (2009) and Duso (2012) for reviews of the literature.

European gas market.[3] A hub, if operating efficiently, can promote competition in the market and allow for price transparency. This, in turn, results in a reduction in transaction costs, a more secure supply and a wider choice for buyers.

Our specific aim is to quantitatively evaluate the price effects of the merger and the remedies approved by the EC through a Difference-in-Difference (DiD) analysis on the market for trading on the Zeebrugge hub (ZEE hub). Prior to the merger, the ZEE hub suffered limited infrastructure access and liquidity issues. Part of the negotiated remedies, which included ownership unbundling of network and supply activities, aimed to free up access to the hub. If effective, these remedies should have allowed for higher traded volumes and lower prices in the hub.

Our evidence suggests that the remedies successfully limited the merger's potential anticompetitive effects. We found not only did prices not increase, but they *declined*. This decline in prices supports the view that ownership unbundling improved access to the hub. Therefore, the remedies may have gone further than mitigating the potential anticompetitive effects of the merger. Given the absence of indicated efficiency gains by the merging parties, our analysis supports the view that the EC's merger policy actions may have become a tool used to liberalize EU energy markets.

There are few studies providing analyses of competition policy enforcement decisions in energy markets. Most of the existing studies provide a qualitative, rather than a quantitative, analysis. Leveque (2006) argues that competition policy in the energy sector raises specific

[3] Gas-trading hubs provide services to facilitate exchanges between buyers and sellers in wholesale markets, enabling them to find sufficient volumes of supplies or to sell excess capacity in the short-term. A hub can be a physical installation, where gas flows are connected to and pass through this point (as in Belgium) or they can be virtual whereby no precise geographical location is specified (as in the UK or in the Netherlands). For an interesting account of the development of gas hubs in Europe, see Miriello and Polo (2015).

problems which require tailored solutions and call for a tougher approach to mergers.[4] Newbery (2007) compares the approach taken by the EU and the US regarding merger analysis in the energy sectors. He claims that, in contrast to the US, mergers between energy companies in Europe have been traditionally subject to rather relaxed standards (up until 2005). Pozzi (2004) shows that, in a given year, antitrust enforcement activity in the US electricity sector has a negative effect on industry profits in subsequent years.

As documented in Federico's (2011) review of ten merger decisions in the EU, the EC raised concerns in a number of them, particularly with respect to the lack of full ownership unbundling of network assets and the effects of merging these assets on activities in the liberalized parts of the market. In contrast to the view of the EC, the (theoretical) academic literature does not provide unambiguous support of the positive effects of ownership unbundling, neither in terms of consumer welfare or in terms of its effects on investment incentives (Bolle and Breitmoser, 2006, Crémer et al., 2006, and Pollitt, 2008).

There are also few studies that analyze the performance of wholesale gas markets. Most of the existing analyses focuses on assessing the degree of integration between hubs, which is, in itself, an important goal of the EU energy strategy (but it is also a key part of defining the extent of a market for competition policy purposes). Heather (2012) and Petrovich (2013), for example, examine the integration of gas hubs using price correlations. Rupérez Micola and Bunn (2007) test for the existence of market power on the arbitrages performed between the

[4] An interesting debate was sparked by Gas Natural's launch of a hostile bid on Endesa's shares in 2005. Two groups of leading academic scholars debated regarding the approach the EC should be adopting when facing a merger. Barquin et al. (2006) called for a stricter approach to be taken in the case of electricity mergers whereas Padilla et al. (2005) argued the opposite. According to Barquin et al. (2006), allowing anti-competitive mergers (type II errors) can be more much more detrimental than prohibiting pro-competitive ones (type I errors). This is because demand elasticity is very low and therefore the potential loss in consumer surplus from anti-competitive mergers is very high. In addition, the efficiency gains from pro-competitive mergers may be limited. Padilla et al. (2005), instead, argue that there is no presumption in economics against mergers in the electricity industry. They claim that price effects need not be higher than those in other sectors and argue that there is evidence on the existence of economies of scale and scope in both the regulated and non-regulated activities of the gas and electricity industries.

gas hubs in Belgium and the UK, which are linked by the “Interconnector” pipeline. Massol and Banal-Estanol (2016) develop a methodology to examine the overall efficiency of the arbitrages performed between gas hubs and use the same Interconnector pipeline as a case study.

The structure of this paper is as follows: in section 2, we begin by presenting the features of the GDF and Suez merger as well as an overview of the industry at that time. We will then present the data and econometric analysis of the impact on the market for trading on the ZEE hub in section 3. Section 4 concludes and discusses policy implications following on from the empirical analysis.

2. The Belgian wholesale gas market and the merger

This section presents the main features of the GDF/ Suez merger decision within the context of the Belgian wholesale gas market and, in particular, of the ZEE hub (for further institutional details, see European Commission, 2006). The Belgian gas network is an integrated network used for domestic transmission, as well as for international transit. Belgium’s reserved transit capacity at the time of the merger represented two-and-a half times the volume of gas consumed in Belgium and around 10 per cent of the total consumption in Western Europe (CREG, 2006a). The ZEE hub was, and remains, crucial for this transit role; the pipelines that go through the ZEE hub are being used almost exclusively for gas transit (Heather, 2012). The role of the hub became more prominent leading up to 2006 with the gradual liberalization of gas markets. This increased short-term negotiations and gas price arbitrage transactions.

2.1. The GDF/Suez merger in relation to the Belgian gas sector

In 2006, GDF and Suez were active on all levels of the Belgian gas sector. The largest energy company in the market, Suez group, had a stake of 57 per cent in Distrigas (gas wholesale and supply) and 57 per cent in Fluxys (gas infrastructure, transit, storage and transport).[5,6] Through these companies, it also controlled Distrigas & Co (capacity rights selling in transit networks), Huberator SA (hub services), Fluxys LNG (terminals), GIE Finpipe (transit network), and Segeo (transit network, jointly owned with GDF). GDF was the second largest competitor in the gas wholesale and supply markets (see Figure 1).

In sum, while the first two gas directives of the European Parliament (98/30/EC and 2003/55/EC) had led to "legal unbundling" in both the transit and transmission networks, in terms of ownership, Suez controlled a large part of the Belgian gas infrastructure. Domestic transmission was solely owned by Fluxys as a monopoly. Fluxys was responsible for the management, maintenance and sale of capacity around the transmission network. These domestic transmission activities were regulated with regards to third-party access and tariffs, subject to Belgian law and to a "code of conduct". Gas transit infrastructure and capacity rights selling was mostly under the control of either Distrigas or Fluxys. Moreover, in 2006, no code of conduct or other third-party access document existed in relation to transit activities.

[Insert Figure 1 about here]

2.2 The Commission's merger decision

On 10 May 2006, the European Commission received prior notification of a concentration between the Gaz de France group and the Suez group via an exchange of shares. The Commission's investigation found that, given the horizontal and vertical overlaps between the two companies' activities, the proposed transaction raised significant competition concerns

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[5] While the firm was originally named Distrigaz, it was later renamed Distrigas. We use Distrigas throughout the paper.

[6] Throughout the paper, we refer to Belgian wholesale markets as the import of gas from abroad and trading between gas shippers (among others, on the hub). We refer to Belgian supply markets as the markets where gas is sold to large customers, power generators or retailers.

across all levels of the Belgian gas market (European Commission, 2006). In particular, due to control over Fluxys, the EC was concerned about the parties' control over essential infrastructure. In particular, the EC was concerned the parties may have had privileged access to supply infrastructure and storage. Despite the existing unbundling provisions, new entrants had claimed they lacked effective access with Fluxys being suspected of putting the interests of the integrated company first.

The Commission was concerned that the merger might further impede access to the ZEE hub, which was suffering access and liquidity issues. Actual or potential competitors of Distrigas wishing to access the hub had to obtain capacity rights through an entry/ exit agreement with Distrigas & Co, who were capacity rights seller of the transit network. This meant that Distrigas & Co could make non-transparent agreements with all hub customers negotiated on a bilateral basis. Distrigas itself was also a competitor in the hub, and therefore, their central role in making agreements posed a real problem in terms of access. For example, there were issues regarding privileged access to information because Distrigas could obtain details of the positions of competitors. This may have undermined confidence and discouraged market entry.

In response to these concerns, GDF and Suez offered extensive remedies, including (i) the divestiture of the Suez group's holdings in Distrigas to a third party, and (ii) the restructuring of the activities of Fluxys into two entities, Fluxys SA and Fluxys International, and relinquishing of all control over these. Fluxys SA was to own the entire Belgian gas transmission and transit system and all Belgian gas storage infrastructure. To this end, Suez would also transfer Distrigas & Co to Fluxys SA. The parties undertook not to hold more than 45 per cent of the capital of Fluxys SA (with Publigas holding another 45 per cent). Fluxys International was to own the Zeebrugge LNG terminal, Huberator and the other non-regulated Belgian and international assets. The parties further agreed not to hold more than 60 per cent of the capital of Fluxys International as well as to give partial control of its investment activities to the management committee of Fluxys SA.

These remedies were intended to facilitate the entry of new competitors and foster competition between existing competitors. They were also intended to generate increased access to the hub which, in theory, should lead to higher liquidity and volumes traded, and to lower prices. In November 2006, as a result of these remedies, the Commission concluded that the merger would not significantly impede competition in the European Economic Area or any substantial part of it.

3. The empirical analysis

3.1 The data

The dependent variable for the empirical analysis is the daily transaction price for day-ahead wholesale natural gas traded during working days, as published by Platts, both for the Belgian hub (ZEE) and for the Dutch hub (TTF). TTF is the counterfactual we use to identify the causal effect of the merger on prices (see the next subsection for a description of our empirical model). Our sample period extends from January 2005 until December 2011. For each working day (i.e., Monday to Friday), these data reflect the price range of a standardized quantity of natural gas to be delivered at a constant flow rate throughout the next working day, after assessment (e.g., Friday's assessment reflects Monday's delivery). All prices are denominated in €/MWh.[7]

It would also be interesting to assess the effect of the merger on traded volumes. Unfortunately the available data are not suitable for the proposed empirical analysis and therefore this was not possible.[8] Illustrative evidence indicates that volumes and liquidity at the ZEE hub increased after 2008 (European Commission, DG Competition, 2015, pp. 119-120).

[7] Given the limited liquidity of within-day markets, the usual convention is followed and we refer to these day-ahead prices as 'spot' since they provide traders with a final opportunity to trade gas out of a forward position before physical delivery.
[8] Data on traded volumes are available only since 2007 and only on a monthly basis for the control hub.

A set of control variables have been collected from various sources and included in the estimation equation. The data sources for the variables used in our analysis are described in Appendix A.

3.2 The econometric model

The empirical analysis aims to quantify the effects of the merger and associated remedies on the prices at the ZEE hub. As explained in the previous section, the remedies imposed on the merging parties aimed to remove barriers to entry and facilitate access to the hub. In order to estimate the effect of the merger on hub prices, we use a Difference-in-Difference (DiD) approach – a methodology that is widely used in policy evaluation exercises.[9] The basic idea behind the DiD methodology is to compare what happened to the treated group (here the ZEE hub, which is affected by the merger) before and after the merger with what happened to a control group (a comparable hub, see below for a discussion on the selection of such hub). The control group represents what would have happened to the treated group in the absence of the treatment. The double differencing removes the common factors that might be otherwise confounded with the effect of the merger, thereby allowing the identification of the effect of the merger on prices. The identification strategy lies therefore on the selection of a suitable control group that is comparable to the treated group. We discuss this issue in detail below.

In our empirical model, hub prices depend on a set of demand- and supply-side variables, as well as on merger-related dummies. In particular, we estimate the following equation:

$$p_{it} = \beta treat_i + \gamma post_j + \delta treat_i \times post_j + +\omega_1\, power_{it} + \omega_2\, oil_t + \omega_3\, coal_t + \rho_1\, temp_{it} + \sum_{d=1}^{4} \varphi_d D_{d,t} + \sum_{m=1}^{11} \mu_m M_{m,t} + \sum_{y=2005}^{2010} \vartheta_y Y_{y,t} + \epsilon_{it} \qquad (1)$$

[9] Most merger retrospective studies use this methodology. See Weinberg (2008) for a review.

The dependent variable p_{it} is the daily price in hub i at time t. The regressors are demand-side variables such as season and business cycles (day D, month M, and year Y), as well as temperature (*temp*).[10] Supply-side controls are indices of power prices as well as oil products, to which gas prices are typically related (*power, oil*, *coal*).[11,12]

The identification strategy crucially relies on the comparison between the ZEE hub and the control hub. The dummy *treat* is therefore equal to 1 for the treated prices, i.e. prices at the ZEE hub. The dummy $post_j$ is equal to 1 in the period after each event related to the merger took place (as discussed below, we use different definitions of the *post* period, which explains the j subscript). The interaction dummy $treat \times post$ is the main variable of interest as its coefficient represents the price difference between the ZEE hub and the counterfactual hub after the merger-related events.

Finally, we allow for autocorrelation and heteroscedasticity of the error terms by estimating Newey-West standard errors. In our main specification we assume the maximum lag order of autocorrelation to be equal to one week (seven days). In the appendix, we present the results of several robustness checks, including different modeling assumptions on the error structure (see Section 3.3.3 for a discussion). We discuss our choice of the control hub in section 3.2.1. In section 3.2.2 we discuss instead the strategy to identify the effects of the merger and associated remedies.

3.2.1 Identification of the control group

[10] We also account for non-linearities in the effect of temperature by including a quadratic term in the regression.
[11] Coal prices may influence gas prices as coal and gas plants are both important electricity generators.
[12] Our demand-and supply-side variables are similar to those that Böckers and Heimeshoff (2014) use in the estimation of electricity prices.

The robustness of the identification strategy depends on the selection of a suitable control group which represents what would have happened in the absence of the merger and remedies. In principle, the control group should be unaffected by the event and also have similar characteristics, in so far as possible, to the treated group. In this context, the choice of the control group proves to be a challenging task for several reasons. First, there are no other hubs in Belgium, therefore we are required to use a hub in another country as a counterfactual. Comparing different countries is generally problematic in the context of a DiD approach, as different countries have different institutional features and are, therefore, subject to different shocks. However, within this context, we are comparing hubs which, in spite of being located in different countries, are marketplaces sharing most features. With this in mind, the structure and functioning of the hubs is similar and several market players are active in the same hubs in continental Europe.

Another issue representing difficulties with comparator selection is the fact that European hubs are, at least to some extent, interconnected. This implies that the possibility that a major event affecting one hub does not affect another hub cannot be ruled out.

Taking into account these limitations, we identified the TTF hub in the Netherlands as the most similar to the ZEE hub and therefore the most suitable control hub.[13] There are three reasons for our selection. First, at the time of the merger, the ZEE hub and TTF hub were the two largest hubs in continental Europe in terms of liquidity (CREG, 2006b). Second, the degree of interconnection between the ZEE hub and the TTF hub was low at the time of the decision. Indeed, during their investigation the European Commission concluded that they belonged to

[13] One difference between the Belgian hub and the Dutch hub is that the ZEE hub is a physical hub (i.e. where the gas physically passes through the hub) while the TTF hub is a virtual hub (i.e. where gas enters only virtually after entering into a national system). However, this aspect does not pose too serious problems in terms of comparing both hubs, as even in virtual hubs the gas physically passes through, albeit at a national level as opposed to a local level.

different markets.[14] Third, there is limited data availability for hubs in the mid-2000's. Data is available for the TTF hub, as well as the British hub. The British hub would not be suitable because of the high degree of interconnection with the Belgian hub. Therefore, in combination, the three reasons described above contributed to our decision to use TTF as the suitable control hub.

Figure 2 compares prices at the ZEE hub to those in the Netherlands. This comparison is only intended to observe trends at a high level. The two prices follow a similar pattern, consistent with the 'common trend assumption' on which the DiD strategy hinges. This assumption states that the treatment and control group would follow the same trend in the absence of the treatment. Some short-term price spikes at the end of 2005 and beginning of 2006 reflect external events, including a cold snap in the UK and a shortage in the UK's main gas storage facility due to a fire outbreak. This had an immediate impact on the spot prices given the interconnectedness between the Belgian and UK markets.[15]

[Insert Figure 2 about here]

3.2.2 Identification of the treatment period

To quantify the impact of the two main events related to the merger decision, two different definitions of the 'post' period are used. We can identify two periods as most relevant to assess the overall effect of the merger, namely:

1 The period after the official publication of the Commission's decision (November 2006).

[14] It must, however, be mentioned that the Dutch and UK grids became more connected through the BBL pipeline starting in December 2006. This may have indirectly increased the connection between the TTF and ZEE hubs through the UK grid.

[15] BBC News. 2006. 'Gas shortage sends prices soaring': http://news.bbc.co.uk/1/hi/business/4802786.stm.

2 The period after the merger was effectively finalised and the different structural remedies were implemented. These events took place around June 2008.

Before we explain in detail our identification strategy, it is worth noting that when mergers are subject to authorisation, it is common in the retrospective evaluation literature to consider the date of the decision as the main relevant date to assess the effect of the merger (see for instance Choné and Linnemer, 2012; Björnerstedt and Verboven, 2016; Aguzzoni et al., 2016). In the case under consideration, there was a time lapse of more than one-and-a-half-years between the Commission's decision and the actual consummation of the merger and its remedies. Given this sequence, the decision most certainly commenced at the time of the merger and remedy process. It could be fairly assumed that the parties started negotiating the terms of the merger and sale of assets at this time. More generally, it is likely that after the decision, other market operators began to adjust their strategies anticipating the finalisation of the merger and its remedies. Therefore, an assessment of the price impact at the time of the decision itself is important.[16]

Our identification strategy aims at quantifying both the individual effect of each of the two events and their overall effect in the long run. These effects are summarised in Figure 3 below. We now describe our identification strategy for both the individual events and the overall effect of the merger-related events.

[Insert Figure 3 about here]

[16] There are at least three merger retrospective studies finding evidence of price changes before the merger was actually completed (Kim and Singal, 1993; Prager and Hannan, 1998; and Borenstein, 1990).

Individual Effects of the Merger Events

To disentangle the effect of each event, we run two separate regressions on two different sample periods, each of which represents the relevant before/ after period around each event. The individual effects are therefore identified on a reduced sample period. Since the two events are far enough apart in time (more than one and a half year between each other), the number of observations on which we identify each treatment effect is quite large. Therefore, these should not be regarded as merely short-run effects. They represent the individual effect of each merger-related event in the period in which the event is assumed to display its effects.

To measure the effect of each of the two events, we thus consider two different definitions of the $post_j$ dummies, one for each event j, and of the form:

$$Post_1 = \begin{cases} 1, & for\ \ t \in (T_1, T_2) \\ 0, & else \end{cases}$$
$$Post_2 = \begin{cases} 1, & for\ \ t \in (T_2, T\ \ ) \\ 0, & else \end{cases} \tag{2}$$

where T_1 and T_2 are the dates of event 1 and 2 respectively, and T is the last date in our sample period.

Overall Effect of the Decision

To measure the cumulative effect of the merger and of its associated remedies, we identify the treatment effect from a long-run perspective. In particular, we assume that the overall effect of the decision can be observed only from when the remedies have been implemented. This is done by comparing what happened after all remedies were implemented and the period prior the Commission's decision. We thus estimate the effect of the previously defined $post_2$ dummy and exclude the implementation period (December 2006 - May 2008) from the analysis.

3.3 Main results

We present here the results of the main set of estimations using the econometric framework described above. We show here two specifications for each treatment; one where the effect is measured from the exact day of each event, and one in which we drop a three-month window surrounding the event. This is commonly done in the retrospective merger literature to take into account possible anticipation/ delay effects (see subsection 3.3.3 below for further discussion on this issue). In both regressions, we estimate Newey-West standard errors while allowing for autocorrelation of up to 7 lags.

3.3.1 Individual Effects of the Merger Events

In Table 1 we present two main sets of regressions, one for each definition of the 'post' period, corresponding to the two different events related to the merger.

[Insert Table 1 about here]

In the first two columns of Table 1, we present estimation results where the relevant event is the Commission's decision (event 1). As explained above, this regression is run on the period January 2005 (beginning of our sample period) to June 2008 (date of event 2). The main coefficient of interest is the interaction coefficient $Treat*post_1$, which is negative and significant in both specifications. This suggests that there was a price decline at the Belgian hub relative to the control hub after the decision. The result is slightly larger if a time window around the decision is excluded (column 2). The positive coefficient for the *treat* dummy indicates that prices at the ZEE hub were on average higher than at the TTF hub over the period under consideration, controlling for the observable variables. The coefficient for the *post* dummy suggests that prices were not significantly different, on average, in the period after the decision with respect to the period before. The coefficients for the other control variables generally have the expected signs, indicating a positive relationship with the prices of other inputs and a negative effect of temperatures.

Columns (3) and (4) in Table 1 show instead the results of the regressions that consider the effects of the 2008 events, namely the effective divestitures of Distrigas, Distrigas & Co and partial divestitures of Fluxys, and the consummation of the merger (event 2). These regressions are run on the period from November 2006 (date of event 1) and December 2011 (end of the sample period). The coefficients of the treatment effect variable show that the events around June 2008 had a negative and significant impact on price at the ZEE hub, relative to our control hub. This finding holds true (and is even reinforced) if a window of three months around that date is dropped. Note that this is an *additional* price decrease with respect to the first event. This suggests that there was a price decline at the Belgian hub, relative to the control hub, after the effective implementation of the merger and associated remedies, although this additional effect is smaller than the effect of the decision.

3.3.2 Total Effects of the Merger events

We also estimate the total effect of the merger and of its associated remedies, assuming that this effect can only be observed when the last remedy has been implemented. We thus estimate the effect of the previously defined $post_2$ dummy and exclude the implementation period (December 2006 to May 2008) from the analysis. As in the three previous sets of estimations, we show in Table 2 a regression with Newey-West standard errors at the baseline specification, and estimate a regression where we drop a three-month window around the left out period.

[Insert Table 2 about here]

The interaction coefficients are negative and significant, which provides evidence that the overall effect of the merger and of its associated remedies was a decrease in prices at the hub. As expected, the magnitude of the estimated overall impact is similar to the sum of the estimated individual effects of the two main events, suggesting that these were the principal determinants of the merger effect. Other merger-related events may have played a role, but they do not seem to be of first-order importance in regards to the realised effect on prices.

3.3.3. Robustness checks

We now discuss some issues that are potentially problematic for our estimations and provide robustness checks and additional analyses intended to overcome these. The results of these additional robustness checks are reported in appendix B (Tables B.1 – B.4).

As is usual with high-frequency data, the estimation strategy has to deal with the issue of autocorrelation in the error term. We address this in three ways. First, we estimate our regressions with Newey-West standard errors, assuming heteroscedasticity and allowing for autocorrelation of the error term up to some lag. In our main specification, the specified autocorrelation lag is 7, but we also use a 1-lag specification as a robustness check. Another common way to deal with this issue is to estimate bootstrapped standard errors, something we also undertake as a robustness check. Finally, we reduce the frequency of data from daily to weekly.

Retrospective merger studies are faced with the task of correctly defining ‘before’ and ‘after’ periods. This task is often challenging because there might be both anticipation effects (i.e.

strategic behaviours that may take place before the merger is approved) and delayed effects (i.e. it might take time before the merger is finalised, particularly if remedies have to be implemented). The same anticipation/ delay effects might also be relevant for remedies. One way to at least partially overcome this problem is by excluding from the analysis a time window surrounding the merger. It is common practice in the literature to drop the data in a three-month or a six-month window around the merger. In order to address this issue, for each of the three events we dropped a three-month window. We further checked that our results are robust across different definitions of the time windows (one and six months).

Because we have a long time series, we also estimate a specification with real prices rather than nominal prices. Finally, we estimate a specification in logs, which should yield a more straightforward interpretation of coefficients.

The robustness checks shown in Tables B.1-B.3 in Appendix B yield very similar results to those presented in Tables 1 and 2. In particular, in all regressions the coefficient of the *Treat*Post* variable is negative and significant for the first two events and the cumulative effects: (i) with real prices instead of nominal prices, (ii) with Newey-West with lower order of autocorrelation (lag 1), (iii) with bootstrapped standard errors, (iv) with smaller (1 month) or larger (6 months) time windows dropped around the event, and (v) with weekly instead of daily data.

Finally, the results for the first event and for the overall effect might partly be driven by the large price movements that took place in the period prior to the merger decision.[17] In order to test the sensitivity of our results to these price shocks, we run our regressions on a reduced sample where we cut out the periods with the extreme spikes (November 2005 and March 2006). The magnitude of the interaction coefficient, shown in Table B.4, becomes smaller but

[17] Note that our estimation results for event 2 is affected by the price spikes, since the sample period for the corresponding regressions does not include the period before 2007.

the sign is unchanged and still significant. This suggests that the size of the effect should be interpreted with some caution, but that prices went down in any case around the decision.

4. Conclusions

The results of the empirical analysis suggest that the Commission's decision and the implementation of the merger and its associated remedies had an impact on wholesale gas prices in Belgium. Prices at the ZEE hub fell relative to the TTF hub following the Commission's merger decision (November 2006) and the implementation of associated remedies (June 2008).

It is interesting that the first event. i.e., the Commission's approval of the merger subject to conditions, may have had the most significant effect. As argued above, one needs to be cautious when drawing implications based on the magnitude of this coefficient as it may partly be due to the unusual price movements in the pre-merger period. However, the finding of a large coefficient for the merger approval might suggest that there has been an anticipatory effect. In particular, as the implementation of the remedies and the consummation of the merger took quite some time, it is likely that at least some of the effects took place before the merger and remedy events officially occurred. This would imply that the effect of the merger decision may partly incorporate the effect of subsequent events.

As a whole, the evidence could suggest that the remedies were effective in limiting the potential anti-competitive effects of the merger, as the net effect of merger and remedies shows a price decline. It is not possible to disentangle the merger and the remedies, as they occurred around the same time. However, the net effect is informative of which effect dominated. The estimated decline in prices also supports the view that ownership unbundling has generated better access to the hub. In this respect, the remedies seem to have done more than simply mitigate the potential anti-competitive effects of the merger. It must be mentioned that one cannot totally exclude that price declines are a consequence of some efficiency gains generated by the merger. However, this is unlikely, given that no potential efficiency gains at the hub were indicated by the merging parties.

Our results are thus in line with the view that for merger transactions that fall within its jurisdiction, the EC can bypass Member States in applying EU merger policy in order to reduce the power of national champions. Indeed, through the application of merger remedies, the EC can ensure third-party access and unbundle vertically integrated companies. These remedies may at first sight seem like an overreach of limiting potential anti-competitive effects. However, the European Court of Justice pointed out in its judgement of ENI/EDP/GDP merger that there exists no legal problem to the EC pursuing liberalization of energy markets through its merger policy actions, as they both share the aim of increasing competition.[18]

[18] Case T-87/05 EDP-Energias de Portugal SA v Commission [2005] ECR II-3745.

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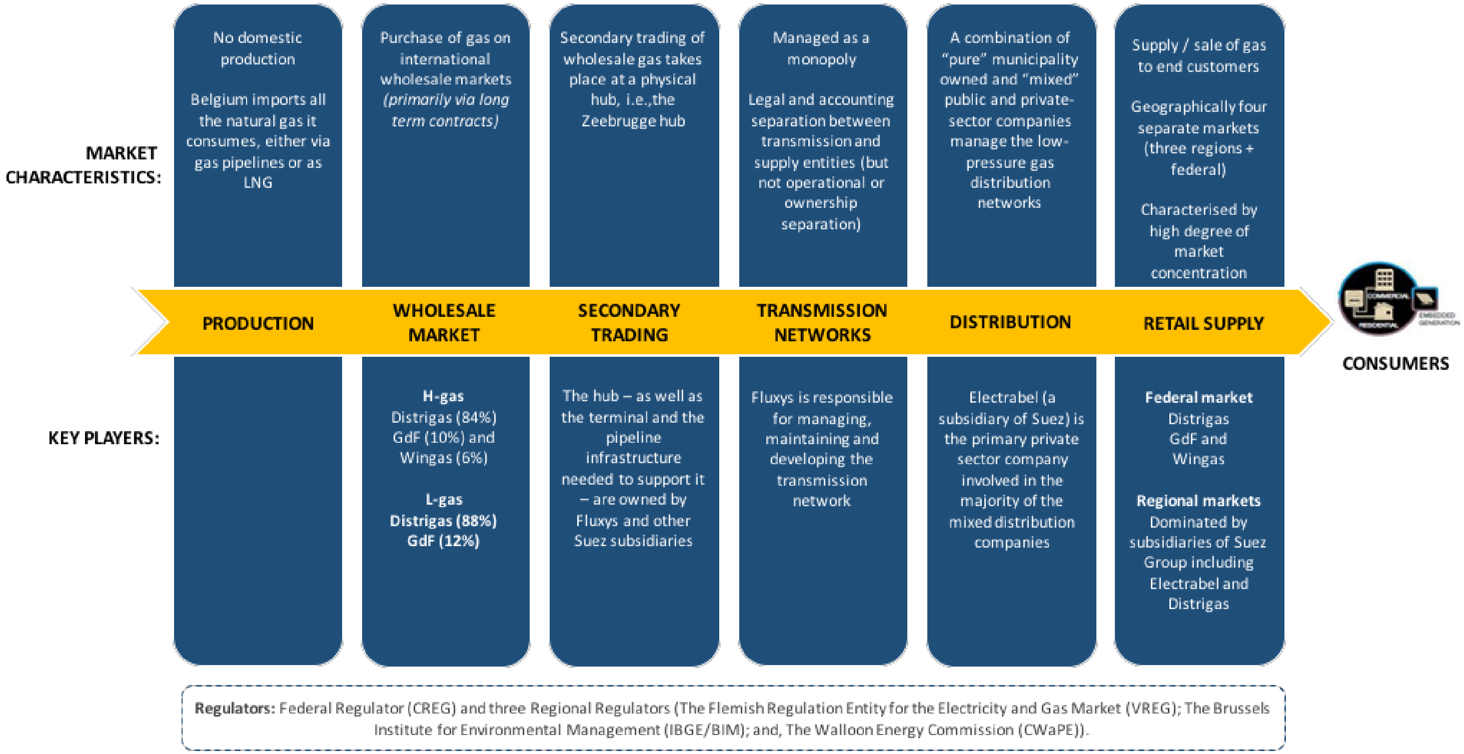
Figures and Tables

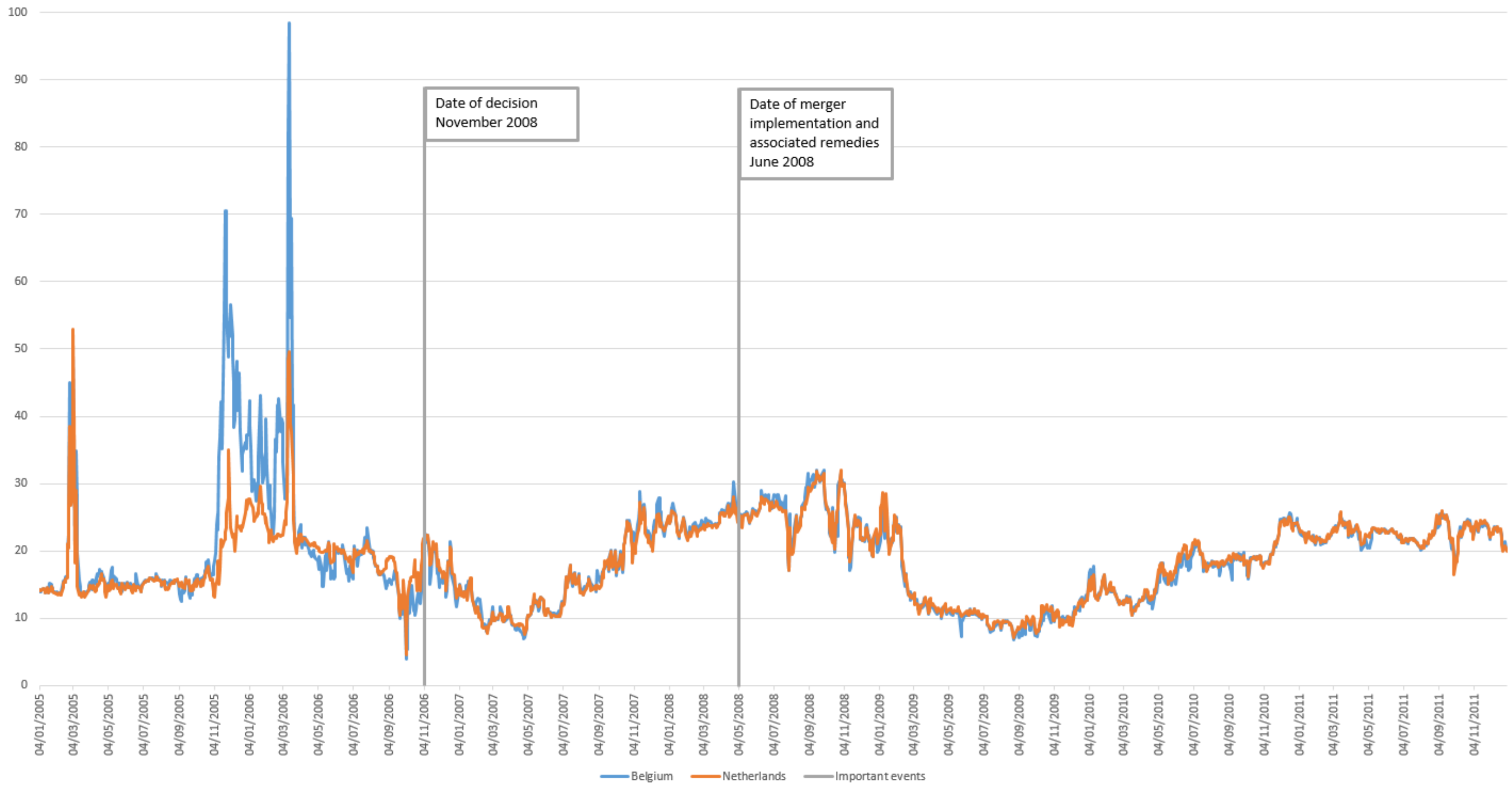
Figure 1 Stylized overview of the structure of the Belgian gas market before the merger



Based on information sourced from CREG (2008)

Notes: (i) Belgium consumes two different types of natural gas, namely H-gas (with high caloric value) and L-gas (with low caloric value), (ii) the above diagram is a simplification and should not be seen as a comprehensive depiction of the Belgian gas market. For example, it does not include the storage segment of the supply chain

Figure 2 Evolution of prices at the ZEE hub and at the TTF hub, 2005 - 2011



Source: Platts database. 2013.

Figure 3 Individual and overall effects of the events related to the merger

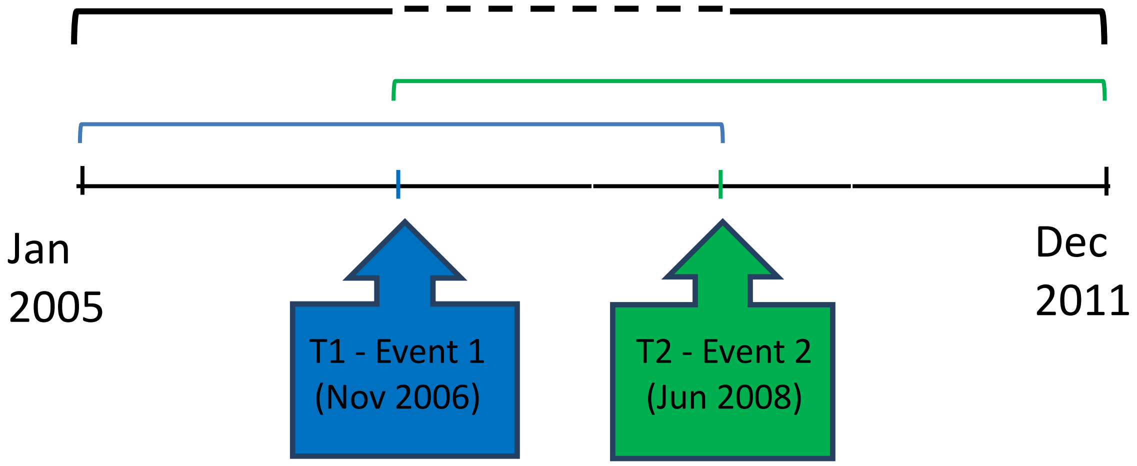


Table 1 – Price effects of individual events

	(1) Baseline	(2) 3-month dropped time window	(3) Baseline	(4) 3-month dropped time window
Treat	2.593***	2.940***	0.235***	0.224***
	(0.576)	(0.601)	(0.0610)	(0.0655)
$Post_1$	1.339	-0.597		
	(1.358)	(2.646)		
$Treat*Post_1$	-2.364***	-2.604***		
	(0.586)	(0.612)		
$Post_2$			0.351***	0.456***
			(0.101)	(0.109)
$Treat*Post_2$			-0.384***	-0.410***
			(0.0721)	(0.0755)
Power	0.00296	0.00226	0.00105	0.000926
	(0.00532)	(0.00505)	(0.000724)	(0.000729)
Oil	0.670***	0.661***	0.970***	0.972***
	(0.0925)	(0.0978)	(0.00617)	(0.00626)
Coal	0.166*	0.161*	-0.0219	-0.0224*
	(0.0971)	(0.0959)	(0.0134)	(0.0131)
Temperature	-0.226**	-0.242**	-0.00480	-0.00466
	(0.104)	(0.110)	(0.0103)	(0.0103)
Temperature squared	0.00552	0.00595	5.43e-05	0.000109
	(0.00351)	(0.00367)	(0.000446)	(0.000446)
Constant	-6.713	-6.365	1.177***	1.166***
	(5.689)	(5.756)	(0.301)	(0.301)
Observations	1,759	1,636	2,586	2,460
F-test	597.95	571.31	7,652.96	6,986.05
Prob > F	0.0000	0.0000	0.0000	0.0000

Note: The dependent variable is the daily gas price at the hub. In all specifications, we also include day, month, and year dummies. Newey-West standard errors are reported in parentheses. The symbols ***, **, * represent significance at the 1%, 5%, 10% levels respectively.

Table 2 - Overall price effects of merger events

	(1) Baseline	(2) 3-month dropped time window
Treat	2.595***	2.940***
	(0.576)	(0.602)
$Post_2$	3.964	4.231
	(2.900)	(2.892)
$Treat*Post_2$	-2.734***	-3.116***
	(0.584)	(0.610)
Power	0.00135	0.000705
	(0.00854)	(0.00872)
Oil	0.717***	0.717***
	(0.0760)	(0.0771)
Coal	0.00198	0.00362
	(0.0505)	(0.0509)
Temperature	-0.143**	-0.147**
	(0.0644)	(0.0648)
Temperature squared	0.00333	0.00378
	(0.00236)	(0.00244)
Constant	3.288	3.058
	(3.134)	(3.219)
Observations	2,715	2,588
F-test	633.93	581.74
Prob > F	0.0000	0.0000

Note: The dependent variable is the daily gas price at the hub. In both specifications, we also include day, month, and year dummies. Newey-West standard errors are reported in parentheses. The symbols ***, **, * represent significance at the 1%, 5%, 10% levels respectively.

Appendix

A. Data

The variables used in the estimation, together with their corresponding data sources, are reported in Table A.1 below, with the descriptive statistics reported in Table A.2.

Table A.1 Description of the variables

Variable	Description and source
Price	Daily hub prices at time t for hub i. Measured in €/MWh (Source: Platts data base)
Treat	Treat dummy, 1 for Zee hub prices in BE and 0 for TTF hub price in NL
$Post_1$	Post dummy set to 1 for time after Commission's merger decision (14 Nov 2006)
$Post_2$	Post dummy set to 1 for time after merger and remedies were effective (30 June 2008)[19]
Temperature	Daily temperature data for Belgium and the Netherlands in degrees Celsius (Sourced: national administrative bodies).
Temperature Squared	Square of temperature
Oil	Daily spot price for Brent crude oil. Measured in $/bbl (Source: Platts data base)
Coal	Average daily price of coal. This is a combined price series of two sources which measures the daily European reference price for coal imports into North-Western Europe.
Power	Daily price at the power exchange. Since the Belgian Power Exchange (Belpex) started operating on 21 November 2006, there is no data for Belgium before 2007. Dutch power prices for 2005 and 2006 are used as a proxy for this time period[20] (Source: Platts Database).
Day	Dummy variables for each day of the week
Month	Dummy variables for each month
Year	Dummy variables for each year

[19] We do not know the exact dates of the June 2008 remedies. Furthermore, in July 2008 the merger was finalized. We choose therefore an intermediate date (30 June) as our relevant treatment date, which aims to capture both the remedies and the finalization of the merger.

[20] We tested whether Dutch power prices were similar enough to the Belgian ones: the correlation between the two price series at later dates is high (.93) and therefore deemed to be high enough to use as a proxy for this gap in the data series.

Table A.2 Descriptive statistics of the variables used in the estimation

Variable	Obs	Mean	Std. Dev.	Min	Max
Price	3,532	18.77	6.96	3.89	98.44
Treat	3,532	0.5	0.5	0	1
$Post_1$	3,532	0.73	0.44	0	1
$Post_2$	3,532	0.50	0.50	0	1
Temp	3,532	10.77	6.47	-10.07	28.4
Oil	3,532	19.10	7.95	3.88	98.43
Coal	3,532	16.97	19.42	0.01	75.1
Power	3,532	61.82	26.91	16.32	432.83

B. Additional tables and robustness checks

Table B.1 Robustness checks on the effects of the Commission's decision (Event 1)

VARIABLES	(1) Baseline (Robust s.e.)	(2) Real prices	(3) Logs	(4) Newey-West s.e. (1 lag)	(5) Bootstrap	(6) 1-month window	(8) 6-month window	(9) Weekly average
Treat	2.593***	2.162***	0.0683***	2.593***	2.593***	2.659***	3.320***	2.519***
	(0.266)	(0.257)	(0.00836)	(0.350)	(0.269)	(0.271)	(0.299)	(0.563)
$Post_1$	1.339*	1.451**	0.0404**	1.339	1.339*	1.210	1.076***	1.102
	(0.730)	(0.702)	(0.0197)	(0.921)	(0.718)	(0.993)	(0.365)	(1.509)
Treat* $Post_1$	-2.364***	-2.506***	-0.0590***	-2.364***	-2.364***	-2.399***	-2.991***	-2.290***
	(0.271)	(0.262)	(0.00885)	(0.357)	(0.275)	(0.276)	(0.321)	(0.573)
Power	0.00296	0.00225	0.0180*	0.00296	0.00296	0.00337	0.0112**	0.00535
	(0.00418)	(0.00401)	(0.0104)	(0.00456)	(0.00428)	(0.00416)	(0.00535)	(0.0135)
Oil	0.670***	0.656***	0.787***	0.670***	0.670***	0.671***	0.723***	0.656***
	(0.0518)	(0.0501)	(0.0229)	(0.0658)	(0.0523)	(0.0525)	(0.0471)	(0.112)
Coal	0.166***	0.143***	-0.0297***	0.166***	0.166***	0.168***	-0.0253***	0.165*
	(0.0453)	(0.0439)	(0.00463)	(0.0605)	(0.0468)	(0.0461)	(0.00694)	(0.0969)
Temperature	-0.226***	-0.222***	-0.00355*	-0.226***	-0.226***	-0.226***	-0.132*	-0.280**
	(0.0647)	(0.0630)	(0.00187)	(0.0774)	(0.0643)	(0.0649)	(0.0671)	(0.141)
Temperature squared	0.00552**	0.00547**	6.31e-05	0.00552**	0.00552**	0.00551**	0.00181	0.00668
	(0.00217)	(0.00212)	(6.60e-05)	(0.00258)	(0.00219)	(0.00218)	(0.00239)	(0.00542)
Constant	-6.713**	-4.526*	0.615***	-6.713*	-6.713**	-6.951**	4.454***	-6.294
	(2.674)	(2.585)	(0.0717)	(3.538)	(2.690)	(2.790)	(1.267)	(5.671)
Observations	1,759	1,759	1,759	1,759	1,759	1,719	1,512	366
R2	0.8538	0.8526	0.9269	-	0.8538	0.8544	0.8411	0.8633
F test	1,995.93	1,695.22	3,004.64	1,255.90	-	2,000.09	195.95	555.51
Prob > F	0.0000	0.0000	0.0000	0.0000	-	0.0000	0.0000	0.0000

Note: The dependent variable is the daily gas price at the hub. In all specifications, we also include day, month, and year dummies. Newey-West standard errors are reported in parentheses. The symbols ***, **, * represent significance at the 1%, 5%, 10% levels respectively.

Table B.2 Robustness checks on the effects of the merger and remedies' implementation (Event 2)

VARIABLES	(1) Baseline (Robust s.e.)	(2) Real prices	(3) Logs	(4) Newey-West s.e. (1 lag)	(5) Bootstrap	(6) 1-month window	(8) 6-month window	(9) Weekly average
Treat	0.235***	-0.339***	0.00948***	0.235***	0.235***	0.225***	0.187***	0.225***
	(0.0323)	(0.0307)	(0.00208)	(0.0402)	(0.0330)	(0.0329)	(0.0358)	(0.0610)
$Post_2$	0.351***	0.264***	0.0179***	0.351***	0.351***	0.365***	0.487***	0.371***
	(0.0613)	(0.0573)	(0.00287)	(0.0708)	(0.0604)	(0.0628)	(0.0705)	(0.103)
Treat* $Post_2$	-0.384***	-0.632***	-0.0213***	-0.384***	-0.384***	-0.386***	-0.402***	-0.381***
	(0.0396)	(0.0379)	(0.00249)	(0.0482)	(0.0402)	(0.0401)	(0.0422)	(0.0718)
Power	0.00105**	0.00147***	0.0128***	0.00105*	0.00105*	0.00105**	0.000927*	0.000243
	(0.000524)	(0.000470)	(0.00368)	(0.000596)	(0.000546)	(0.000525)	(0.000529)	(0.00158)
Oil	0.970***	0.892***	0.960***	0.970***	0.970***	0.971***	0.979***	0.977***
	(0.00378)	(0.00340)	(0.00479)	(0.00445)	(0.00376)	(0.00381)	(0.00374)	(0.00697)
Coal	-0.0219**	-0.00493	-0.00383***	-0.0219**	-0.0219**	-0.0220**	-0.0236***	-0.0186
	(0.00868)	(0.00878)	(0.00111)	(0.00911)	(0.00885)	(0.00865)	(0.00849)	(0.0140)
Temperature	-0.00480	-0.00480	7.55e-05	-0.00480	-0.00480	-0.00374	-0.00374	-0.00125
	(0.00759)	(0.00757)	(0.000388)	(0.00840)	(0.00752)	(0.00758)	(0.00755)	(0.0153)
Temperature squared	5.43e-05	-2.09e-05	-6.03e-06	5.43e-05	5.43e-05	-1.38e-05	0.000224	-0.000154
	(0.000331)	(0.000326)	(1.65e-05)	(0.000365)	(0.000331)	(0.000331)	(0.000332)	(0.000689)
Constant	1.177***	2.413***	0.0436***	1.177***	1.177***	1.166***	1.078***	1.064***
	(0.170)	(0.157)	(0.0138)	(0.203)	(0.174)	(0.170)	(0.167)	(0.327)
Observations	2,586	2,586	2,586	2,586	2,586	2,546	2,336	534
R2	0.9938	0.9930	0.9936	-	0.9938	0.9938	0.9935	0.9963
F test	20,596.61	17,148.35	19,997.85	14,870.81	-	19,886.89	19,708.92	7,642.00
Prob > F	0.0000	0.0000	0.0000	0.0000	-	0.0000	0.0000	0.0000

Note: The dependent variable is the daily gas price at the hub. In all specifications, we also include day, month, and year dummies. Newey-West standard errors are reported in parentheses. The symbols ***, **, * represent significance at the 1%, 5%, 10% levels respectively.

Table B.3 Robustness checks on the long-run effect (overall effect)

VARIABLES	(1) Baseline (Robust s.e.)	(2) Real prices	(3) Logs	(4) Newey-West s.e. (1 lag)	(5) Bootstrap	(6) 1-month window	(8) 6-month window	(9) Weekly average
Treat	2.604***	2.175***	0.0678***	2.595***	2.595***	2.660***	3.306***	2.522***
	(0.277)	(0.263)	(0.00839)	(0.350)	(0.260)	(0.271)	(0.306)	(0.558)
$Post_{total}$	1.237***	0.0226	0.0491***	3.964**	3.964***	4.936***	1.543***	3.992
	(0.237)	(0.222)	(0.00824)	(1.798)	(1.344)	(1.759)	(0.296)	(3.020)
Treat* $Post_{total}$	-2.746***	-3.137***	-0.0794***	-2.734***	-2.734***	-2.811***	-3.512***	-2.667***
	(0.282)	(0.265)	(0.00859)	(0.355)	(0.264)	(0.274)	(0.312)	(0.565)
Power	0.00315	0.00577	-0.0168*	0.00135	0.00135	0.00151	0.000293	0.000959
	(0.00647)	(0.00614)	(0.0101)	(0.00712)	(0.00633)	(0.00646)	(0.00648)	(0.0175)
Oil	0.785***	0.728***	0.832***	0.717***	0.717***	0.718***	0.779***	0.716***
	(0.0350)	(0.0330)	(0.0174)	(0.0542)	(0.0417)	(0.0428)	(0.0365)	(0.0920)
Coal	-0.0327***	-0.0283***	-0.0244***	0.00198	0.00198	0.00741	-0.0310***	0.00330
	(0.00558)	(0.00534)	(0.00253)	(0.0315)	(0.0235)	(0.0250)	(0.00710)	(0.0528)
Temperature	-0.0451	-0.0739**	-0.00382***	-0.143***	-0.143***	-0.145***	-0.0612*	-0.167*
	(0.0345)	(0.0330)	(0.00115)	(0.0450)	(0.0362)	(0.0369)	(0.0345)	(0.0856)
Temperature squared	0.000370	0.000960	0.000102**	0.00333**	0.00333**	0.00346**	0.00129	0.00381
	(0.00140)	(0.00133)	(4.07e-05)	(0.00169)	(0.00139)	(0.00140)	(0.00143)	(0.00372)
Constant	3.469***	4.434***	0.574***	3.288	3.288**	2.899*	3.448***	3.257
	(0.675)	(0.646)	(0.0584)	(2.013)	(1.556)	(1.625)	(0.873)	(3.204)
Observations	2,715	2,715	2,715	2,715	2,715	2,675	2,464	560
R2	0.8622	0.8702	0.9467	-	0.8773	0.8766	0.8584	0.8850
F test	279.72	256.39	5,112.40	1,658.09	-	2,582.11	222.28	697.62
Prob > F	0.0000	0.0000	0.0000	0.0000	-	0.0000	0.0000	0.0000

Note: The dependent variable is the daily gas price at the hub. In all specifications we also include day, month, and year dummies. Newey-West standard errors are reported in parentheses. The symbols ***, **, * represent significance at the 1%, 5%, 10% levels respectively.

Table B.4 Robustness checks dropping periods of price spikes

VARIABLES	(1) Effect of event 1 with two months dropped	(2) Long-run effect with two months dropped
Treat	1.341***	1.342***
	(0.418)	(0.421)
Post	0.783	1.414
	(0.982)	(2.412)
Treat*Post	-1.114***	-1.483***
	(0.430)	(0.427)
Power	0.000648	-0.00198
	(0.00201)	(0.00269)
Oil	0.731***	0.789***
	(0.0712)	(0.0570)
Coal	0.103	-0.0261
	(0.0757)	(0.0411)
Temperature	-0.195*	-0.140**
	(0.106)	(0.0637)
Temperature squared	0.00522	0.00378*
	(0.00340)	(0.00198)
Constant	-2.946	4.528*
	(4.225)	(2.411)
Observations	1,669	2,625
F test	880.77	1,031.08
Prob > F	0.0000	0.0000

The dependent variable is the daily gas price at the hub. The sample size cut out November 2005 and March 2006 (the periods with the most extreme spikes). We control for prices of gas, oil, and coal, as well as temperature (both linear and quadratic), day, month, and year dummies. Newey-West standard errors with 7 lags standard errors are reported in parentheses. The symbols ***, **, * represent significance at the 1%, 5%, 10% levels respectively.

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