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Forward integration and market entry: Evidence from natural gas markets for household customers in Germany

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Evidence from Natural Gas Markets
for Household Customers in Germany**

Vigen Nikogosian and Jürgen Weigand

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Non-technical summary

In contrast to residential electricity markets in Germany, the entry of newcomers in residential natural gas markets is not frequently observed. Newcomers might face difficulties in purchasing gas on the wholesale market and in transporting it across geographically distinct market areas within Germany. The latter caused by pipeline capacity constraints between those areas, while the wholesale markets, on the other hand, suffer liquidity problems. For newcomers themselves gas imports to Germany are de facto unrealizable due to pipeline bottlenecks at the border. These pipelines are operated by gas importing firms, which maintain long-term contracts with mainly foreign gas producers. About 90 percent of total consumption is imported by 5 major gas importing firms. Two of those namely, E.on and RWE, are extensively forward integrated with retail (downstream) incumbents supplying retail markets. Due to potential abuse of the market power in wholesale and retail markets, the German Federal Cartel Office prohibited further forward integration from 2005/2006 to 2010. The Authority argued that the very few dominant gas importing companies, which also own and operate the gas pipelines, could have an incentive to foreclose the competitors or deter entry in retail markets.

Our study aims at investigating the effects of vertical integration between gas importers and retail incumbents on market entry of newcomers. To preserve retail subsidiaries' profits, natural gas importers may wish to deter market entry, since in markets for household customers entry induces business stealing rather than market expansion. To analyze possible vertical integration issues empirically we employ cross sectional data (for September 2009) for about 500 sub markets for household customers in Germany. For this purpose ownership and market entry data were merged, and market and consumer characteristics were taken into account. Applying a structural entry model, which is based on market entry model introduced by Bresnahan and Riess (1991), our estimation results do not show clear evidence that market entry of newcomers is restricted by vertical integration. Therefore, we conclude that the decision of the German Federal Cartel Office to repeal the regulation of vertical integration in 2010 was appropriate. However, the estimation results show that in high quality gas markets, there are more market entries than in low quality gas areas. Further investigations have to be conducted for those markets.

Das Wichtigste in Kürze

Im Vergleich zum Strommarkt für Haushaltskunden in Deutschland ist die Anzahl neuer Wettbewerber, die in den seit Jahren liberalisierten Gasmarkt eingetreten sind, sehr gering. Dies könnte daran liegen, dass sowohl die Gasbeschaffung auf dem Großhandelsmarkt als auch möglicherweise der Transport zwischen unterschiedlichen Großhandelsmärkten innerhalb Deutschlands problematisch sind. Insbesondere die Kapazitätsengpässe der Hochdruckleitungen zwischen den Großhandelsmärkten und die Tarifstruktur stellen Hindernisse für die Händler dar. Zudem sind es die illiquiden Großhandelsmärkte, die den Handel und damit den Wettbewerb nicht richtig aufkommen lassen. Der eigenständige Import aus dem Ausland ist für neue Wettbewerber ebenfalls kaum zu bewerkstelligen, denn die Pipelinekapazitäten an den Grenzen sind mittel- bzw. langfristig ausgebucht. Fünf große Gasimporteure, die einen großen Teil der Verbrauchsmenge nach Deutschland importieren (etwa 90%), betreiben die Pipelines und kontrollieren damit das gesamte Gasfernleitungsnetz in Deutschland. Zwei dieser Gasimporteure, nämlich E.ON und RWE, sind auch im Einzelhandel aktiv bzw. halten viele Beteiligungen an ehemaligen Monopolisten im Einzelhandel. Aufgrund dieses Missbrauchspotentials im Groß- und Einzelhandel, das durch die Kontrolle der Wertschöpfungskette begründet ist, untersagte das Bundeskartellamt weitere vertikale Verflechtung bzw. die Eigentumsbeteiligung der Gasimporteure an Einzelhandelsunternehmen in den Jahren 2005/2006 bis 2010.

Das Ziel dieser Analyse ist die Erforschung der Effekte der vertikalen Integration bzw. der Verflechtung der Gasimporteure mit dem Einzelhandelsunternehmen auf die Markteintritte von Wettbewerbern. Denn die vertikal verflochtenen Unternehmen haben möglicherweise den Anreiz den Wettbewerb im Einzelhandel zu verhindern, da Markteintritte zu einem intensiveren Wettbewerb führen. Um dies empirisch zu untersuchen, wurden Querschnittsdaten für etwa 500 Märkte (für September 2009) aus unterschiedlichen Quellen herangezogen. Diese beinhalten nicht nur Informationen über die Eigentumsstruktur, sondern auch über Markteintritte sowie Markt- und Kundencharakteristiken. Für die Schätzung wenden wir das strukturelle Markteintrittsmodell von Bresnahan and Reiss (1991) an. Unsere Schätzergebnisse zeigen keine eindeutigen negativen Effekte auf die Markteintritte, die durch vertikale Verflechtung entstehen könnten. Deshalb war die Aufhebung des aufgehängten Verflechtungsverbots durch das Bundeskartellamt im Jahr 2010 sinnvoll. Allerdings zeigen die Ergebnisse, dass in Märkten mit geringer Gasqualität weniger Eintritte zu beobachten sind, was tiefergehender untersucht werden sollte.

Forward Integration and Market Entry – Evidence from Natural Gas Markets for Household Customers in Germany

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Abstract:

Due to potential abuse of the market power at wholesale and retail market level for natural gas the Federal Cartel Office in Germany prohibited further forward integration of gas importing firms with retail incumbents from 2005/2006 to 2010. The Authority argued that the very few dominant gas importing companies, which also own and operate the gas pipelines, could have an incentive to foreclose existing competitors or prevent potential market entry. However, two of the importing companies remained extensively forward integrated. To analyze possible forward integration issues empirically we employ cross sectional data (for September 2009) for about 500 sub markets for household customers in Germany. These submarkets have different vertical ownership structures. Our data set contains information on ownership and market entry. By applying a market entry model, which is based on the framework introduced by Bresnahan and Reiss (1991), we do not find clear evidence that market entry is restricted by forward integration of gas importers and retail incumbents.

Keywords: Energy markets, natural gas, market entry, forward integration, vertical integration, market foreclosure

JEL Class: L40, L42, L94, L97

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Introduction

Natural gas in Europe and in Germany is of strategic importance for electricity generation and heating. Since Germany's decision in 2011 to phase out nuclear electricity generation, natural gas has become more crucial for the security of the nations' electricity supply. Beside electricity generation, gas is used extensively for cooking and heating in German households. Despite the economic crisis in 2007/2008, price changes and other shocks in recent years, households' total gas demand has remained constant. Interestingly, as the wholesale gas price fell in 2009, the prices for household customers followed the wholesale price changes only moderately.

In contrast to residential electricity markets in Germany, the entry of newcomers in residential gas markets is rather rare. Newcomers might face difficulties in purchasing gas on the wholesale market and in transporting it across geographically distinct market areas within Germany. The latter caused by pipeline capacity constraints between those areas, while the wholesale markets, on the other hand, suffer liquidity problems. For newcomers themselves gas imports to Germany are de facto unrealizable due to long run pipeline bottlenecks at the border. These pipelines are operated by gas importing firms, which maintain long-term contracts with mainly foreign gas producers. About 90 percent of total consumption is imported by 5 major importing firms. Two of those, E.on and RWE, are extensively forward integrated with downstream incumbents supplying the retail markets. Due to potential abuse of market power at upstream and downstream level the Federal Cartel Office prohibited further forward integration of natural gas importers (NGI) from 2005/2006 to 2010.¹ The Authority argued that the very few dominant gas importing companies, which are already extensively integrated and also own and operate the gas pipelines, could have an incentive to foreclose existing competitors or prevent potential market entry.

There exist a large number of studies on vertical integration. In general, the effects of vertical integration on downstream market performance could be twofold. Potential efficiency gains caused by vertical integration under a particular market structure are well known in theoretical literature. For example, double marginalization is an argument in favor of vertical integration. In contrast, concerns about negative welfare effects caused by foreclosure or exclusion of competitors are rare and brought forward only in particular industries. Hastings and Gilbert (2005) analyzed the US gasoline market and found evidence for foreclosure. Another example is Chipty (2001) for Cable TV programs. Chipty's analysis shows that vertical integrated firms tend to exclude rivals by denying access to the distribution network. Most of the conducted research, however, does not find any evidence

¹ Long term contracts with a length of more than 4 years were also prohibited from 2006 until 2010.

that integration cause exclusion of rivals.² Thus, vertical integration is classified as less harmful than horizontal integration.

In this paper, we aim at shedding light on the effects of the vertical integration of gas importing companies with downstream incumbents on potential newcomers and their decisions to enter a particular geographically delineated sub market for household customers. We employ cross sectional data for September 2009 and analyze the impact of integration on newcomers' variable profits. Our empirical model is based on market entry model introduced by Bresnahan and Reiss (1991), which describes the equilibrium number of newcomers in a local market. This model relies mainly on the assumption that entry occurs as long as expected profits of potential entrants are non-negative. Under particular assumptions the model allows revealing the variable profit of newcomers and the magnitude of the effects arising from vertical integration.

The paper is organized as follows. First, we briefly describe the German gas market and discuss the potential problems newcomers probably face by entering downstream markets. In the next section, we discuss the free market model and show how it could reveal the information we need to make a statement about effects of vertical integration on newcomers' variable profits. In section 4 we describe the data employed in our empirical analysis. The data have been merged from different sources and required extensive analysis of the ownership structure. We continue with a discussion of the empirical specification and show the estimation results. In the final section, we present a conclusion based on the results.

German natural gas market

The gas market in Germany consists of two main sub-markets: gas trading and gas transportation. While gas trading at the wholesale and retail level has been liberalized, the transportation, as a natural monopoly, is regulated. In contrast to the German electricity market, the liberalization process of the gas market was extremely tedious due to numerous regime changes. The starting point for the liberalization was the introduction of European law that forced all European countries to open their network industries for competition at the end of the 1990s. As the gas market structures among the countries differed from each other substantially, each country had the opportunity to implement its own regulations and requirements within the given framework. This led to different market designs. Some countries, including Germany, engaged in a trial and error process to select the best working market mechanism. So, for example, the regulation of gas transport with a so called 'point to point' regime, which required that a firm that wanted to supply a customer in area A while the gas is in B, had to negotiate and sign contracts with all pipeline and distribution system operators that lie between A and B. Since there could be numerous operators to negotiate

² See, e.g., Hortascu and Syverson (2007) for the cement industry, Mullin and Mullin (1997) the steel industry.

with, this type of regulation led to high transaction costs and became impracticable. Based on this experience the Federal Network Agency (BNetzA) has switched to another regime which allows the firms to ship gas with only two formal agreements. The so called 'entry-exit' model requires one contract for 'entry' (point where gas from outside enters a pipeline or a network system) and one contract for 'exit' where gas is taken out the network (for example by a consumer). In contrast to 'point to point,' the handling between entry and exit point is realized solely by network operators. The network access charges for the volume which enters and exits the system are regulated. This type of market design turned out to be more successful than the previous one and led to some market entry of newcomers. However, the trial and error process caused a delay in development of competition compared with the electricity market in Germany.

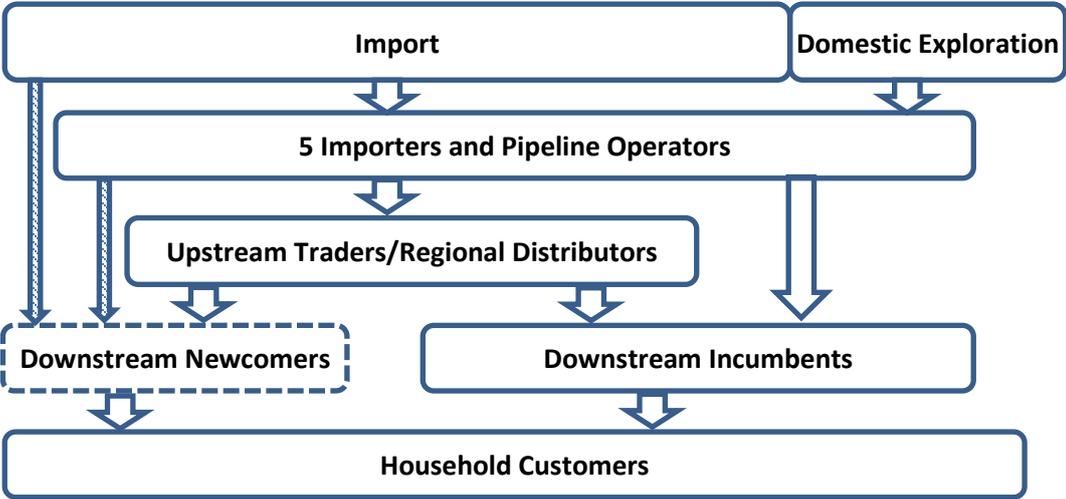


Figure 1: Natural gas market structure in Germany

Natural gas demand in Germany is mainly satisfied by gas imports. As mentioned above, about 90 percent of the total market consumption (914 TWh/a in 2009) has to be imported to Germany; it comes mainly from Russia, Sweden and the Netherlands. There are five firms at the wholesale level that import gas to Germany and which cover almost the entire consumption. Natural gas importers (NGIs) generally have long term contracts with foreign natural gas producers. Usually, these are take-or-pay contracts signed for up to 25 years, where the price might be tied (with a time lag of 6 months to) to the oil price.³ Most of the long-term contracts originated before market liberalization took place. Beside the gas import, the NGIs also operate their own pipeline systems in Germany and control the connecting points at the German border.⁴ In the case that a competitor would like to import

³ Germany acts as a transfer country for natural gas transport from Eastern Europe to France, Spain or Italy. Usually, foreign firms have to buy pipeline capacities from German NGIs if they are not operating their own.

⁴ In a special report, the Federal Network Agency investigated the competition between pipelines and concluded that NGIs' pipelines, in fact, do not face competition. The geographic location of pipelines is an

gas to Germany, existing bottlenecks at the German border could put an end to that project. The capacities are booked out for a long period in advance (at least two years in advance), mostly by the NGIs.⁵

Beside the lack of available capacity at the German border, the upstream (wholesale) market is geographically divided into several market areas. These are delineated by capacity constraints of connecting points between different pipelines (operators). If for example E.ON and RWE each operate a pipeline that have a common connection point without any capacity constraints, then the two pipelines delineate one market area. In contrast, capacity constraints at the connection point would divide this area into two market areas, even when these are not physical but contractual capacity constraints. Each market area has its own virtual wholesale market. Trading across markets is not only difficult, due to the capacity, but also expensive. Since the 'entry-exit' rule applies also in cross market trading, a firm with gas located in market A that wants to supply customer in market B pays an 'exit' charge in A, an 'entry' charge in B and finally an 'exit' charge in B when customer withdraw gas out of the system. Among other factors, this causes a low liquidity in the wholesale market. Interestingly, upstream market areas equaled the areas served by only one gas importer and pipeline operator. However, the NGIs were under the pressure to reduce the number of market areas through bilateral agreements. Consequently, the number of the upstream market areas fell from 13 in 2007 to 6 in October 2009.⁶ To overcome the liquidity problem the authority aims at reducing the number of wholesale markets to only two by October 2013.

Wholesale trading takes place mainly over the counter. In general, the importers signed bilateral supply contracts with retail incumbents. Until 2006, these contracts used to have a very long duration (up to 25 years). Between 2006 and 2010 the Federal Cartel Office prohibited such long term contracts and allowed only contract terms with maximum 4 years. Only a marginal part of the total consumption (1.6 percent of all trades in 2009) is traded at the energy exchange. Although some of the regional network operators buy their balancing gas at the exchange, it still is quite illiquid. Therefore, the resulting price at the exchange is not a reference price for other wholesale contracts.

important factor for the competition intensity between operators. As the pipelines are connected with the distribution network in regional and local markets, suppliers in retail markets can transport gas only through the pipelines which have a connection to a local market that they would like to supply. Thus, the majority of downstream network operators, which have access to only one pipeline, would suffer monopoly pricing and discrimination. Therefore, the Federal Network Agency has implemented the regulation of the access charge for pipelines.

⁵ Interestingly the capacity constraints arise from the contractual situation rather than from physical constraints.

⁶ In general a 'gas-year' in Germany begins in October and ends in September in the following year. Therefore, most changes in structure, prices and demand are realized or implemented in October.

The downstream retail market for household customers in Germany is geographically divided into 700 sub markets. According to German Competition Authority, the markets are geographically delineated by the supplied area of a distinct distribution network operator. Thus, only one distribution network operator serves a sub market. As in the electricity markets, this market definition is applied, in cases of abuse of market power of dominant firms, by the Authority. In each of these markets only one incumbent supplier (former monopolist) is providing gas to the majority of household customers. Mostly the incumbent is vertically integrated with the distribution network operator and switching of households from incumbent to new supplier is very rare. Beginning with market liberalization until the end of 2009 only about 5 percent of the overall household consumption was supplied by firms other than the local incumbent. On average, the incumbent has 90 percent of the market share for household customers. Compared with electricity markets in Germany, gas markets still lack newcomers. On average there are only five newcomers and six 'incumbent-entries' in each of these markets (in 2009). However, one has to distinguish between newcomer und incumbent entries. The latter means that an incumbent in market A enters retail market B where another incumbent serves the customers.⁷ We discuss the difference while describing the data below.

Until 2009 the main issue for newcomers, however, remained the upstream market that lacked liquidity and available pipeline capacities. The situation has changed slightly since October 2009: the number of wholesale market areas has been reduced from 13 to 6, and, at the same time, the gas consumption of German manufactures decreased significantly due to the worldwide financial crisis. Since that time, the prices at the wholesale markets have dropped and gas importers that had long term take-or-pay contracts with foreign gas producers met problems due to gas price coupling to the (world) oil price. Thus, if a contract was tied in with the oil price, the NGI had to pay a higher price to the producer than the price he received at the German wholesale market. Interestingly, the retail prices for household customers dropped by only nine percent while the prices at the wholesale market decreased more than 50 percent.⁸ Regardless the crisis and the price drop the household gas consumption remained constant.

While the major importing firms operate their own pipelines, two of them are extensively forward (vertically) integrated with the downstream incumbents. E.on and RWE are the biggest importers and besides the forward integration with retail incumbents they also have their own retail departments. In our analysis we distinguish between own downstream (self-operated), direct forward integrated and indirect integrated incumbents. The latter is the case when the importer does not directly holds stakes in downstream incumbents but through other (shareholding) subsidiaries. Moreover, E.on and RWE are fully integrated with local distribution network operators in their self-operated retail markets. Thus, they control

⁷ In some cases local incumbent and 'entrant' are the same firm, so they are horizontally integrated. This allows brand and price differentiation for those customers who want to switch suppliers.

⁸ Bundesnetzagentur 2010

the complete vertical chain. Observing this market structure, the question arises how strategic interventions of dominant upstream and downstream incumbents could affect market entry of newcomers.

Econometric model

While the bulk of vertical integration literature focuses on firms' performance differences which arise through integration, we are rather interested in the effects of vertical integration on competitors. In particular, we are interested in answers to question how forward integration affects the market entry decision. We presume that in downstream markets for household customers (where the incumbent is a subsidiary of one of the major gas importers) retail competitors face higher (upstream) costs. The rationale could be the protection of the own downstream subsidiary from competition and retaining the generated profits in downstream. As household consumption is assumed to be constant⁹ (at least in the short run), entry of newcomers triggers business stealing effects rather than market expansion effects.¹⁰ Thus, the first derivative of given total demand function in market i , $D_i = D_i(N_i, \cdot)$, with respect to the number of competitors N_i is equal zero: $\frac{\partial D_i}{\partial N_i} = 0$.¹¹ However, the individual demand of each firm d_N is negatively affected by the number of competitors: $\frac{\partial d_N}{\partial N_i} < 0$. Thus, poaching customers results in lower prices than without market entry.¹² Given this demand situation and the entry effect, a vertically integrated incumbent potentially loses market share in its retail business. Now assume that at the profit function of the integrated incumbent is $\pi = (P_d - c_u - c_d)d_d + (P_u - c_u)(D - d_d)$, where $d_d = d_d(N_i, \cdot)$ is incumbent's demand in downstream, P_j incumbent's prices in downstream and upstream, respectively. The marginal costs downstream and upstream are represented in c_j . The losses in the downstream market when entry occurs could be compensated with additional profits at the wholesale level by selling the residual demand, $D_R = D - d_d$, to newcomers at the optimal P_u . Thus, if the integrated incumbent is the only one supplying gas at the wholesale level, the total profit is maximized by choosing the optimal number of newcomers N as they affect downstream and, at the same time, the upstream profit of the monopolist.¹³

Two aspects have to be noticed: First, beside the price inelastic household demand firms supply also industry customers that show lower price elasticity and market expansion effects may appear to be due to higher downstream competition. Second, there could be other upstream firms active in the market. However, in 2009 many wholesale markets were

⁹ Bundesnetzagentur 2010

¹⁰ See for example Ferrari & Verboven (2010) who consider the two effects caused by market entry of new press shops.

¹¹ In case of market expansion, we rather would observe $\frac{\partial D_i}{\partial N_i} > 0$, that is, total demand rises with additional market entry.

¹² See also the extensive literature on pricing behavior in markets with switching and searching costs.

¹³ See for example Ferrari & Verboven (2010)

delineated by an area supplied by a single pipeline operator and a gas importer. Despite the fact that the price at the gas exchange fell in 2009 the liquidity problem remained in that market areas. If a newcomer wanted to buy gas at a liquid wholesale market, the transport to the target market could be either costly because of the 'entry-exit' regulation or not possible due to capacity constraints.

To analyze vertical integration effects on market entry decisions of newcomers we use an empirical entry model, which has been introduced by Bresnahan and Reiss (BR, 1991) and describes the equilibrium number of newcomers in a market. The assumption of free entry is associated with the zero profit condition, that is, as long as one firm earns non-zero profits potential competitors will enter the market if their expected profits are non-negative. The entry process continues until a potential entrant's expected profits are negative. Due to free market entry, the profits of all entrants fall to zero as the assumption in BR model is that all firms are equal and earn the same profits if they decide to enter the market.¹⁴ So, the zero profit condition is required to identify the variable profits or the fixed costs of the firms, respectively. The main question we are interested in is how variable profits are affected by market and demand characteristics which influence newcomers' entry decisions into the downstream market.

Let us assume that a firm enters market i and earn profits:

$$\pi_N = d_N v_N - F_N,$$

where d_N is N-firm's demand, v_N per-capita variable profit and F_N firm's fixed cost. Further decomposition of the total variable profit V_N leads to:

$$\pi_N = S k_N (P_N - c_N) - F_N.$$

As we consider entry of N newcomers, competition is poaching customers away from incumbents. Thus, newcomers compete for customers with relatively low search and switching costs who are willing to switch their current incumbent supplier. Switching occurs when related costs are lower than the price difference and savings, respectively. The demand for each newcomer can be defined as a product of total market size S and a fraction of customers k_N which are attracted by a newcomer. Due to the symmetry assumption, all newcomers have the same market share k_N . The per firm demand multiplied with per-capita profit, that is equilibrium price P_N minus variable cost c_N , equals the total variable profit $V_N = S k_N (P_N - c_N)$. The newcomers which have entered the market set the equilibrium price P_N that determines the demand for newcomers. We abstract from price discrimination that newcomers could be engaged in and, as in BR, assume symmetry among newcomers, so that everything, including costs and resulting profits, is the same for each newcomer.

The determinants of total variable profit are then:

¹⁴ This assumption is reasonable as the newcomers considered here were not involved in gas market before market liberalization and have no ownership links to incumbents which presumably have a different cost structure.

$$V_N(Y_i, Z_i, N_i, P_N, X_i, W_i, Own_i) = S_i(Y_i)k_N(P_N, Z_i)[P_N(N_i, Z_i, W_i, Own_i) - c_N(W_i, Own_i)]$$

where the market size S_i in market i is a function of the usual market characteristics Y_i which determine the total market demand, such as total number of households, number of houses or buildings with many flats and further exogenous variables that we discuss in the data section. The fraction of customers that switch to a newcomer depends on the equilibrium price P_N and on the customers' characteristics, Z_i . For example, a customer with higher education is more likely to switch than a customer with lower education.¹⁵ All characteristics of customers in a particular market captured in Z_i affect the fraction of switched customers. Thus, total market demand multiplied with the fraction k_N equals newcomer's demand d_N . The equilibrium price is a function of the number of competing firms N_i , customer characteristics Z_i , market specific cost shifters W_i , such as distribution charges, and finally the ownership structure of local incumbent Own_i . We capture the degree of integration Own_i taking values $[0, 1]$ on importers' shares in downstream incumbent.

BR assume that fixed cost of newcomers, F_N , beside the variable profits, are affected by the number of entrants. We give up this assumption because we do not think that this applies in the gas market for household customers. Thus, our fixed cost $F_N(W_i)$ in the profit function π_N is not affected by the number of newcomers in a certain market, affected are rather the variable profits of newcomers due to increased competition. We assume that local cost shifters W_i , in particular the density in market area, which should be correlated with advertising costs, have an impact on the fixed cost.

As free entry lowers firms' profits in a particular market to zero, this results in the following equilibrium number of firms that a market can host:

$$\pi_N = V_N(N_i, \cdot) - F_N \geq 0 \text{ and } \pi_N = V_N(N_i + 1, \cdot) - F_N < 0,$$

which means that if an additional firm enters the market all newcomers gain negative profits due to the symmetry assumption. Therefore, in equilibrium we would observe the N_i newcomers each with $\pi_N \geq 0$. This restriction allows identifying the fixed cost and variable profit shifters as $V_N(N_i, \cdot) \geq F_N > V_N(N_i + 1, \cdot)$, e.g., firms enter as long as their fixed costs are covered by the variable profits.

Econometric specification

To estimate the effects of vertical integration, we first specify the profit function of a newcomer $\pi_N = Sk_N(P_N - c_N) - F_N$. Here, we follow the approach of Abraham et al.

¹⁵ A survey conducted by the geo-marketing company Axiom shows which of the customer characteristics are correlated with the willingness to switch their supplier.

(2007) and take logarithmic specification instead of linear functions as in BR. Below we show the specifications for the components of the profit function:

$$S_i(Y_i) = \exp(Y_i\lambda)$$

$$k_N(P_N, Z_i) = \exp(Z_i v_z + W_i v_w + Own_i v_o - v_N)$$

$$v_N(N_i, Z_i, W_i, Own_i) = P_N - c_N = \exp(Z_i a_z + W_i a_w + Own_i a_o - \alpha_N)$$

$$F_N(W_i) = \exp(W_i \eta_w)$$

As demand data is not available we apply a reduced profit model. The vectors of the parameters $\lambda, v_z, v_w, v_o, a_z, a_w, a_o, \eta_w$ show the effects of the exogenous factors that we include in our estimation. The effects of market entry or the number of newcomers are captured in parameters v_N and α_N in the demand equation and per-capita profit equation, respectively. Note that in contrast to Abraham et al. (2007) per firm market share does not increase with the number of newcomers. Due to business stealing effects, which exceed market expansion effects, the per firm share of switchers would decline with increasing number of firms. The same is true for per-capita profit that declines with the number of competitors. Thus, increasing v_N and α_N indicate a decrease in per firm profit due to market entry. Assembling all the specified profit function components and including error terms for variable profit and fixed cost functions, we construct the total profit function:

$$\pi_N = \exp[Y_i\lambda + Z_i(v_z + a_z) + W_i(v_w + a_w) + Own_i(v_o + a_o) - v_N - \alpha_N + \varepsilon_v] \\ - \exp[(W_i\eta_w + \varepsilon_F)]$$

Applying the non-zero profit condition to the profit function we obtain the compactly written function

$$\pi_N = -\theta_N + Y_i\lambda + Z_i\beta + W_i\delta + Own_i\gamma + \varepsilon_{ij} \geq 0,$$

$$\text{with } \beta = v_z + a_z; \delta = v_w + a_w - \eta_w; \gamma = v_o + a_o; \theta_N = v_N + \alpha_N; \varepsilon_{ij} = \varepsilon_v - \varepsilon_F$$

Note that we can identify the effect of market entry on variable profits with θ_N but we cannot distinguish between v_N and α_N , separately. The error term ε_{ij} , which consists of the error ε_v in variable profit function and the error ε_F in fixed cost function, captures all unobservable factors, in the regional market j and the enclosed local market i , such as cost and demand shifters that are not in our data sample. The definition of our markets follows in the next section. The error term is assumed to be normally distributed with mean zero and standard deviation σ . Further discussion on property of the error term follows in the next section.

According to our assumptions, market entry of a potential competitor does not occur if the following condition holds:

$$Y_i\lambda + Z_i\beta + W_i\delta + Own_i\gamma + \varepsilon_{ij} < \theta_1 .$$

The general term of the argument with N firms can then be written as:

$$\theta_N \leq Y_i\lambda + Z_i\beta + W_i\delta + Own_i\gamma + \epsilon_{ij} < \theta_{N+1},$$

where θ_N and θ_{N+1} are the threshold conditions or boundaries to observe exactly N firms.

As we assume a standard normal distribution for the error term ϵ_{ij} , the probability that a market entry does not occur, i.e. 0 newcomers are in the market, is given by:

$$\Pr(\pi_0) = \Pr(Y_i\lambda + Z_i\beta + W_i\delta + Own_i\gamma + \epsilon_{ij} < \theta_1) = \Phi(\theta_1 - Y_i\lambda - Z_i\beta - W_i\delta - Own_i\gamma),$$

where $\Phi(\cdot)$ is the cumulative distribution function of standard normal distribution and where the econometric model follows the ordered probit model. Thus the probability for N firms is then given by:

$$\Pr(\pi_N) = \Phi(\theta_{N+1} - Y_i\lambda - Z_i\beta - W_i\delta - Own_i\gamma) - \Phi(\theta_N - Y_i\lambda - Z_i\beta - W_i\delta - Own_i\gamma).$$

Finally, the probability of observing 5 or more newcomers in a market is:

$$\Pr(\pi_5) = 1 - \Phi(\theta_5 - Y_i\lambda - Z_i\beta - W_i\delta - Own_i\gamma).$$

Data

Market definition

A crucial factor in this study is the definition of the market. We could, for example, use the market definition of the Federal Cartel Office (FCO) which delineated the relevant market for household customers in cases of abuse of market power. Thus, the geographical delineation of the relevant market equals the area served by one local distribution network operator and one former downstream monopolist as mentioned in the market description section. These markets, which are very heterogeneous with respect to the covered area, we call incumbent-markets. In the northern part of Germany the market areas are usually larger than in south Germany. Conversely, in south Germany the population and thus the density in markets is greater. In each of the incumbent-markets only one incumbent (former monopolist) serves the majority of the customers. However, for our purposes, market definition according to the FCO might not be suitable. We observe that the newcomers, if they decide to offer gas contracts to households, do that not necessarily throughout the entire incumbent-market but in a particular zip-code area within an incumbent-market. As the incumbent-market might accommodate more than one zip-code area, a cherry-picking strategy is possible. As a consequence, in some cases newcomers' offers are limited to households living in a zip-code area that is one of the few in the incumbent-market. To distinguish between the two market definitions we refer to zip-code-markets and incumbent-markets. As we consider the entry of newcomers that do not offer gas contracts necessarily throughout the incumbent-market, and given the differences in demographic structure among the zip-code areas, we define a zip-code area as the relevant market. Note that the former monopolists' offers are available throughout an incumbent-market and not only in a specific zip-code area. Furthermore, the market specific costs, such as distribution charges, are the same in all zip-code markets within an incumbent-market.

Because the covered areas of the incumbent markets are different, we face some difficulties in cases where, in one zip-code area, two incumbent-markets coexist. Our data for market characteristics is at the zip-code level which means that without further information on the distribution of these characteristics between the two markets making a clear cut assignment is not possible. To avoid any distortion, we decided to consider only the zip-code areas with one single incumbent. Nevertheless, in our estimation we have to take into account the fact that different zip-code-markets could be assembled to one incumbent-market.

As zip-code markets which are part of one incumbent-market might all be affected by common shocks, the error term ϵ_{ij} captures the unobservable determinants in zip-code market i and incumbent-market j . In case an incumbent-market accommodates more than one zip-code market, we allow the error term to correlate between those zip-code markets i which are located within the j market. Otherwise, the assumption of independent distribution of the error term would be violated. As mentioned above, since the incumbent

offers throughout the incumbent-market there could be factors which influence profits of newcomers located only in i but also ones offering throughout the incumbent-market j . Also cost unobservables, for example, required payments which are set up by the local authority (for example pipeline path charges) are relevant in all zip-code areas in the incumbent-market, have to be taken into account.¹⁶ Thus, ϵ_{ij} captures also the variables in j which affect the profits of all newcomers independent of their zip-code-market choice. There are also cost shifters in W_i which are valid throughout the incumbent-market but also which are zip-code-market specific.

Entrants and newcomers

We employ data on all offers at zip-code level available at Verivox, which is one of the biggest price comparison platforms for customers who want to switch their current contract or supplier. The database includes firms that have entered a specific zip-code market by offering a gas contract to household customers. We consider the number of firms that offer contracts for households with yearly 20,000 kWh consumption.¹⁷ It seems that a huge number of market entries occurred but we have to distinguish between different entrant 'types' by analyzing their ownership structure as we otherwise not able to distinguish between newcomers, entry of affiliated firms and incumbent entry. For example, E.on and RWE have created discount brands ('E Wie Einfach' and 'Eprimo') and compete with other entrants in particular markets. Besides, we observe recent market entry of former local monopolists (incumbents) in other markets. Nevertheless, both the importing firms and the former local monopolists do not face the problems of the newcomers (as described above) which first have to purchase gas at the wholesale market. We are particularly interested in 'real' newcomers and thus have selected firms out of the database that do not have any ownership in relation to incumbent companies. Nevertheless, any market entry decision depends on the number of existing firms in the market regardless the ownership relations, and thus, we control for the number of entrants which either are former local monopolist or linked with gas importing firms. The vertically integrated importing firms can influence only newcomers' entry decision. Therefore we treat the number of incumbent-entrants as exogenous.¹⁸

¹⁶ One example is so called „Konzessionsabgabe' which is a permit fee set by the local authority and paid by the suppliers. Unfortunately, we do not have that specific data and capture that in the error term.

¹⁷ This is the typical consumption of a 4 person household or a 100 m² flat.

¹⁸ We also distinguished between incumbent-entrants which are based in the neighbor local market and non-neighbor-incumbent-entrants. Most of them are non-neighbor-incumbent-entrants.

Demand and market characteristics

The market and customer characteristics we use for our estimation proxy electricity demand in zip-code-markets. Data on characteristics are provided by Acxiom, a geomarketing firm that collects such kind of data. Firms that are interested in market entry make use of the data to screen for the most promising entry opportunities. We selected, in particular, variables which correspond with the total market demand, such as number of households, buildings or age of buildings. Furthermore, we use customer characteristics, which reflect the probability of switching to another supplier, as demand shifters. The entry of newcomers causes business stealing rather than market expansion wherein, thus, we have to take into account characteristics which are correlated with the probability of switching. According to results of a survey conducted by Acxiom with household customers the probability of switching is higher among customers with higher education, ages 18 to 40 and with higher monthly income.¹⁹ Acxiom have created an index which shows the household status in terms of education and income, which we also employ.

Market characteristics are mainly the distribution charges which have to be paid if a firm supplies a customer in a retail market. For household customers these are two part tariffs with a variable charge and a fixed part independent of the consumption (the fixed charge also includes the fixed metering price). The distribution charges are regulated and differ among incumbent-markets. The data are provided by E'net, one of the biggest energy information providers in Germany. The databank allows also the geographical delineation of incumbent-markets and the market areas. We are able to distinguish between the (wholesale) market areas to which the incumbent-markets are connected and control for that in our estimation. Note that several retail incumbent-markets have access or are connected to more than one market area.

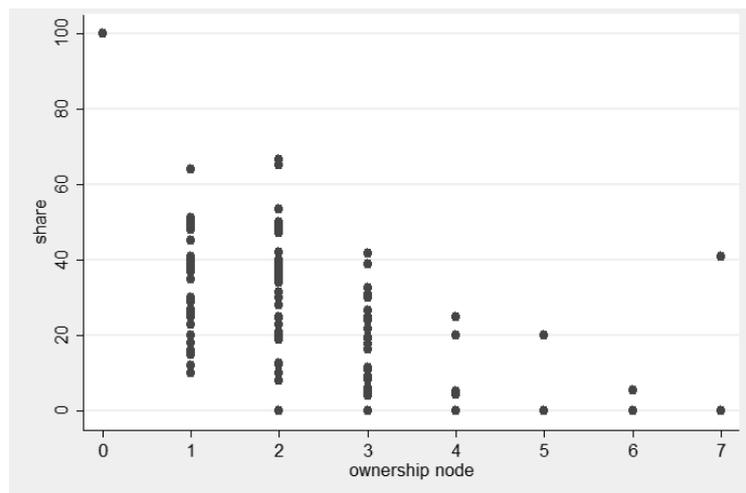
Another variable that enters into the equation affects the fixed cost of the entrants. The density of zip-code-market influences the marketing costs of entering firms. The higher the density, the more potential customers can be convinced to switch. Thus, fixed costs in dense markets might be lower compared with rural markets.

¹⁹ Acxiom conducted a survey among 1.5 Million household customers with 300.000 replies.

Ownership structure

To identify both the 'real' newcomers and forward integrated firms we use data provided by Creditreform. The databank contains ownership information that allows the detection of ownership links which are not directly observable at first glance. As gas importers' shares in the target downstream firm not only held directly but rather on detours, this is a crucial analysis to determine the ultimate firm that holds the stakes at the end of the ownership chain. Figure 2 exemplarily shows E.on's vertical shares in downstream incumbents. Node 0 means that E.on itself operates as downstream incumbent (or has a retail department) in particular markets. Node 1 shows the shares that E.on directly holds in downstream incumbents and for example node 4 indicates E.on's ownership link through 4 intermediary firms. As shown in this figure 2, E.on has 7 nodes at the most. In all nodes greater 1 the ultimate share of an importer in a retail incumbent have to be computed. For example, if E.on holds 60 percent in a firm B, and B in turn has 50 percent share in downstream Incumbent A, when the E.on's ultimate share in A is $0.6 \cdot 0.5 = 0.3$, i.e., is 30 percent.²⁰

Figure 2: E.on's vertical ownership structure



For our purposes, we distinguish between self-operated, directly linked and indirectly linked ownership relations. The latter describes the cases for nodes greater than 2. In contrast, directly linked are all the firms with nodes 1 and 2.²¹

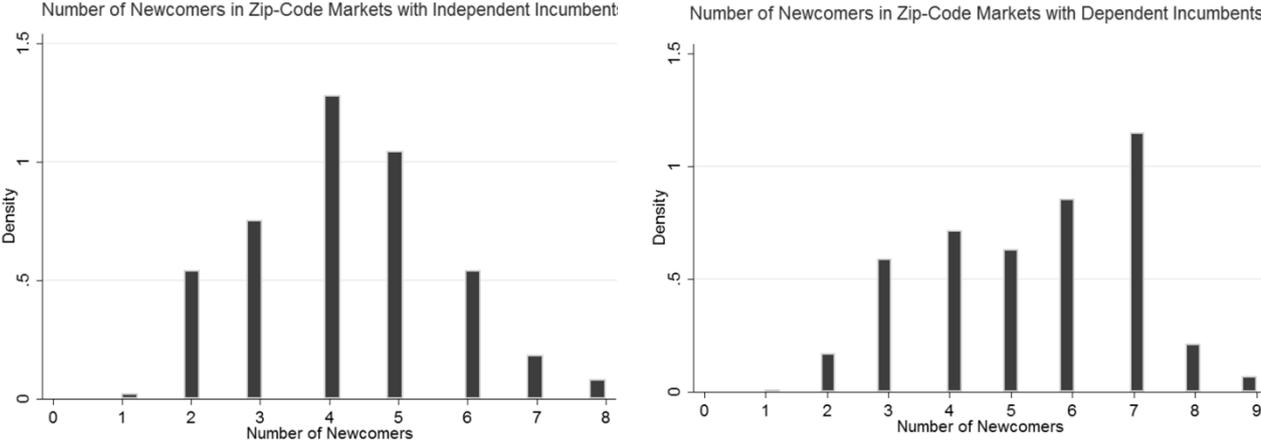
Descriptive statistics

²⁰ There are several ways to compute the ultimate share of a firm which are discussed in the literature. For example the so called 'weakest link' rule, which in the example above, results in an ultimate share of 50 percent. See, for example, Bortolotti et al. (2007)

²¹ We define the cases in the second node as directly linked because the majority of the links go through shareholding firms of the importing companies which were set up to manage the numerous stakes. Recently E.on was forced by the EU Commission to sell its holding society Thüga, which managed E'ON's more than 200 (mostly minority) stakes in downstream companies. Thüga is in our data sample.

As we want to investigate how market entry of newcomers is affected by vertical integration, our first look is directed towards the distribution of the number of newcomers depending on vertical relation with an importer. The left graph in Figure 3 shows the distribution of number of newcomers in zip-code markets where the incumbents are not integrated with gas importers. In contrast, a negative skew of distribution is observed in markets with vertically linked incumbents (indirect shares are not considered). The comparison of distribution shows that the number of entrants is higher in markets with vertically linked incumbents.

Figure 3: Distribution of newcomers



As mentioned above, we distinguish between zip-code markets and incumbent-markets. These are not necessarily equal as Table 1 shows. In our sample, 5900 zip-code markets are covered by only 510 incumbent-markets with a mean of 11 zip-code areas.

Table 1: Number of natural gas submarkets

Number of zip-code markets	5879
Number of incumbent-markets	511
Zip-code markets per incumbent market: min	1
Average	11.5
Maximum	404

Table 2 shows the variables we have included in our estimation. The endogenous variable is the number of newcomers whose ownership is independent from gas importers and downstream incumbents. In each of the zip-code markets there is at least one newcomer active and the maximum number of newcomers is 9. We have grouped the number of newcomers in our estimations for markets with 5 and more newcomers. Regarding the ownership structure we use dummy variables which indicate when the share of importers’

exceeds 50 percent.²² Furthermore, we take into account further competitors, i.e., the number of incumbents that entered a new market.²³

Table 2: Descriptive statistics

Variable	Description	Mean	Std. Dev.	Min	Max
# of newcomers	Number of newcomers	4.317	0.938	1	9
Market Size Y_i					
# of households (hh)	in (1000)	5.241	4.485	0.004	28.089
# of buildings age > 15	in (1000)	0.351	0.307	0.001	2.695
# of buildings age < 25	in (1000)	1.739	1.415	0.002	12.292
# individual houses	in (1000)	1.428	1.253	0.001	12.599
# of buildings > 3 Apt	in (1000)	0.417	0.461	0	3.07
Demand Shifters Z_i					
Share of hh age < 40	# hh age < 40/ # hh	0.357	0.034	0.222	0.573
Share high-status hh	# high status hh/ # hh	0.279	0.237	0	1
Share of 4-pers. hh	# 4-pers. hh/ # hh	0.122	0.033	0	0.25
Purchasing power 3-pers. hh	In Euro (Mio.)	79.905	67.104	0.05	571.536
Jobless rate	In Percent	8.850	4.972	0	32.7
Variable	Description	Mean	Std. Dev.	Min	Max
Cost Shifters W_i					
Network charge (log)	Charge for 20,000 kWh (4-pers. hh)	5.453	0.222	3.599	6.420
Density	# hh/ area (in 1000)	1.117	2.492	0.003	27.404
Further Competitors					
# of Incumbent-Entrants	Incumbents that entered new markets	6.986	3.191	0	18
Self- operated Incumbents Own_i					
E.on_avacon		0.036	0.186	0	1
E.on_bayern		0.032	0.176	0	1
E.on_hanse		0.069	0.253	0	1

²² We also considered the shares in our estimation, however, the results remain unchanged.

²³ As we are interested in the entry of newcomers we treat the number of incumbents that offer contracts in other markets, and thus compete with newcomers, as exogenous. To take into account the influence of the entered incumbents on newcomers' profitability we include that number in our estimation.

E.on_mitte		0.017	0.131	0	1
E.on_thüringen		0.016	0.125	0	1
E.on_westfalen		0.007	0.082	0	1
E.on_edis		0.008	0.087	0	1
RWE		0.032	0.176	0	1
		Mean	Std. Dev	Min	Max
Direct Ownership Own_i					
D. E.on > 50%	Dummy: 1 if more than 50 percent	0.083	0.275	0	1
D. RWE > 50%	Dummy	0.018	0.134	0	1
D. GDF > 50%	Dummy	0.004	0.061	0	1
E.on direct share	Direct share in downstream incumbent (%)	11.696	20.380	0	66.5
RWE direct share	in (%)	2.833	11.293	0	100
VNG direct share	in (%)	0.851	4.487	0	25
GDF direct share	in (%)	0.190	3.098	0	51

Endogeneity

The market characteristics which we do not observe might be correlated with the vertical ownership and with the number of entrants. In particular markets which are profitable for entry are probably also attractive for importers to integrate forward with the downstream incumbent. As we consider the entry in particular zip-code area, newcomer's decision to enter a market will depend on characteristics at zip-code level. For example, a newcomer would enter a market if, given the demand characteristics in the zip-code market, the expected profits are positive. In contrast, a gas importer might want to integrate forward if the demand characteristics for the entire incumbent-market area are promising. This depends not only on household demand but also on industry and business customers. Table 3 illustrates the number of served zip-code areas of each of E.on's downstream incumbents.

Table 3: E.on's self-operated downstream incumbents

E.on's downstream subsidiaries (self-operated)	Number supplied zip-code markets	Number supplied zip-code markets, with one unique incumbent
E.on Hanse	504	406
E.on Avacon	227	211
E.on Bayern	203	189

E.on Thüringen	128	94
E.on Mitte	120	102
E.on Edis	73	45
E.on Westfalen Weser	42	40

Furthermore, both E.on and RWE are also the major electricity producers, maintaining about 50% percent of the production capacities in Germany. Therefore, importer's decision to integrate could also be caused by the fact that most of the downstream incumbents supply gas and electricity and serve the majority of the customers in both markets. In contrast, GDF, VNG and Wintershall, the other gas importing companies, are active solely in the gas market and are hardly forward integrated with downstream incumbents.

Estimation results and discussion

We ran five estimations with independent equations between which we vary the controls. The estimation results are shown in Table 6 in the appendix. The first estimation includes only the market size, demand and cost shifters without considering the ownership relations and without controlling for the upstream market areas. In the second and third equation, we take into account the number of competitors (in terms of incumbent-entrants) and the ownership relations, respectively. In the fourth equation we include all controls for upstream market areas. The references are the incumbent-markets that are not assigned to a specific market area. As mentioned above, the importers' downstream ownership is correlated with the geographical location of the market area, therefore we take out the market areas which could cause a bias in the results for markets with vertically integrated incumbents in the fifth estimation.

With regard to the effects of market size, the results show a positive but insignificant effect of the number of households on market entry throughout all estimations. The age of the buildings is an important aspect for indicating market size. In particular in zip-code areas where the buildings are relatively new (< 15 years), heating with gas does not seem to be very common. In areas with older buildings (> 25 years) demand is not significantly affected by the number of buildings in the last two equations although the parameter has a negative sign. Both type of buildings, individual houses and buildings with more than 3 apartments, show significant positive effects in last two equations. However, considering the effects of market size on variable profits, it is shown that in almost all estimations the impact of our variables is relatively low.

Apparently, there are other factors that significantly affect the variable profits of newcomers. If we consider the demand shifters and their effects on variable profits in the first equation, we observe insignificant coefficients in our first estimation, although almost all variables have the expected coefficient sign (except for the share for 4-person

households). When we add the number of incumbent competitors to the first equation, result shows a significant positive effect of growing competition. This means that in markets with more incumbent-entrants we observe more newcomers. We interpret this result as lack of market information (or market knowledge) of newcomers. As incumbents are very well informed about market and demand characteristics which reflect the potential demand, newcomers follow the decision of incumbents by entering the same markets.²⁴ Please recall that we assume the number of incumbent-entrants to be exogenous.

The cost shifters, in particular the network charges, show rather unexpected result. The coefficient for the regulated network access charge is not significant. This result is opposed to findings in electricity markets as shown in Nikogosian and Veith (2011). The study shows that the number of entrants is strongly affected by the network charge. Nevertheless, the electricity markets are much more competitive compared to gas markets as the number of entrants is significantly higher in the former. Regarding the density in a zip-code market, as fixed cost shifter, it shows the expected result with positive sign and significance in all but first estimation. The higher the density the lower the fixed costs, for example, for marketing.

Our third estimation includes the vertical ownership variables (but do not control for the market areas). The result shows positive coefficients for almost all markets with self-operated downstream incumbents. Thus, we do not observe any negative effects of vertical integration on newcomers' profit functions in integrated markets. In markets with directly controlled downstream incumbents, the effects are not significant. In the fourth estimation where we control for market areas, the results for E.on Avancor, Hanse and Thüringen show surprising changes. In contrast to previous results the coefficients turn from positive to negative and remain statistically significant. Disregarding the market areas of E.on and RWE in the last estimation due to multicollinearity issues, again change the coefficients with the exception of E.on Hanse. The results for markets with RWE's operated downstream incumbents also vary substantially throughout the last three estimations. Nevertheless, the results are statistically not significant when we control for market areas.

Furthermore, it seems that in markets in which customers are supplied with 'L-Gas' (low quality gas) from the Netherlands or Sweden less newcomers are active compared to the 'H-Gas' (high quality gas) markets. Currently, the European Commission works on the issues associated with different gas qualities and aims at harmonizing of the gas quality in Europe.

Considering the impact of further market entry on newcomers' profits, the results show that further market entry reduces newcomers' profits. However, the profit reduction caused by

²⁴ This result is robust and the coefficient for the number of incumbent-entrants is significant and positive in all estimations. By adding this variable in our second estimation the coefficients for the demand shifters change as well. In particular, the share of households with members younger than 40 changes the sign from positive to negative and turned out to be significant. The same is true for purchasing power although the sign of the coefficient remains the same. This indicates the multicollinearity of the number of incumbent-entrants with those two demand shifters. However, we keep the competition measure in our estimations since it seems that newcomers follow incumbents' decision and have a significant effect on the profitability of newcomers.

the entry of up to four firms does significantly affect the profits of entered newcomers. Since competition is poaching the customers from each other (especially from the incumbent), competition intensity does not necessarily depend on the number of the newcomers but on the price set by firms. Thus, in the extreme case of Bertrand competition two firms are enough to reach perfect competition where the price reveals the (average) variable costs. As there are other competitors, in terms of incumbent-entrants, in the market the effects of further newcomers seem to be negligible.²⁵

Conclusion

The study aims at investigating the effects of vertical integration between gas importers and retail incumbents on market entry, in particular on profits of market newcomers. To preserve retail subsidiaries' profits, natural gas importers may wish to prevent market entry, since in markets for household customers entry induces business stealing rather than market expansion. For importers it might be possible to hurt newcomers by the limited availability of gas in the wholesale market which is caused by limited foreign purchasing sources and pipeline capacity bottlenecks at German border but also within Germany. Moreover, the pipelines are owned and operated by the (five) major importers. In particular, E.on and RWE, as dominant gas importers, are extensively engaged in downstream business, holding shares in retail incumbents or operating their own downstream subsidiaries. To analyze possible vertical integration issues empirically we apply the empirical market entry framework of Bresnahan and Reiss (1991) employing data for about 500 sub markets for household customers. For this purpose ownership and market entry data were merged, and market and consumer characteristics were taken into account. Controlling for upstream (wholesale) market areas within Germany, we obtained the results identifying the retail markets in which retail sub markets entry is unlikely, for example, due to vertical integration and wholesale liquidity issues.

The results of our empirical analysis show that in a few downstream markets in which E.on has a self-operated subsidiary, the number of newcomers is small compared with other markets. Nevertheless, this outcome seems to be not robust. Therefore, further investigations have to be conducted for those integrated markets that show significant negative effect on market entry as a clear cut result is not possible here. The coefficients for direct ownership do not appear to be significant. In sum, we do not find clear evidence that market entry is restricted by vertical integration of gas importers and retail incumbents. Therefore, we conclude that the decision of the FCO to repeal the regulation of vertical integration in 2010 was appropriate.

²⁵ Although gas itself is a homogenous product, differentiation in prices and contracts details (such as contract term) for certain customer groups (usages) is commonly used by gas suppliers. This may relax competition between the firms and can also lead to negligible effects on profits caused by market entry.

Furthermore, we show that in high quality natural gas markets, there are more market entries than in low quality gas areas. This might be due to liquidity issues specific to these markets. Surprisingly, the results also show that market entry of newcomers and their profits are positively affected by the number of incumbent-entrants that already entered the market. In contrast, demand characteristics play a minor role. In-depth market knowledge of incumbent-entrants can be the rationale behind this finding.

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Appendix A:

Table 4 reports the number of newcomers both in incumbent-markets and in zip-code-market.

Table 4: Number of newcomers

Number of entrants	in incumbent-market	in zip-code-market
1	7	20
2	105	419
3	177	1146
4	189	1591
5	106	1369
6	59	1194
7	34	1307
8	14	238
9	4	61
Sum	695	7345

Geographical location of integrated markets

Table 5 shows the relation between the location of the downstream subsidiary and the importer’s covered upstream (wholesale) market area. About 70 percent of RWE’s self-operated downstream incumbent markets are within their own upstream market area (RWE H-Gas Market area). In contrast, E.on’s self-operated downstream incumbent markets do not have control in their own market area. Nevertheless, the incumbents that supply about 30 percent of the zip-code markets located in E.on’s upstream market area, have direct ownership link to E.on.

Table 5: Relation ownership and upstream market area

	Self-operation	Direct Forward Integration	Indirect Forward Integration
RWE H-Gas Market Area	0.7155	0.1048	-0.0193
RWE L-Gas Market Area	0.2399	-0.0763	-0.0506
E.on H-Gas Market Area	-0.0725	0.2857	0.0942
E.on L-Gas Market Area	0.1527	-0.1617	-0.1533

Appendix B:
Table 6: Estimation results

	(1)	(2)	(3)	(4)	(5)
Market Size Effects λ					
# of households (hh)	0.085 (0.053)	0.079 (0.052)	0.078 (0.056)	0.028 (0.055)	0.010 (0.057)
# of buildings age < 15	-0.351 (0.372)	-0.312 (0.319)	-0.537* (0.322)	-0.844*** (0.315)	-0.742** (0.323)
# of buildings age > 25	-0.463** (0.229)	-0.139 (0.204)	-0.349* (0.187)	-0.213 (0.216)	-0.165 (0.210)
# of individual houses	0.205 (0.292)	0.159 (0.262)	0.402 (0.245)	0.434* (0.241)	0.398* (0.240)
# of buildings > 3 Apt	-0.212 (0.392)	-0.017 (0.395)	0.478 (0.403)	0.662* (0.377)	0.831** (0.390)
Demand Shifters β					
Share of hh age > 40	0.145 (2.497)	-4.125* (2.382)	-5.347** (2.722)	-0.770 (2.702)	-1.285 (2.597)
Share high-status hh	0.571 (0.385)	0.403 (0.326)	0.487 (0.334)	0.296 (0.354)	0.161 (0.330)
Share of 4-pers. hh	-2.782 (2.416)	-0.635 (2.108)	-1.888 (1.986)	-1.090 (1.658)	0.086 (1.732)
Purchasing power 3- pers. hh	-0.001 (0.002)	-0.005*** (0.002)	-0.006*** (0.002)	-0.006*** (0.002)	-0.006*** (0.002)
Jobless rate	-0.005 (0.019)	0.007 (0.019)	-0.010 (0.018)	-0.023 (0.021)	-0.033 (0.022)
Cost Shifters δ					
Network charge (log)	0.263 (0.421)	0.169 (0.380)	0.092 (0.382)	0.271 (0.309)	0.303 (0.326)
Density	0.032 (0.027)	0.063** (0.030)	0.080** (0.032)	0.092*** (0.031)	0.080** (0.033)
# of Incumbent- Entrants		0.274*** (0.027)	0.289*** (0.032)	0.334*** (0.044)	0.349*** (0.043)
Ownership Effects γ					
E.on_avacon			0.485** (0.195)	-1.571*** (0.513)	-0.663 (0.455)
E.on_bayern			1.631*** (0.155)	0.717** (0.365)	0.686** (0.293)
E.on_hanse			0.500*** (0.188)	-1.221*** (0.461)	-1.094** (0.462)

<i>(continued)</i>	(1)	(2)	(3)	(4)	(5)
E.on_mitte			1.176*** (0.166)	-0.507 (0.629)	0.218 (0.448)
E.on_thüringen			0.232 (0.300)	-1.004* (0.522)	-0.356 (0.498)
E.on_westfalen			1.441*** (0.225)	0.856 (0.619)	0.789 (0.487)
E.on_edis			1.551*** (0.405)	1.500*** (0.572)	1.350** (0.540)
RWE			0.820*** (0.149)	-1.266 (1.002)	0.089 (0.721)
Direct Ownership					
D. E.on > 50%			0.312 (0.579)	-0.342 (0.459)	0.031 (0.456)
D. RWE > 50%			0.278 (0.335)	0.099 (0.521)	0.483 (0.374)
D. GDF > 50%			0.403 (0.288)	-0.242 (0.298)	0.203 (0.231)
Market Area Controls					
Bayernets				0.982*** (0.315)	1.009*** (0.305)
BEB H-Gas				1.470*** (0.337)	0.853*** (0.274)
BEB L-Gas				0.229 (0.269)	-0.041 (0.237)
E.on H-Gas				1.143*** (0.242)	
E.on L-Gas				0.063 (0.215)	
Erdgas Münster				-0.000 (0.361)	-0.231 (0.323)
EWE				-2.234*** (0.432)	-1.972*** (0.392)
GDF				-0.119 (0.305)	-0.722*** (0.277)
GVS-ENI				1.258*** (0.357)	0.870** (0.377)
Ontras-VNG				1.775***	1.421***

<i>(continued)</i>	(1)	(2)	(3)	(4)	(5)
RWE H-Gas				(0.386)	(0.345)
				0.126	
RWE L-Gas				(0.320)	
				-0.423*	
Wingas				(0.220)	
				0.721***	0.870***
				(0.258)	(0.238)
Newcomers' Entry Effects					
θ_N					
θ_2 , Firm 2	-2.106 (2.510)	-2.239 (2.250)	-3.186 (2.219)	-0.190 (2.134)	-0.447 (2.228)
θ_3 , Firm 3	-0.718 (2.490)	-0.708 (2.227)	-1.592 (2.193)	1.750 (2.114)	1.323 (2.217)
θ_4 , Firm 4	0.095 (2.527)	0.228 (2.273)	-0.606 (2.235)	2.966 (2.113)	2.448 (2.213)
θ_{5+} , Firms 5+	0.727 (2.523)	1.038 (2.269)	0.246 (2.245)	3.996* (2.129)	3.425 (2.221)
Observations	5,879	5,879	5,879	5,879	5,879
Log likelihood	-6166	-5207	-5014	-4361	-4545

*, **, *** represent significance at the 10, 5 and 1 percent significance levels, respectively.