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Buyer Power and Suppliers' Incentives to Innovate

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Das Wichtigste in Kürze

Zulieferer sehen sich immer wieder mit Kunden konfrontiert, die aufgrund von Konzentrationsprozessen in ihrer Branche über Käufermacht verfügen. Die Ausübung von Käufermacht wird oft als negativ für die Innovationstätigkeit von Zulieferern betrachtet, da angenommen wird, dass sie zu niedrigeren Gewinnen bei den Zulieferern und mithin auch zu niedrigeren Investitionsanreizen führt.

Allerdings können Käufermacht und die damit einhergehenden Wettbewerbsverhältnisse im Käufermarkt die Innovationsanreize des Zulieferers durchaus erhöhen. Wir betrachten sowohl die Preis- als auch die Technologiedimension des Käufermarktwettbewerbs. Firmen, die in intensivem Preiswettbewerb stehen, können ihre Verhandlungsmacht gegenüber Zulieferern dazu nutzen, Kostensenkungen (durch Prozessinnovationen) oder Qualitätsverbesserungen (durch Produktinnovationen) zu fordern, um sich selbst im eigenen Markt von ihren Wettbewerbern absetzen zu können. Zulieferer, deren Kunden in starkem Technologiewettbewerb stehen, müssen notwendigerweise innovativ sein und Wissenstransfer vom Kunden sicherstellen. In beiden Fällen sind Käufer und Zulieferer auf Kooperation und Kollaboration angewiesen, die erhebliche Investitionen verursachen. Dies wiederum stärkt die Verhandlungsposition des Zulieferers und erhöht damit auch seine Innovationsanreize.

Bislang haben sich allerdings erst wenige empirische Untersuchen dem Zusammenhang zwischen Käufermacht und Innovationsanreizen des Zulieferers gewidmet. Die vorliegenden Arbeiten finden regelmäßig einen negativen Effekt, verwenden jedoch keine objektiven Maße bzw. lediglich Maße auf Branchenebene, um Käufermacht abzubilden. Darüber hinaus sind sie auf Branchen beschränkt, die als besonders stark von Käufermacht betroffen gelten, ohne dabei die Wettbewerbsverhältnisse im Käufermarkt zu berücksichtigen.

Wir überprüfen empirisch den Effekt von Käufermacht auf die Innovationsanreize der Zulieferer sowohl in Bezug auf die Entscheidung, in Innovationen zu investieren, als auch auf die Höhe dieser Investitionen. Dazu verwenden wir Unternehmensdaten des Mannheimer Innovationspanels (MIP). Unser Datensatz umfasst 1.129 Unternehmen aus Deutschland aus dem verarbeitenden Gewerbe und dem Dienstleistungssektor. Er enthält Angaben zum Anteil der drei größten Kunden am Umsatz des Zulieferers sowie zu den Möglichkeiten der Kunden zu konkurrierenden Zulieferern zu wechseln, sodass das Ausmaß von Käufermacht objektiv auf Unternehmensebene abgebildet werden kann.

Wir zeigen, dass Käufermacht einen negativen Effekt auf die Innovationsentscheidung eines Zulieferers hat. Dieser negative Effekt wird jedoch abgemildert, wenn sich ein Zulieferer mit Kunden konfrontiert sieht, die ihrerseits in starkem Preiswettbewerb stehen und über Käufermacht gegenüber dem Zulieferer verfügen. Wir finden keine Hinweise darauf, dass Käufermacht einen direkten Einfluss auf die Entscheidung eines Zulieferers hat, wie intensiv in Innovationsaktivitäten investiert wird. Stattdessen finden wir, dass der Effekt von Käufermacht auf die Innovationsintensität des Zulieferers von Grad des technologischen Wettbewerbs im Käufermarkt abhängt. Je stärker dieser Wettbewerb ist, desto niedriger sind die FuE- Investments eines Zulieferers, der sich einem Kunden mit Käufermacht gegenüber sieht.

Non-technical summary

With many industries experiencing significant concentration processes during the last years, suppliers are increasingly confronted with powerful buyers. The common belief is that exertion of buyer power negatively affects the innovation decisions of suppliers. The rationale behind this view is that buyer power leads to decreasing profits of suppliers, which at the same time lowers their investment incentives.

This explanation may be too narrow as competition in the buyer market may spur suppliers' innovation incentives. We consider both the price and the technology dimension of buyer market competition. A powerful buyer confronted with strong price competition might have the incentive to demand lower prices or higher quality in order to gain a cost advantage or to differentiate away from competitors. Moreover, for suppliers exposed to powerful technologically competing buyers it may be a precondition to be innovative and to utilize knowledge spillovers from the buyer side. Then supplier and buyer need cooperation and collaboration which requires considerable investments into their relationship. In turn this leads to a stronger bargaining position for the supplier and thus increases innovation incentives.

A few empirical studies are dedicated to the analysis of buyer power and suppliers' incentives to innovate and they frequently find a negative relationship. However these studies lack an objective measure for buyer power or merely use industry measures. Furthermore the focus is by now on particular industries which are perceived to be heavily affected by concentration processes among buyers. Besides, all these studies tend to neglect the dimensions of competition in the buyer market.

We analyse the relationship between buyer power and suppliers' innovation incentives empirically in different stages of the innovation process. That includes the innovation decision and the decision on the intensity of innovation activity. We apply firm level data provided by the Mannheim Innovation Panel (MIP). Our dataset comprises 1,129 observations from German firms across manufacturing and service sectors and allows us to apply objective measures for buyer power taking account of a supplier’s economic dependency from the largest three customers and the buyers’ opportunities to switch to competing suppliers.

We find a negative effect of buyer power on a supplier’s likelihood to invest in R&D. This negative effect is mitigated by the intensity of price competition in the downstream market. In contrast, we find no evidence of buyer power to affect a supplier’s decision how much to invest in R&D directly. Instead, there is weak evidence that the effect of buyer power depends on the intensity of technology competition in the downstream market. The stronger the technology competition downstream, the lower R&D investments of a supplier confronted with a powerful buyer.

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Abstract

Buyer power is widely considered to decrease innovation incentives of suppliers. However, there is little empirical evidence for this statement. Our paper analyses how buyer power influences innovation incentives of upstream firms while taking into account the type of competition in the downstream market, namely price and technology. We explore this relationship empirically for a unique dataset containing 1,129 observations of German firms from manufacturing and service sectors including information on the economic dependency of firms from their buyers. Using a generalised Tobit model, we find a negative effect of buyer power on a supplier's likelihood to start R&D activities. This negative effect is mitigated if the supplier faces powerful buyers operating under strong price competition. There is also weak evidence for a negative effect of buyer power on suppliers' R&D intensity if the powerful buyer operates under strong technology competition.

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1. Introduction

The impact of market structures on innovation activities has received much attention in innovation research. The vast majority of the literature concentrates on the effects of horizontal competition on innovation incentives and neglects the incentives resulting from vertical interactions in markets. With many industries experiencing concentration processes suppliers are often confronted with powerful buyers. Yet, relatively little is known about how powerful buyers may affect innovation incentives of upstream firms. A common belief is that exertion of buyer power negatively affects innovation decision of suppliers because buyer power will lead to decreasing profits of suppliers, which at the same time lowers their investment incentives. This is expected to reduce the variety in suppliers' range of products (OECD, 1998; European Commission, 1999; Inderst and Shaffer, 2007). However, recent theoretical findings suggest that buyer power might have positive impacts on the suppliers' innovation incentives (Inderst and Wey, 2007; Inderst and Wey, 2011).

So far, the role of suppliers' innovation incentives in the presence of powerful buyers has been discussed largely from a theoretical perspective.[1] From an empirical point of view, only a few studies exist that analyse suppliers' incentives to innovate when facing a powerful buyer. These studies often lack an objective measure for buyer power on firm level but rather use either aggregated industry measures or firms' subjective assessment whether they are confronted with powerful buyers. Furthermore, analyses of the relationship between buyer power and suppliers' incentives to innovate are mostly focused on particular industries which are perceived to be heavily affected by concentration processes among buyers. Besides, all these studies tend to neglect the dimensions of competition in buyer markets.

We argue that it does make a difference for the upstream firm whether it is supplying to a buyer engaged in intensive competition or to a buyer facing no or only low level competition. We consider both the price and the technology dimension of competition in the downstream market. A powerful buyer confronted with strong price competition might have the incentive to align innovation activities along the value chain in order to gain a cost advantage or to differentiate away from competitors. Moreover, it may be a precondition to be innovative and to utilise knowledge spillovers from the buyer side for firms supplying to powerful buyers which are exposed to intensive technological competition. What is more, fierce technological competition in the buyer market may generate new technological opportunities for suppliers to invest in own R&D activities. As a consequence competition in the buyer market may lead to increased innovation incentives on the supply side.

We test these hypotheses empirically with a dataset that contains 1,129 observations from German firms across manufacturing and service sectors based on the German Innovation Survey. In contrast to existing studies the dataset enables us to apply an objective measure for buyer power which takes account of a supplier's economic dependency from the largest three customers and the buyers' opportunities to switch to competing suppliers. We decompose the

[1] For a comprehensive review of the theoretical development on buyer power see e. g. Inderst and Mazzarotto (2008).

effects of buyer power on the suppliers' innovation incentives into the effect on the decision to start innovation activities and the effect on the amount of resources spent on innovation.

Our results show that buyer power shapes a supplier’s innovation incentives. In addition, the type of competition in downstream markets matters but it affects supplier’s innovation decision at different stages differently. We find a negative effect of buyer power on a supplier’s likelihood to invest in R&D. This negative effect is mitigated by the intensity of price competition in the downstream market. Our finding implies that a supplier confronted with buyer power has a higher likelihood to start R&D activities, if price competition in the buyer market is strong. In contrast, we find no evidence of buyer power to affect a supplier’s decision how much to invest in R&D directly. Instead, there is weak evidence that the effect of buyer power depends on the intensity of technology competition in the downstream market. The stronger the technology competition downstream, the lower R&D investments of a supplier confronted with a powerful buyer. Our interpretation of this result is that for firms supplying to highly competitive industries in terms of technology, it is a precondition to have R&D activities but it seems that at the same time suppliers are not able to improve their bargaining position with further investments into a supplier-buyer relationship. Hence, powerful buyers are able to extract a larger share of joint profits which reduces suppliers innovation incentives compared to independent suppliers.

The remainder of this paper is organised as follows. Section 2 reviews the existing theoretical and empirical literature on the effects of buyer power on suppliers' innovation incentives and explores the possible effects of the type of competition prevailing in the buyer market. Section 3 presents the data, the variable specification and our estimation strategy. Descriptive statistics as well as estimation results are presented in section 0. Section 5 provides a discussion of the results while section 6 concludes and offers further directions of research.

2. Theoretical framework

2.1. Buyer power and innovation incentives

Literature provides different approaches to the emergence and impacts of buyer power. In contract theory it is assumed that supplier and buyer negotiate bilaterally over prices and quantities of the respective good or service to be traded. Given that contracting between the supplier and the buyer leads to joint profit, the split of the profit then depends on the bargaining position of each contracting party. The strength of the bargaining position and hence bargaining power is determined by the profits to be realised when the contract is made with an alternative supplier or buyer. The higher such outside-option payoffs in relation to the counterparts outside-option payoffs the stronger the bargaining position of the respective contractor. According to this approach, buyer power results from the fact that more valuable outside options are at the disposal of the buyer thereby allowing the buyer to extract a larger share of joint profits (Inderst and Valletti, 2007; Dobson and Inderst, 2008). In this paper we adopt the view of buyer power being a consequence of bargaining power exerted by the downstream firm (buyer) on the upstream firm (supplier) (Dobson and Inderst, 2008; Inderst and Mazzarotto, 2008).[2]

When deciding on investment in innovation efforts a supplier will consider the discounted value of future rents collectable from this activity and whether these rents are appropriable. Given that buyer power results from a stronger bargaining position of the buyer relative to the supplier, the effect of buyer power on suppliers' innovation incentives seems to be clear-cut: When facing powerful buyers, the supplier has less incentive to innovate, as the appropriability of innovation rents is too low. Recent theoretical studies show, however, that buyer power may provide additional innovation incentives for suppliers. Suppliers facing large buyers have an incentive to invest in both product and process innovations, given that size is the sole source of buyer power (Inderst and Wey, 2007). While process innovation allows lower unit costs at high volumes compared to a supplier facing many smaller buyers, product innovation renders higher revenues compared to the old product. Either way, supplier innovation leads to a devaluation of the buyer's outside options and in turn strengthens the bargaining position of the supplier allowing for a larger share of joint profits.

Given the life-cycle hypothesis of Utterback and Abernathy (1975), a positive effect of buyer power on suppliers' innovation incentives might also occur since suppliers with few buyers may suffer less from uncertainty over innovation demand of buyers and therefore have a declined risk of innovation failure (Klepper, 1996). In addition, a larger size of orders might induce higher incentives for suppliers to engage in R&D as there is more certainty in the sales of new products (Peters, 2000).

In contrast, merger in buyer markets may reduce incentives for product differentiation by suppliers. Product differentiation is often linked to innovation since entering new product markets typically constitutes an innovation activity. In case of a buyer merger, the consolidated buyer may be better off using a single sourcing strategy, i.e. to stock only goods of one supplier. If the likelihood of a buyer merger is increasing, this strategy will lead to a lower degree of product differentiation of suppliers (Inderst and Shaffer, 2007). Large buyers may have an incentive to force their suppliers into contracts which constitute an exclusive relationship between supplier and buyer. Such supply contracts will reduce upstream innovation because suppliers will bear disadvantages of low-scale production and have less incentive to innovate (Stefanadis, 1997). What is more, larger buyers can more credible threat to integrate backwards (Katz, 1987; Inderst and Wey, 2007) and may intensify competition on supplier markets. By breaking up collusion among suppliers they lower suppliers' profits (Scherer and Ross, 1990). This effect is increasing in the size of the buyer (Snyder, 1996; Snyder, 1998). Also, they are in a position to alleviate market entries on the supply side, e.g. by overtaking fix costs of otherwise unprofitable entrants or pre-committing some of their purchases (Dobson and Inderst, 2008).

The concern about negative effects of buyer power on innovation incentives of suppliers led the UK Competition Commission (CC) to conduct a market investigation focusing on adverse

[2] One could also study buyer power in the framework of monopsonistic behaviour (see e. g. Mas-Colell et al., 1995). The main argument of this approach is that monopsonistic firms strategically reduce demand in order to maximise profits. However, this may not apply for most supplier-buyer relationships.

effects on competition in the supply for groceries in the UK due to the behaviour of retailers. One part of the investigation examined whether buyer power of retailers may "impose excessive risks and unexpected costs on suppliers, which reduces suppliers' incentive or ability to invest and innovate. This could lead to reduced capacity, reduced product quality and fewer new product offerings" (Competition Commission, 2008, p. 157). Although the CC did not find evidence that UK grocery suppliers exhibit less innovation efforts, they expect the innovation performance to be decreasing in future if consequences of buyer power, e.g. retrospective price adjustments or excessive transfer of risks, continue at the observed level (Competition Commission, 2008, p. 173).

Empirical studies frequently find a negative relationship between buyer power and innovation activities of suppliers. These existing studies follow quite different approaches to capture buyer power and innovation incentives of suppliers. Farber (1981) analysed the effect of market structure in the buyer market on R&D efforts in supplier industries using cross-sectional industry level data of 50 4-digit manufacturing SIC-industries from the US. Market structure in both supplier and buyer markets is measured by concentration ratios, reflecting the share of industries sales generated by its four largest enterprises. Employing a simultaneous equation model explaining the share of scientist and engineers in the workforce, the advertising intensity and the seller concentration rate, he finds evidence that concentration in the buyer market affects R&D incentives of suppliers. However, the sign of this effect depends on the concentration in the supplier market. If the supplying industry is weakly concentrated, an increase in concentration of the buyer industry will have a negative effect on the share of scientists and engineers in the workforce. Conversely, this effect is positive if the market concentration in the supplier industry is sufficiently high.

This findings are in line with the results of Peters (2000) who investigates the effect of market structure in the buyer market both on suppliers' innovation inputs and innovation outputs using firm-level data consisting of 401 German automotive suppliers. Innovation inputs are measured by R&D expenditure divided by sales as well as by total innovation expenditure divided by sales.[3] Innovation output is captured by the introduction of product or process innovations within a two year span. Market structure in the buyer industry is represented by industry's concentration ratio (CR3) and by an additional dummy variable indicating whether the supplier has 10 or more customers. Regarding innovation intensity, the result indicates that firms supplying highly concentrated buyer industries exhibit lower levels of innovation intensity. The negative correlation is mitigated, however, if suppliers are operating in a concentrated industry. With respect to R&D intensity, market structure in the buyer industry is found to moderate the effect of market structure in the supplier industry. Suppliers operating in a concentrated industry and supplying highly concentrated buyer industries exhibit a significantly higher R&D intensity. Conversely, suppliers operating in a concentrated industry and supplying buyer industries with a low degree of concentration show significantly lower R&D intensities. Interestingly, there is no evidence that the market structure of buyer industries has a significant impact on the supplier's probability to introduce new products. Also, the suppli-

[3] Innovation expenditure includes expenses not only for R&D but also for other activities aiming at the introduction of new products or processes, such as design, marketing, training and purchase of machinery, equipment, software and intellectual property.

er's probability to introduce process innovations is not affected by the concentration in the buyers industry but by the number of customers.

Weiss and Wittkopp (2003a; 2003b) use survey data from German food manufacturers. Innovative activity is measured by the overall number of new products introduced within a three year time span (Weiss and Wittkopp, 2003b) and by the number of new products with either regular or superior quality introduced within a three year time span (Weiss and Wittkopp, 2003a). Market power of the retailers is captured by firms' assessment whether retailers are able to exert pricing pressure on them on a scale ranging from 1 (very low) to 5 (very high). Using a small sample of 88 and 87 firms, respectively, they observe that suppliers experiencing very high pricing pressure of retailers introduce significantly less new products. With respect to quality differences among the newly introduced products they yield mixed results. While they observe a negative relationship between retailers' pricing pressure and the number of new products with regular quality, retailers' pricing pressure does not have a significant effect on the number of new products with premium quality.

2.2. The role of downstream competition

So far, researchers rarely looked at the type of competition in the buyer market when analysing the relationship between buyer power and suppliers' innovation incentives. We argue that it is important to take the competitive environment of the buyer into account because it is likely to be transferred by a powerful buyer to the upstream market. We will distinguish between a price and a technology dimension of competition. Let us first consider the price dimension of competition. If price competition in the downstream market is strong, margins are low. Then a powerful buyer may squeeze suppliers' profit margins to gain competitive advantages over competitors. Supplying firms need to supply a higher quality (a higher quantity) to the same price or conversely, the same quality (the same quantity) to a lower price. In result the magnitude of expected innovation rents may be too small to induce R&D investments on the suppliers' side, especially against the background of a high failure risk and the financial burden attached to an innovation project. In contrast to this traditional argument which is brought forward frequently (OECD, 1998; Competition Commission, 2008), suppliers can strengthen their bargaining position relative to the buyer by realising lower unit costs at high volumes (Inderst and Wey, 2007). This increases process innovation incentives for suppliers as outside options of the buyer are devaluated and suppliers can appropriate a higher share of innovation returns.

If price competition in the downstream market is strong, buyers may aim to increase their margins by differentiating away from each other. This would also decrease price competition. In this case buyers may use their power to stimulate suppliers' product innovation activities in order to align innovation activities along the value chain. However, investments in R&D on the supplier side may be necessary to make use of the buyer's innovation impulses since knowledge acquired from the buyer has to be integrated in the supplier's knowledge stock before it can be commercially exploited. The effect of suppliers' in-house R&D may hence be twofold: to generate new knowledge and to create absorptive capacity which allows evaluation and exploitation of externally available knowledge (Cohen and Levinthal, 1989). This knowledge exchange will likely result in the building of co-specialised assets (Teece, 1986).

Such a situation obviously increases innovation incentives on the supply side as the supplier's bargaining position relative to the buyer improves and allows a more favourable split of the joint profit. Suppliers' innovation incentives may be even further spurred if specific demands of powerful buyers are anticipatory for larger market segments in the future (von Hippel, 1988). Hence, suppliers exposed to buyer power and strong price competition in the downstream market have higher innovation incentives than suppliers with powerful buyers that are less exposed to price competition. We derive our first hypothesis accordingly:

Hypothesis 1: *Buyer power will have a more positive effect on suppliers' innovation incentives the stronger the price competition in the buyer market.*

Another dimension of competition in the buyer market is technology intensity which is likely to be transferred to the supplier market as well. Intense technology competition urges buyers to invest heavily into the development of new products and new process technology, which reduces their profits. In the context of patent races, some part of this investment may not be turned into commercial success but is sunk, hurting profits further (Fudenberg et al., 1983). Buyers with bargaining power vis-à-vis their suppliers may use this power to shift a significant share of these costs and risks to their suppliers. In order to maintain commercial relations with buyers, suppliers will have to invest into own R&D efforts along the innovation activities of their buyers. Consequently, suppliers' innovation incentives are higher than in a situation with low technology intensity in the downstream market. In fact, many studies found buyers are a main source for technological advance in upstream firms (Klevorick et al., 1995).

Technology competition in the buyer market can also be seen as technological opportunity for suppliers. The higher R&D investments carried out in the buyer market, the more demand there is also for innovative upstream products (Scherer, 1982). This leads us to our second hypothesis:

Hypothesis 2: *Buyer power will have a more positive effect on suppliers' innovation incentives the stronger the technological competition in the buyer market.*

3. Empirical study

3.1. Data

The empirical part of our study employs firm level information from the Mannheim Innovation Panel (MIP) which consists of a representative stratified random sample of German firms. Data collection is carried out by the Centre for European Economic Research (ZEW) on behalf of the Federal Ministry of Education and Research. The MIP has provided annual information on innovative behaviour in the German manufacturing sector since 1992 and in the service sector since 1994 and is at the same time the German contribution to the European Community Innovation Survey (CIS). Definitions of innovation and innovative activities are taken from the OECD's Oslo Manual. The target population of the MIP is enterprises located in Germany with at least five employees.[4]

The 2005 survey wave of the MIP offers unique information on firms' market environment which is merged with data from the 2006 survey wave to observe innovation behaviour of firms in the following period. Since we are interested in the interaction between upstream and downstream firms, we drop all observations of firms indicating that private households or public institutions are the largest customers. Additionally we exclude all firms reporting that R&D expenditure exceeds their sales to avoid outlier problems. This leaves us with a sample of 1,137 observations for which information on all model variables is available.

3.2. Variables

3.2.1. Innovation incentives

A number of authors have proposed different concepts for measuring innovation activities.[5] Since we are interested in innovation incentives we choose an input measure as a proxy for the innovation incentives of suppliers, as it represents discounted future rents attached to innovative efforts no matter whether these efforts are successful. We use the R&D intensity which is defined as the expenditure on R&D activities divided by sales. It is widely used as measure of innovation input in the literature (see e. g. Cohen and Levin, 1989; Crepon et al., 1998).

3.2.2. Buyer power

Our main explanatory variable of interest is buyer power.[6] As we define buyer power to result from a relatively stronger bargaining position of the buyer compared to the supplier, we have to construct a measure which captures whether a supplier is confronted with buyer power or not. One of the factors determining a supplier's bargaining position is the share of sales generated by one buyer, as this measure can indicate substantial economic dependency. Once, "a buyer accounts for sufficiently large fraction of a supplier's overall business, this may lead to a more-than-proportional reduction in the value of the supplier's profits outside a relationship with the particular buyer" (Dobson and Inderst, 2008, p. 339). This is due to the fact that in case the supplier loses the contract with the buyer, the supplier's economic viability could be undermined. Losing a large contract will result in free capacity on the supplier's side and will require the supplier to significantly lower prices in order to sell the excessive capacity to remaining buyers (Inderst and Wey, 2007). Therefore, our measure will include the extent to which a supplier's sales depend on its three largest customers.

The degree to which a supplier is confronted with buyer power also depends on the buyer's opportunities to switch to another supplier. The ease of such a switch is determined by the market structure in the supply market on the one hand and the substitutability of the demanded product on the other. A monopoly in the supply market does not allow for an outside op-

[4] For a more detailed description of the MIP see Peters (2008).

[5] For an overview see Haagedorn and Cloodt (2003).

[6] For an overview of all applied variable definitions see Appendix A.

tion of the buyer, resulting in a powerful bargaining position of the supplier, even if the buyer is a monopsonist.[7] Conversely, a polypolistic supply market and a monopsonistic buyer market enable the buyer to behave opportunistically and might lead to hold-up. That is, after the supplier carried out necessary investments to fulfil contracted obligations, the buyer may initiate ex-post negotiations and force the supplier to accept conditions which reduce profit margins or even lead to loss (Williamson, 1975). Thus, our measure has to include information about the concentration in the supplier's market and the substitutability of the supplied products.

Table 1: Definitions of buyer power measures

Measure of buyer power	Share of sales generated with the three largest customers	Number of a supplier's competitors		Degree of substitutability of a supplier's product
BP_1	≥50%			
BP_2	≥50%	>5	OR	High substitutability (agree, fully agree)

We consider different degrees of buyer power and subsequently define two measures (see Table 1) using information on the share of sales generated with the three largest customers, on the number of competitors in the suppliers' main market and whether the suppliers' main product is easy to substitute by competitor products. Our first measure for being exposed to buyer power BP_1 is a dummy variable reflecting the fact that the three largest customers of a supplier account for 50 or more percent of the sales. We interpret this as a degree of dependency from buyers which could seriously undermine the economic viability of a supplying firm.[8] Hence it is included in all measures of a supplier's exposure to buyer power. Our second measure BP_2 equals BP_1 but takes the value one only, if additionally the supplier has either more than 5 competitors or its products are easy to substitute. Compared to BP_1, this definition reflects a weaker bargaining position of the supplier since it not only covers economic dependency in terms of sales but also a buyer's opportunities to switch to other suppliers.

3.2.3. Dimensions of competition in the buyer market

To derive measures for the intensity of price and technology competition in the buyer market, it is desirable to have information about the identity of the most important buyers. Such data is extremely difficult to obtain through voluntary surveys since most firms will refrain from

[7] Such circumstances, characterized by highly concentrated markets on both sides, have been described as a countervailing power situation by Galbraith (1956).

[8] One might object that this measure is not providing a sufficiently accurate degree of economic dependency, as the share of sales generated by the largest single customer could be considerably lower. However, in the merger case Rewe/Meinl, the European Commission established that a supplier whose business with the two merging chains accounted for more than 22 percent has to be considered as "economically dependent" on them. A survey among grocery producers provided evidence that this was the most suppliers could afford to lose without a serious danger of bankruptcy. With respect to our measure of buyer power, the smallest possible share of sales generated by one customer is roughly 17 percent, given that a supplier indicates he is economically dependent on his three largest customers. Hence, we consider our measure to be sufficiently precise in order to correctly reflect serious economic dependency from buyers.

disclosing such information, and sometimes confidentiality agreements with buyers restrict disclosure at all. In the MIP 2005 survey, firms were asked to name the sector of their three largest customers. Questionnaire instructions helped firms to provide buyer sector information that corresponds to 3-digit level of Nace[9], though firms did not give industry codes but short description of sectors which have been coded to Nace 3-digits. Based on this sector information, we construct industry level measures of competition. For the degree of price competition we use an industry's price cost margin (PCM) since it gives an indication whether firms are able to achieve margins high above their marginal costs. For the sake of interpretation, we transform the variable to 1–PCM, i.e. values close to zero indicate low price competition in the buyer market and values close to one refer to very intense price competition. As an indicator of technological competition we use a sector’s R&D intensity (RDint: R&D expenditure over sales) since firms will dedicate a higher share of their resources to R&D if keeping pace with technological change is crucial for competing in their market.

We do not have information on the location of the largest buyers which implies that we do not know whether they are domestic or international buyers, but we do know the firms’ export share in total sales. We calculate both 1–PCM and R&D intensity for Germany and for OECD countries, to capture the intensity of competition on domestic and foreign markets. We weight the values with the respective share of a supplier’s domestic and international sales.[10] In addition, we also introduce dummy variables indicating the position of the buyer industry in the value chain. We distinguish between the production of raw materials, intermediaries, capital goods, consumer goods, producer services and consumer services.[11]

3.2.4. Competitive environment of the supplier

A supplier’s incentive to invest in innovation activities may be shaped by the competitive environment in their own market as well. Therefore, we control for concentration in the supplier's market since a monopoly or oligopoly may allow for higher margins and thus for higher investments in R&D or conversely for lower incentives to invest in R&D.[12] Concentration in the supplier's market is measured by two dummy variables capturing the number of main competitors. The first dummy takes the value one if the firm responded to have no competitors and zero otherwise. The second dummy takes the value one if the firm indicated to have at most 5 main competitors and zero otherwise.

What is more, there are firm characteristics which alleviate the influence of powerful buyers and strengthen a supplier’s bargaining position. On one hand, compared to a single-product-supplier, a high degree of product diversification offers more outside options to the supplier and allows to escaping from profit squeeze as described above. Hence we include the degree of product diversification of a supplier, measured as the share of sales which is not generated

[9] Nace is the industrial classification system used in European Union statistics. This study uses Nace rev. 1.2.

[10] For a detailed description of buyer market competition measures see Appendix B.

[11] The definition of these industry groups can be found in Table C1 in the Appendix.

[12] For an overview of the extensive literature dealing with the effects of market structure on innovation see e.g. Cohen (2010).

by a supplier's main product line.[13] On the other hand, suppliers may be very active in expanding their marketing activities. The extension of marketing activities can attract new customers and hence increase the number of the supplier's outside options. We control for this by a dummy variable indicating whether the supplier has introduced a new design or new methods for selling products in the past three years.

3.2.5. Further control variables

Following the literature on firms propensity to innovate (see e. g. Cohen, 1995; Crepon et al., 1998), we also include firm size measured by the number of employees, firm age (in logs), a firm's ability to absorb knowledge measured by the share of graduated employees and whether a firm belongs to an enterprise group as explanatory variables. Moreover, we also control for a firm's sector affiliation and whether a firm is located in the territory of the former GDR.

3.3. Estimation strategy

Innovation incentives of suppliers are shaped by a supplier's bargaining position vis-à-vis its buyers and by the type of competition that characterises buyer markets. Accordingly, we model the innovation decision of a supplier to be dependent on a measure reflecting the relation between a supplier's and a buyer's bargaining position, the dimensions of competition in the buyer market as well as further determinants. Since we measure innovation incentives by R&D intensity, we have to take a possible selection bias into account as this variable is only observable for firms that engage in research and development activities. To control for this we apply the well-known generalised Tobit model (Heckman, 1979).

This approach furthermore enables us to separate the effect of buyer power and buyer market competition on the supplier's probability to start R&D activities from the effect on the decision how much to invest in R&D once the supplier decided to start R&D. As many authors point out, when using a generalised Tobit model one needs to make sure to have an exclusion restriction which explains the selection but not the structural equation and is not correlated to the error term of the latter. We use firm size to be the exclusion restriction for two reasons. First, firm size will positively affect the probability to start R&D activities as larger firms have an advantage in spreading the fix costs of R&D over larger output (Cohen and Klepper, 1996). At the same time firm size should not have an effect on R&D intensity as the latter is already by definition scaled by size. Second, related research frequently uses firm size as exclusion restriction in this context (see e. g. Griffith et al., 2006).

In the first stage we estimate the probability of a supplier to spend a positive amount on R&D activities in the next period which is followed in the second stage by the estimation of R&D intensity given the supplier started with R&D activities.[14] Analogous to Crepon et al. (1998) we assume that firms take up R&D activities if discounted future profits from R&D activities are positive. Let $RD^{*}_{i,t+1}$ be the discounted future profits from R&D of supplier i in period

[13] Note that the extent to which the largest three customers account for supplier's sales refers to the main line of product.

[14] We use the R&D activities in $t+1$ to avoid simultaneity problems, which may occur from the fact that R&D investments of a supplier can also have an effect on a supplier's exposure to buyer power as well as a supplier's market environment.

t+1. These expected profits are not observable and depend on the supplier's bargaining position relative to those of the buyer, i.e. whether the supplying firm is subject to the exertion of buyer power (BP), and the intensity of competition in the buyer industry (BC^k with k = 1, 2) reflecting the price and technological dimension of competition, respectively. The cross term accounts for possible interactions between a supplier's exposure to buyer power and the type of competition in the downstream market and allows us to test our hypotheses. In addition we include a vector of variables reflecting a supplier's competitive environment (SC) which is likely to shape the innovation incentives of the supplier, too. Other relevant firm specific characteristics are captured by a vector of control variables (X). The unobserved error term is represented by ε. We observe that firms invest in R&D in *t+1* if $RD^*_{i,t+1}$ is positive.

Furthermore we assume the true R&D intensity $RDint^*_{i,t+1}$ of supplier *i* in period *t+1* to be determined by a mostly identical set of explanatory variables, i. e. the supplier's bargaining position relative to those of the buyer (BP), the intensity of competition in the buyer industry (BC^k with k = 1, 2), the cross terms as well as a vector of variables reflecting a supplier's competitive environment (SC). Firm specific characteristics are captured by vector Y.

We will estimate the following model with equation (1) denoting the selection equation and equation (2) denoting the intensity equation.

$$RD^*_{i,t+1} = \beta_1 BP_{i,t} + \beta_2^k BC^k_{i,t} + \boldsymbol{\beta}_3^k (BP_{i,t} \times BC^k_{i,t}) + \beta_4 SC_{i,t} + \beta_5 \boldsymbol{X}_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$RDint^*_{i,t+1} = \beta_1 BP_{i,t} + \boldsymbol{\beta}_2^k \boldsymbol{B}C^k_{i,t} + \beta_3^k (BP_{i,t} \times BC^k_{i,t}) + \beta_4 SC_{i,t} + \beta_5 Y_{i,t} + \boldsymbol{\mu}_{i,t} \quad (2)$$

Note that vector X is identical to vector Y with the exception of firm size, since we need to take the exclusion restriction into account. Due to the fact, that $RDint^*_{i,t+1}$ is only observable when $RD^*_{i,t+1}$ is positive, we assume joint normality of both disturbance terms $\varepsilon_{i,t}$ and $\mu_{i,t}$.

4. Results

4.1. Descriptive Statistics

Table 2 shows descriptive statistics of the variables of interest differentiated by a supplier's exposure to buyer power. The descriptive analysis reveals some interesting differences which are robust across the two specifications of the buyer power variable. We find the share of R&D performing firms to be significantly lower in the subsamples of suppliers confronted with buyer power. In fact, the share decreases in the degree of buyer power. Contrastingly, we observe no significant differences in the means of R&D intensity.

Considering the competition variables in the most important buyer's industry, we find no significant differences between the total sample and the various subsamples. Hence, there is no indication for powerful buyers to have more intensive competition may it be in terms of prices or R&D. We observe a higher share of dependent suppliers to be monopolists when we apply the widest definition of buyer power B_1.[15] In addition, suppliers being exposed to buyer power are less diversified in their product range, have less employees, show less continuous R&D activities, are younger and a significantly higher share of them is located in the former East Germany.

Table 2: Descriptive statistics differentiated by a supplier's exposure to buyer power

	Mean	SD	Mean		SD	Mean		SD
	All		BP1=1			BP2=1		
RD_{t+1}[a]	0.493	0.500	0.423	***	0.495	0.404	***	0.492
$RDint_{t+1}$[a]	0.031	0.092	0.028		0.079	0.021	*	0.057
Buyer's 1-PCM_t[b]	0.639	0.128	0.640		0.126	0.630		0.133
Buyer's $RDint_t$[b]	0.402	1.135	0.448		1.251	0.375		1.094
No. of competitors: $None_t$[a]	0.038	0.191	0.055	**	0.227	0.004	***	0.060
No. of competitors: $1\text{-}5_t$[a]	0.571	0.495	0.579		0.494	0.484	***	0.501
Product $diversity_t$	0.282	0.241	0.217	***	0.214	0.211	***	0.215
$Marketing_t$[a]	0.240	0.427	0.179	***	0.384	0.207		0.406
No. of employees $(ln)_t$	3.844	1.598	3.518	***	1.427	3.523	***	1.481
Share of graduated $employees_t$	0.198	0.235	0.213		0.259	0.207		0.260
Continuous R&D activities	0.326	0.469	0.275	***	0.447	0.240	***	0.428
Firm age (ln)	2.535	0.868	2.394	***	0.825	2.378	***	0.834
Part of enterprise $group_t$[a]	0.566	0.496	0.548		0.498	0.556		0.498
East $Germany_t$[a]	0.367	0.482	0.442	***	0.497	0.440	***	0.497
N	1,129		385			275		

Results are derived from Two-sample t tests comparing sample means of dependent and independent suppliers. Asterisks indicate the level of significance that the differences of sample means are not equal 0: * p<0.10, ** p<0.05, *** p<0.01. The descriptive statistics of the remaining variables is shown in Table C2 in the Appendix.
[a] Dummy variable
[b] For details on the calculation see in the Appendix B.

4.2. Regression results

Table 3 shows the estimated coefficients using first a specification without the interaction terms. The columns 1 and 3 show the estimated coefficients of the selection equation while columns 2 and 4 show the estimated coefficients of the intensity equation. With respect to our measures of a supplier's exposure to buyer power we predominantly find effects on the decision how much to invest in R&D. Regardless of the measure for buyer power, the estimated coefficients show a significantly negative sign in the intensity equations with the levels of significance increasing the narrower our definition of buyer power. The magnitude of the coefficient is higher in the estimation using BP_2, indicating that the effect is stronger the more accurate buyer power is measured. For the selection equation, we find no significant coefficient for BP_1 while BP_2 is negative although it is only weakly significant.

Regarding the dimensions of competition in the most important buyer's market – no matter whether this buyer has a stronger bargaining position than the supplier – we find no evidence that price competition is correlated to the probability of a supplier to start R&D activities when applying BP_1. For BP_2 however there is a weakly significant negative correlation, i. e. the stronger price competition in the downstream market, the lower a supplier's probability to

[15] Note that the definition of BP_2 requires the suppliers has to have more than 5 competitors or a high degree of substitutability. We thus refrain from interpreting the descriptive statistics on the number of competitors and show them for the sake of completeness.

start R&D activities. Across both model specifications we find no evidence that downstream price competition affects the R&D intensity of suppliers. Regarding R&D competition in the downstream market, we find weakly significant coefficients in the selection equation while the coefficient estimates are insignificant for the intensity equation across both model specifications. Hence, downstream R&D competition intensity positively affects the decision to start R&D while it has no consequences for a supplier's decision how much to invest.

Table 3: Estimated coefficients of the Generalised Tobit model without interaction terms

	$RD_{i,t+1}$		$RDint_{i,t+1}$		$RD_{i,t+1}$		$RDint_{i,t+1}$	
	1		2		3		4	
$BP1_t$[a]	-0.166		-0.025	**				
	(0.104)		(0.011)					
$BP2_t$[a]					-0.191	*	-0.033	***
					(0.112)		(0.012)	
Buyer's 1-PCM_t[b]	-0.726		-0.031		-0.741	*	-0.033	
	(0.449)		(0.045)		(0.449)		(0.045)	
Buyer's $RDint_t$[b]	0.097	*	0.006		0.099	*	0.006	
	(0.059)		(0.004)		(0.059)		(0.004)	
No. of competitors: $None_t$[a]	-0.471	*	0.072	**	-0.548	**	0.061	*
	(0.275)		(0.036)		(0.276)		(0.036)	
No. of competitors: $1\text{-}5_t$[a]	0.007		0.002		-0.017		-0.002	
	(0.097)		(0.009)		(0.098)		(0.009)	
Product $diversity_t$	0.147		-0.011		0.147		-0.011	
	(0.207)		(0.020)		(0.207)		(0.020)	
$Marketing_t$[a]	0.297	***	0.016		0.305	***	0.017	
	(0.114)		(0.011)		(0.114)		(0.011)	
No. of employees $(ln)_t$	0.151	***			0.152	***		
	(0.037)				(0.037)			
Share of graduated $employees_t$	1.024	***	0.153	***	1.040	***	0.154	***
	(0.278)		(0.025)		(0.278)		(0.025)	
Continuous R&D $activities_t$	1.583	***	0.073	***	1.577	***	0.077	***
	(0.125)		(0.027)		(0.125)		(0.026)	
Firm age (ln)	-0.063		-0.008		-0.064		-0.007	
	(0.057)		(0.005)		(0.057)		(0.005)	
Part of enterprise $group_t$[a]	0.085		-0.024	**	0.084		-0.022	**
	(0.099)		(0.010)		(0.099)		(0.010)	
East $Germany_t$[a]	-0.048		0.008		-0.053		0.009	
	(0.103)		(0.010)		(0.103)		(0.010)	
Mills Lambda			0.050				0.057	*
			(0.033)				(0.032)	
Constant	-1.120	***	-0.053		-1.098	***	-0.059	
	(0.387)		(0.058)		(0.388)		(0.058)	
N	1,129				1,129			
LR/Wald chi2	224				225			
P-value	0.000				0.000			

* p<0.10, ** p<0.05, *** p<0.01. Standard errors in parentheses. Estimations include 20 industry dummies and 5 dummies capturing the buyer's position in the value chain. Estimation results can be found in Table C 3 in the Appendix.

[a] Dummy variable

[b] For details on the calculation see Appendix B.

With respect to the further explanatory variables we find highly robust results irrespective of the applied measure of buyer power exposure. Suppliers holding a monopoly exhibit a lower likelihood to invest in R&D but once they decided to start R&D activities they invest more in R&D. In addition, we find significantly positive coefficients in the selection equation for larger firms and for suppliers who introduced marketing instruments. For the share of graduated employees we find significantly positive coefficient estimates in both equations of the model, implying that higher absorptive capacity contributes positively to the likelihood of investing in R&D as well as to a higher R&D intensity. Similarly, performing continuous R&D activities also positively affects both the likelihood of starting R&D as well as the R&D intensity. For a supplier being part of an enterprise group we find significantly negative coefficients in the intensity equation which indicates that R&D is optimized within the group and resources are allocated accordingly among subsidiaries. Mills lambda is significant in our estimations using BP_2, which is an indication that controlling for selection is necessary in our dataset.

Let us now consider the results of the estimations including the interaction terms which are presented in Table 4. Again, columns with odd numbers show the estimated coefficients of the selection equation while columns with even numbers show the estimated coefficients of the intensity equation.

Table 4: Estimated coefficients of the Generalised Tobit model with interaction terms

	$RD_{i,t+1}$		$RDint_{i,t+1}$		$RD_{i,t+1}$		$RDint_{i,t+1}$	
	5		6		7		8	
$BP1_t$[a]	-1.460	***	-0.075					
	(0.547)		(0.060)					
$BP2_t$[a]					-1.351	**	-0.104	*
					(0.568)		(0.063)	
Buyer's $1\text{-}PCM_t$[b]	-1.447	***	-0.058		-1.317	**	-0.062	
	(0.554)		(0.054)		(0.535)		(0.053)	
Buyer's $RDint_t$[b]	0.075		0.011	**	0.108		0.008	*
	(0.072)		(0.005)		(0.070)		(0.004)	
BP_t[a] x Buyer's $1\text{-}PCM_t$[b]	2.002	**	0.089		1.830	**	0.115	
	(0.862)		(0.090)		(0.891)		(0.095)	
BP_t[a] x Buyer's $RDint_t$[b]	0.082		-0.012	*	-0.007		-0.007	
	(0.118)		(0.007)		(0.124)		(0.009)	
No. of competitors: $None_t$[a]	-0.517	*	0.073	**	-0.566	**	0.060	*
	(0.278)		(0.036)		(0.277)		(0.036)	
No. of competitors: $1\text{-}5_t$[a]	-0.011		0.001		-0.032		-0.003	
	(0.098)		(0.009)		(0.098)		(0.009)	
Product $diversity_t$	0.135		-0.014		0.124		-0.012	
	(0.208)		(0.019)		(0.208)		(0.020)	
$Marketing_t$[a]	0.299	***	0.015		0.306	***	0.017	
	(0.114)		(0.010)		(0.114)		(0.011)	
No. of employees $(ln)_t$	0.155	***			0.154	***		
	(0.037)				(0.037)			
Share of graduated $employees_t$	1.002	***	0.151	***	1.016	***	0.153	***
	(0.280)		(0.025)		(0.280)		(0.025)	
Continuous R&D activities	1.593	***	0.071	***	1.595	***	0.078	***
	(0.125)		(0.026)		(0.125)		(0.026)	
Firm age (ln)	-0.064		-0.007		-0.065		-0.007	
	(0.057)		(0.005)		(0.057)		(0.005)	
Part of enterprise $group_t$[a]	0.089		-0.025	**	0.085		-0.022	**
	(0.099)		(0.010)		(0.099)		(0.010)	
East $Germany_t$[a]	-0.035		0.008		-0.051		0.009	
	(0.104)		(0.010)		(0.104)		(0.010)	
Mills Lambda			0.046				0.057	*
			(0.032)				(0.032)	
Constant	-0.668		-0.031		-0.726	*	-0.040	
	(0.434)		(0.056)		(0.428)		(0.056)	
Wald-Test on joint significance of BP, BP x Buyer's 1-PCM and BP x Buyer's RDint	χ^2 (3)= 7. 94**		χ^2 (3)= 9. 97**		χ^2 (3)= 7.37*		χ^2 (3)= 8.27**	
N	1,129				1,129			
LR/Wald chi2	231				226			
P-value	0.000				0.000			

* p<0.10, ** p<0.05, *** p<0.01. Standard errors in parentheses. Estimations include 20 industry dummies and 5 dummies capturing the buyer's position in the value chain. Estimation results can be found in Table C 4 in the Appendix.

[a] Dummy variable

[b] For details on the calculation see Appendix B.

Compared to Table 3, we now see significant effects of buyer power in both selection equations. Regardless of the measure, we find significantly negative coefficients of buyer power. The inclusion of the interaction terms disentangles countervailing effects of buyer power and the intensity of price competition in buyer markets. The estimated coefficients of the interaction with price competition in the buyer market are significantly positive with the level of significance being stronger for BP_1 though. Our findings imply that having a less powerful bargaining position than the most important buyer reduces the likelihood of a supplier to start R&D activities. This negative effect is mitigated, however, if the powerful buyer faces strong price competition.

A similar effect in the selection equations is found for the effect of price competition in buyer markets. In contrast to the results of the baseline model, the inclusion of interaction terms yields strongly significant coefficient estimates in both selection equations. Hence, we find a negative correlation of price intensity in buyer markets with a supplier's probability to start R&D which suggests that having buyers who operate in a highly competitive environment with respect to prices reduces a supplier's likelihood to invest in R&D. Interestingly, if buyers have a stronger bargaining position compared to suppliers, this negative effect is mitigated.

The estimated coefficients of buyer power, price competition in the buyer market and its interactions are more significant in the selection equation which applies BP_1. The reason for this is most likely that the lower number of observations in the group of BP_2 in combination with additional two interaction terms regarding competition intensity in buyer markets increases the standard error and lowers the level of significance for estimated coefficients. Considering the effect of buyer market R&D competition we find neither a significant effect of the main term nor the interaction with buyer power.

The significant results of the intensity equations regarding the main terms of buyer power are not robust to the inclusion of the interaction terms. While BP_1 looses significance completely, the significance level of BP_2 drops from 1 to 10 percent. The interaction effect with R&D competition intensity in the buyer market is significantly negative in the specification applying BP_1 – although the level of significance is rather low – while it is insignificant for BP_2. In addition, the inclusion of the interaction terms reveals leads to significantly positive coefficient estimates of buyer market R&D competition intensity which implies that the higher the R&D intensity in the buyer market, the higher the R&D intensity of a supplier. The results presented in column 6 suggest however, that this positive impact is countervailed if the supplier is subject to the exertion of buyer power. We find no evidence of buyer market price competition intensity to affect the R&D intensity of suppliers, neither directly nor when interacted with buyer power. Yet the results of the Wald test show that the Null-hypothesis of the coefficient estimates of buyer power and its interactions being zero, can be rejected at reasonable levels of significance.

The estimated coefficients of all other explanatory variables are robust to the inclusion of the interaction terms, i.e. they keep their sign and their significance in the selection as well as in the intensity equation.

5. Discussion

The aim of this paper is to analyse the relationship between buyer power and innovation incentives of supplying firms while taking the type of competition in the buyer market, namely price and technology, into account. While theory provides mixed results about this relationship, empirical studies typically find a negative correlation between buyer power and suppliers' innovation incentives. However, most studies are limited to certain industries and apply measures of buyer power generated either on an industry level or by subjective assessments of suppliers. Moreover, they do not consider the type of buyer market competition and likely effects on suppliers' innovation incentives. We argue that both dimensions of competition increase suppliers' incentives to innovate in combination with buyer power.

We benefit from a dataset that provides data on firms both from manufacturing and service sectors on a supplier's exposure to buyer power with respect to economic dependency from the largest three customers and the buyers' opportunities to switch to competing suppliers. Using these measures our baseline model shows that – once a supplier decided to invest in R&D – buyer power negatively affects the intensity of R&D investments which is largely in line with the existing empirical evidence. For the narrower definition of buyer power we also find suppliers to be less likely to invest in R&D at all.

When including interaction terms that relate buyer power to the type of competition in the buyer market, we find interesting differences. A countervailing effect appears for suppliers that face powerful buyers operating under strong price competition, i.e. having a powerful buyer lowers a supplier's probability to start own R&D efforts but if this buyer competes intensely in prices this negative effect is alleviated. This finding is in line with our first hypothesis that buyer power will have a more positive effect on suppliers' innovation incentives if price competition in the downstream market is high. Under this circumstance buyers apparently use their power to stimulate suppliers' product innovation activities which requires investments on the supplier's side to make use of the buyer's innovation impulses. This in turn increases innovation incentives on the supply side as the supplier's bargaining position relative to the buyer improves and allows a more favourable split of the joint profit.

On the contrary, we find no evidence for a positive effect on suppliers' innovation incentives if the powerful buyer operates under intense technology competition. Instead, we find a negative effect of technology competition in the downstream market in combination with buyer power on a supplier's decision on how much to invest in R&D activities. This effect is not robust, however, to a variation in the measure of buyer power. Nevertheless, it contradicts our second hypothesis, which stated that buyer power will have a more positive effect on suppliers' R&D incentives the stronger downstream technological competition. Apparently, for firms supplying to highly competitive industries in terms of technology, it is a precondition to have R&D activities but at the same time further investments into the relationship with a powerful buyer are not beneficial since powerful buyers are able to extract a larger share of joint profits.

For practitioners at least three implications can be derived. First, the dimensions of competition in the downstream market matter for the innovation incentives of suppliers. They affect however different stages of a supplier's innovation decision. While downstream price competition affects the decision whether R&D investments are carried out, the technology dimension of buyer market competition affects a supplier's decision how much to invest in R&D. Second, buyer power in combination with strong downstream price competition does not necessarily lead to less upstream innovation incentives. In fact, strong buyer market price competition may even spur innovation activities if it is transferred to suppliers by a powerful buyer. This should be kept in mind when assessing mergers regarding their upstream innovation effects. Third, buyer power primarily affects the supplier's decision on conducting R&D or not rather than how much to invest. Hence policies aimed at fostering innovation in sectors where firms are likely to be confronted with buyer power have to take this into account and should be designed accordingly.

6. Concluding remarks and further research

We examined the effects of buyer power and buyer market competition on suppliers' innovation incentives based on a large sample of firms across many different industries and employing an objective measure of buyer power. Yet there are opportunities for improvements providing various avenues of future research. First, it would be worthwhile from an empirical point of view to extend the analysis on innovation outputs on the firm level. That may include the questions whether the presence of powerful buyers affects innovation success and whether such buyers promote particular types of innovation. Second, suppliers which are confronted with buyer power may choose specific ways to appropriate a sufficient share of innovation rents, patenting for instance. Hence, in such circumstances suppliers may exhibit a different patenting behaviour. Finally, longer time series data may be extremely helpful since there may be a substantial time lag between buyer power, the decision to invest into R&D, and both the corresponding innovation output as well as the use of protection methods for intellectual property.

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References

Cohen, W. M. (1995). Empirical Studies of Innovation Activity. In: P. Stoneman (ed.) *Handbook of the Economics of Innovation and Technological Change*. Oxford, Camebridge. **1:** 182-264.

Cohen, W. M. (2010). Fifty Years of Empirical Studies of Innovative Activity and Performance. In: B. H. Hall and N. Rosenberg (eds.) *Handbook of the Economics of Innovation*. Amsterdam, North-Holland. **1:** 129-213.

Cohen, W. M. and S. Klepper (1996). "A Reprise of Size and R&D." *The Economic Journal* **106**(437): 925-951.

Cohen, W. M. and R. Levin (1989). Empirical Studies of Innovation and Market Structure. In: R. Schmalensee and R. Willig (eds.) *Handbook of Industrial Organisation.* Amsterdam, North Holland**:** 1060-1107.

Cohen, W. M. and D. A. Levinthal (1989). "Innovation and Learning: The Two Faces of R&D." *The Economic Journal* **99**: 569-596.

Competition Commission (2008). "The Supply of Groceries in the UK Market Investigation." *Report*.

Crepon, B. et al. (1998). "Research, Innovation and Productivity: An Econometric Analysis at the Firm Level." *Economics of Innovation and New Technology* **7**: 115-158.

Dobson, P. W. and R. Inderst (2008). "The Waterbed Effect: Where Buying and Selling Power Come Together." *Wisconsin Law Review* **331**: 331-357.

European Commission (1999). Buyer Power and its Impact on Competition in the Food Retail Distribution Sector of the European Union. Report produced for the European Commission. Brussels.

Farber, S. C. (1981). "Buyer Market Structure and R&D Effort: A Simultaneous Equations Model." *The Review of Economics and Statistics* **63**(3): 336-345.

Fudenberg, D. et al. (1983). "Preemption, Leapfrogging, and Competition in Patent Races." *European Economic Review* **22**(1): 3-31.

Galbraith, J. K. (1956). American Capitalism: The Concept of Countervailing Power. Boston, Houghton Mifflin.

Griffith, R. et al. (2006). "Product Market Reform and Innovation in the EU." *The Institute for Fiscal Studies Working Paper 06/17*.

Hagedoorn, J. and M. Cloodt (2003). "Measuring Innovative Performance: Is there an Advantage in Using Multiple Indicators?" *Research Policy* **32**: 1365-1379.

Heckman, J. J. (1979). "Sample Selection Bias as a Specification Error." *Econometrica* **47**(1): 153-161.

Inderst, R. and N. Mazzarotto (2008). Buyer Power in Distribution. In: W. D. Collins (ed.) *Issues in Competition Law*. Chicago, American Bar Association. **3:** 1953-1978.

Inderst, R. and G. Shaffer (2007). "Retail Mergers, Buyer Power and Product Variety." *The Economic Journal* **117**(516): 45-67.

Inderst, R. and T. M. Valletti (2007). "Market Analysis in the Presence of Indirect Constraints and Captive Sales." *Journal of Competition Law and Economics* **3**(2): 203-231.

Inderst, R. and C. Wey (2007). "Buyer Power and Supplier Incentives." *European Economic Review* **51**(3): 647-667.

Inderst, R. and C. Wey (2011). "Countervailing Power and Dynamic Efficiency." *Journal of the European Economic Association* **9**(4): 702-720.

Katz, M. L. (1987). "The Welfare Effects of Third-Degree Price Discrimination in Intermediate Good Markets." *American Economic Review* **77**(1): 154-167.

Klepper, S. (1996). "Entry, Exit, Growth, and Innovation over the Product Life Cycle." *American Economic Review* **86**(3): 562-583.

Klevorick, A. K. et al. (1995). "On the Sources and Significance of Interindustry Differences in Technological Opportunities." *Research Policy* **24**(2): 185-205.

Mas-Colell, A. et al. (1995). Microeconomic Theory. New York, Oxford University Press.

OECD (1998). Buyer Power of Large Scale Multi Product Retailers. Background Paper by the Secretariat for Roundtable on Buying Power. Paris.

Peters, B. (2008). Innovation and Firm Performance: An Empirical Investigation for German Firms. Heidelberg, Physika.

Peters, J. (2000). "Buyer Market Power and Innovative Activities." *Review of Industrial Organization* **16**: 13–38.

Scherer, F. M. (1982). "Demand-Pull and Technological Invention: Schmookler Revisited." *The Journal of Industrial Economics* **30**(3): 225-237.

Scherer, F. M. and D. Ross (1990). Industrial Market Structure and Economic Performance. Boston, MA, Houghton Mifflin.

Snyder, C. M. (1996). "A Dynamic Theory of Counterveiling Power." *The RAND Journal of Economics* **27**(4): 747-769.

Snyder, C. M. (1998). "Why Do Larger Buyers Pay Lower Prices? Intense Supplier Competition." *Economics Letters* **58**: 205-209.

Stefanadis, C. (1997). "Downstream Vertical Foreclosure and Upstream Innovation." *Journal of Industrial Economics* **45**(4): 445-456.

Teece, D. J. (1986). "Profiting from Technological Innovation. Implications for Integration, Collaboration, Licensing and Public Policy." *Research Policy* **15**: 285-305.

Utterback, J. M. and W. J. Abernathy (1975). "A Dynamic Model of Process and Product Innovation." *Omega* **3**(6): 639-656.

von Hippel, E. (1988). The Sources of Innovation. New York, Oxford University Press.

Weiss, C. R. and A. Wittkopp (2003a). "Buyer Power and Innovation of Quality Products: Empirical Evidence from the German Food Sector." *Working Paper FE 0307, University of Kiel*.

Weiss, C. R. and A. Wittkopp (2003b). "Buyer Power and Product Innovation: Empirical Evidence from the German Food Sector." *Working Paper FE 0303, University of Kiel*.

Williamson, O. E. (1975). Markets and Hierarchies: Analysis and Antitrust Implications. New York, Free Press.

Appendix A. Variable definition

The variables listed below with the subscript *t* were constructed from the MIP wave 2005 while the variables with the subscript *t+1* are derived from the MIP wave 2006.

Table A 1: Variable definitions

Variable	*Definition*
RD_{t+1}	Dummy variable taking value 1, if firm reports to have R&D expenditure in 2005 and 0 otherwise.
$RDint_{t+1}$	R&D expenditure in 2005 divided by sales in 2005.
$BP1_t$	Dummy variable taking value 1, if firm reports to generate at least 50% of the sales in 2004 with the largest 3 customers and 0 otherwise.
$BP2_t$	Dummy variable taking value 1 if firm reports to generate at least 50% of the sales in 2004 with the largest 3 customers and reports either to have more than 5 competitors or to have highly substitutable products. If one condition is not fulfilled the dummy takes the value 0.
Buyer's 1-PCM$_t$	1 – PCM on 2-digit level (Nace Rev. 1.2) and 3-digit level for Nace 244.[16]
Buyer's RDint$_t$	Industry R&D intensity on 2-digit level (Nace Rev. 1.2) and 3-digit level for Nace 244.[14]
No. of competitors: None$_t$	Dummy variable taking value 1 if firm reports to have no competitors on the main product market in 2004. Otherwise the dummy takes the value 0.
No. of competitors: 1-5$_t$	Dummy variable taking value 1 if firm reports to have 1 to 5 competitors on the main product market in 2004. Otherwise the dummy takes the value 0.
Product diversity$_t$	1 – share of sales in 2004 generated by the main product line.
Marketing$_t$	Dummy variable taking the value 1, if firm introduced a new design or a new method for selling products during 2002-2004. Otherwise the dummy takes the value 0.
No. of employees (ln) $_t$	Log of number of employees in 2004 (full time equivalents).
Share of graduated employees	Share of employees holding a university degree in 2004.
Continuous R&D activities$_t$	Dummy variable taking the value 1, if firm reports to have continuous R&D activities during 2002-2004 and 0 otherwise.
Firm age (ln) $_t$	Log of the number of years (in 2004) since the enterprise was founded.
Part of enterprise group$_t$	Dummy variable taking the value 1, if firm reports to be part of an enterprise group in 2004 and 0 otherwise.
East Germany$_t$	Dummy variable taking the value 1, if firm are located on the former GDR territory or in West-Berlin in 2004 and 0 otherwise.

[16] For further explanations see Appendix B.

Appendix B. Calculation of buyer market competition measures

PCM and R&D intensity are calculated for domestic and international markets. For domestic industries both measures are calculated on 2-digit-level Nace rev. 1.2 (except for Nace 24, which is separated in 244 pharmaceuticals and other chemicals) using MIP data. The PCM is calculated as given in equation (4). s_{it} represents sales, m_{it} material costs and w_{it} wages and salaries in industry *i* and year *t*. For German data we take the average over the time period from 2001 to 2004.

$$PCM_i^{GER} = \frac{1}{4}\sum_t \left(\frac{s_{it} - m_{it} - w_{it}}{s_{it}}\right) \quad (4)$$

The calculation of domestic R&D intensity is carried out as shown in equation (5) with RD_{it} denoting R&D expenditure of industry *i* in year *t*. Taking the average over the years 2001 to 2004 yields $RDint_i^{GER}$.

$$RDint_i^{GER} = \frac{1}{4}\sum_t \left(\frac{RD_{it}}{s_{it}}\right) \quad (5)$$

For customers in foreign countries we calculate the buyer market competition measures from OECD's Structural Analysis Database (STAN). We use information on the year 2003 from 19 OECD countries which represent the vast majority of export markets of the Germany economy: USA, France, United Kingdom, the Netherlands, Japan, Italy, Spain, Belgium, Korea, Austria, Sweden, Denmark, Finland, Greece, Norway, Ireland, Poland, Czech Republic and Hungary. The PCM on Nace 2 industry level (with the exception of Nace 244) is calculated as shown in equation (6). go_{cit} denotes gross output while ii_{cit} and $lcomp_{cit}$ account for expenditure on intermediate inputs and labour compensation of employees, respectively. The values refer to industry *i* in year *t* and country *c*.

$$PCM_i^{OECD} = \frac{\sum_c go_{cit} - ii_{cit} - lcomp_{cit}}{\sum_c go_{cit}} \quad (6)$$

Data on the R&D intensity of buyers in international markets is taken from OECD's Analytical Business Enterprise Research and Development (ANBERD) data base and linked to STAN. The year 2003 is used as reference year.

$$RDint_i^{OECD} = \frac{\sum_c RD_{cit}}{\sum_c go_{cit}} \quad (7)$$

The calculation of the R&D intensity for international markets is carried out as shown in equation (6). RD_{ci} represents the R&D expenditure in country *c* and industry *i* in the reference year.

Finally, the international values are weighted with firm *i*'s export share of sales while the domestic values of PCM and RDint are weighted with firm *i*'s share of domestic sales. The sum of both parts yields the variables used for the estimations.

Appendix C. Additional tables

Table C 1: Industry breakdown of suppliers' largest customers

Industry group of largest buyer	Nace code (Nace rev. 1.2)
Raw materials	10-11, 13-14, 17.1, 21.1, 23.2-23.3, 24.1, 26.5, 27.1, 37.1-37.2, 40-41
Industry intermediates	15.7, 17.2, 17.5-17.6, 18.3, 19.1, 20.1-20.4, 21.2, 22.2, 24.2-24.7, 25.1-25.2, 26.1-26.4, 26.6-26.8, 27.2-27.5, 28.4-28.7, 31.2-31.6, 32.1, 34.3
Capital goods	28.1-28.3, 29-30, 31.0-31.1, 32.2, 33, 34.1-34.2, 35.1-35.3
Consumer goods	15.1-15.6, 15.8-15.9, 16.0, 17.3-17.4, 17.7, 18.1-18.2, 19.2-19.3, 20.5, 22.1, 22.3, 24.4-24.5, 29.7, 31.5, 32.3, 33.5, 35.4-35.5, 36.1-36.6
Enterprise services	45, 51, 60.2-60.3, 61.1-61.2, 62.2-62.3, 63.1-63.2, 63.4, 64.1, 65.1-65.2, 66, 67.1, 71.2-71.3, 72.1-72.4, 72.6, 73.1-73.2, 74.1-74.8, 90, 92.1, 92.4
Consumer services	45.4, 50, 52, 55, 60.1, 62.1, 63.3, 64.2-64.3, 67.2, 70.1-70.3, 71.1, 71.4, 72.5, 80.4, 92.2-92.3, 92.6-92.7, 93

Table C2: Descriptive statistics differentiated by a supplier's exposure to buyer power (Continued from Table 2)

	Mean	SD	Mean		SD	Mean		SD
	All		BP1=1			BP2=1		
Food_t[a]	0.027	0.161	0.023		0.151	0.029		0.168
Textiles_t[a]	0.033	0.178	0.034		0.181	0.025		0.158
$\text{Wood/Paper/Printing}_t$[a]	0.036	0.187	0.018	**	0.134	0.018	*	0.134
Chemicals_t[a]	0.049	0.215	0.044		0.206	0.055		0.228
Synthetics_t[a]	0.050	0.219	0.062		0.242	0.073	*	0.260
Glass/Ceramics_t[a]	0.021	0.144	0.008	**	0.088	0.007	*	0.085
Metal_t[a]	0.103	0.304	0.112		0.315	0.109		0.312
Machinery_t[a]	0.081	0.272	0.065		0.247	0.062		0.241
Electronics_t[a]	0.125	0.331	0.138		0.345	0.120		0.326
Automotive_t[a]	0.024	0.153	0.047	***	0.211	0.047	***	0.213
$\text{Furniture/Sports/Toys}_t$[a]	0.021	0.144	0.013		0.113	0.015		0.120
Water supply_t[a]	0.028	0.166	0.034		0.181	0.022		0.146
Energy/Mining_t[a]	0.050	0.219	0.057		0.232	0.047		0.213
Wholesale_t[a]	0.035	0.185	0.018	**	0.134	0.022		0.146
Transportation_t[a]	0.066	0.248	0.096	***	0.295	0.098	**	0.298
Media services_t[a]	0.036	0.187	0.016	***	0.124	0.022		0.146
$\text{Computer/Telecommunication}_t$[a]	0.037	0.189	0.055	**	0.227	0.058	**	0.235
$\text{Financial services}_t$[a]	0.015	0.122	0.003	**	0.051	0.004	*	0.060
Consulting_t[a]	0.029	0.169	0.016	*	0.124	0.011	**	0.104
$\text{Technical services}_t$[a]	0.062	0.241	0.081	*	0.272	0.076		0.266
$\text{Enterprise services}_t$[a]	0.040	0.196	0.042		0.200	0.051		0.220
$\text{Buyer: Raw materials}_t$[a]	0.110	0.313	0.158	***	0.366	0.156	***	0.364
$\text{Buyer: Industry intermediates}_t$[a]	0.161	0.368	0.132	*	0.339	0.116	**	0.321
$\text{Buyer: Capital goods}_t$[a]	0.292	0.455	0.353	***	0.479	0.338	*	0.474
$\text{Buyer: Consumer goods}_t$[a]	0.110	0.313	0.096		0.295	0.109		0.312
$\text{Buyer: Enterprise services}_t$[a]	0.177	0.382	0.156		0.363	0.167		0.374
$\text{Buyer: Consumer services}_t$[a]	0.150	0.357	0.104	***	0.306	0.113	*	0.317
N	1,129		385			275		

Results are derived from Two-sample t tests comparing sample means of dependent and independent suppliers. Asterisks indicate the level of significance that the differences of sample means are not equal 0: * p<0.10, ** p<0.05, *** p<0.01.

[a] Dummy variable

Table C 3: Estimated coefficients of the Generalised Tobit model without interaction terms (Continued from Table 3)

	$RD_{i,t+1}$	$RDint_{i,t+1}$	$RD_{i,t+1}$	$RDint_{i,t+1}$
	1	2	3	4
Textiles$_t$[a]	0.444	0.035	0.421	0.034
	(0.299)	(0.035)	(0.298)	(0.035)
Wood/Paper/Printing$_t$[a]	-0.028	-0.010	-0.037	-0.014
	(0.306)	(0.034)	(0.306)	(0.035)
Chemicals$_t$[a]	0.675 **	0.081 ***	0.678 **	0.081 ***
	(0.306)	(0.030)	(0.306)	(0.030)
Synthetics$_t$[a]	0.224	0.021	0.222	0.020
	(0.279)	(0.031)	(0.279)	(0.031)
Glass/Ceramics$_t$[a]	0.007	0.024	0.005	0.020
	(0.371)	(0.039)	(0.372)	(0.039)
Metal$_t$[a]	0.103	0.009	0.092	0.005
	(0.246)	(0.030)	(0.246)	(0.030)
Machinery$_t$[a]	0.552 **	0.018	0.547 **	0.017
	(0.277)	(0.030)	(0.277)	(0.030)
Electronics$_t$[a]	0.504 **	0.042	0.497 *	0.040
	(0.256)	(0.029)	(0.256)	(0.029)
Automotive$_t$[a]	-0.098	0.035	-0.112	0.031
	(0.380)	(0.039)	(0.380)	(0.039)
Furniture/Sports/Toys$_t$[a]	0.977 ***	0.023	0.981 ***	0.024
	(0.370)	(0.038)	(0.370)	(0.038)
Water supply$_t$[a]	0.274	0.040	0.253	0.034
	(0.314)	(0.040)	(0.314)	(0.040)
Energy/Mining$_t$[a]	-0.190	-0.002	-0.193	-0.003
	(0.294)	(0.035)	(0.293)	(0.035)
Wholesale$_t$[a]	-0.117	-0.014	-0.117	-0.018
	(0.313)	(0.044)	(0.313)	(0.043)
Transportation$_t$[a]	-0.490 *	-0.022	-0.506 *	-0.031
	(0.281)	(0.044)	(0.281)	(0.043)
Media services$_t$[a]	-0.124	-0.022	-0.123	-0.024
	(0.301)	(0.036)	(0.301)	(0.036)
Computer/Telecommunication$_t$[a]	0.340	0.037	0.330	0.036
	(0.361)	(0.033)	(0.361)	(0.033)
Financial services$_t$[a]	0.326	0.014	0.323	0.014
	(0.386)	(0.046)	(0.386)	(0.046)
Consulting$_t$[a]	-0.269	0.018	-0.279	0.015
	(0.335)	(0.044)	(0.335)	(0.044)
Technical services$_t$[a]	-0.193	0.114 ***	-0.208	0.111 ***
	(0.297)	(0.032)	(0.297)	(0.032)
Enterprise services$_t$[a]	-0.650 **	-0.017	-0.652 **	-0.022
	(0.319)	(0.050)	(0.319)	(0.050)
Buyer's industry: Raw materials$_t$[a]	0.252	0.003	0.245	0.005
	(0.198)	(0.022)	(0.197)	(0.022)
Buyer's industry: Industry intermediates$_t$[a]	0.403 **	0.044 **	0.396 **	0.045 **
	(0.178)	(0.020)	(0.178)	(0.020)
Buyer's industry: Capital goods$_t$[a]	0.435 ***	0.035 *	0.428 **	0.037 **
	(0.168)	(0.019)	(0.168)	(0.019)
Buyer's industry: Consumer goods$_t$[a]	0.287	0.054 **	0.288	0.056 ***
	(0.197)	(0.021)	(0.197)	(0.021)
Buyer's industry: Enterprise services$_t$[a]	0.257	0.014	0.259	0.017
	(0.175)	(0.020)	(0.175)	(0.020)
N	1,129		1,129	
LR/Wald chi2	224		225	
P-value	0.000		0.000	

* p<0.10, ** p<0.05, *** p<0.01. Standard errors in parentheses.

[a] Dummy variable

Table C 4: Estimated coefficients of the Generalized Tobit model with interaction terms (Continued from Table 4)

	$RD_{i,t+1}$		$RDint_{i,t+1}$		$RD_{i,t+1}$		$RDint_{i,t+1}$	
	5		6		7		8	
$Textiles_t$[a]	0.472		0.035		0.418		0.035	
	(0.302)		(0.035)		(0.300)		(0.035)	
$Wood/Paper/Printing_t$[a]	0.003		-0.008		-0.016		-0.013	
	(0.307)		(0.034)		(0.307)		(0.035)	
$Chemicals_t$[a]	0.750	**	0.082	***	0.721	**	0.084	***
	(0.309)		(0.030)		(0.308)		(0.030)	
$Synthetics_t$[a]	0.232		0.019		0.227		0.020	
	(0.281)		(0.031)		(0.281)		(0.031)	
$Glass/Ceramics_t$[a]	0.002		0.023		0.001		0.020	
	(0.371)		(0.039)		(0.372)		(0.039)	
$Metal_t$[a]	0.128		0.008		0.106		0.006	
	(0.247)		(0.029)		(0.247)		(0.030)	
$Machinery_t$[a]	0.591	**	0.016		0.572	**	0.019	
	(0.278)		(0.030)		(0.278)		(0.030)	
$Electronics_t$[a]	0.531	**	0.039		0.512	**	0.041	
	(0.258)		(0.028)		(0.257)		(0.029)	
$Automotive_t$[a]	-0.136		0.032		-0.123		0.031	
	(0.381)		(0.039)		(0.380)		(0.039)	
$Furniture/Sports/Toys_t$[a]	1.017	***	0.024		1.009	***	0.027	
	(0.373)		(0.038)		(0.372)		(0.038)	
Water $supply_t$[a]	0.308		0.039		0.238		0.033	
	(0.316)		(0.040)		(0.316)		(0.040)	
$Energy/Mining_t$[a]	-0.168		-0.001		-0.185		-0.001	
	(0.294)		(0.035)		(0.293)		(0.035)	
$Wholesale_t$[a]	-0.126		-0.012		-0.126		-0.018	
	(0.317)		(0.043)		(0.316)		(0.043)	
$Transportation_t$[a]	-0.452		-0.019		-0.477	*	-0.029	
	(0.284)		(0.043)		(0.283)		(0.044)	
Media $services_t$[a]	-0.138		-0.021		-0.136		-0.025	
	(0.303)		(0.036)		(0.303)		(0.036)	
$Computer/Telecommunication_t$[a]	0.346		0.036		0.328		0.036	
	(0.363)		(0.033)		(0.362)		(0.033)	
Financial $services_t$[a]	0.273		0.011		0.279		0.011	
	(0.389)		(0.046)		(0.389)		(0.046)	
$Consulting_t$[a]	-0.306		0.017		-0.313		0.012	
	(0.339)		(0.044)		(0.338)		(0.044)	
Technical $services_t$[a]	-0.168		0.113	***	-0.186		0.111	***
	(0.299)		(0.032)		(0.298)		(0.032)	
Enterprise $services_t$[a]	-0.659	**	-0.015		-0.663	**	-0.021	
	(0.320)		(0.050)		(0.319)		(0.050)	
Buyer's industry: Raw $materials_t$[a]	0.242		0.003		0.252		0.005	
	(0.199)		(0.022)		(0.198)		(0.022)	
Buyer's industry: Industry $intermediates_t$[a]	0.395	**	0.042	**	0.398	**	0.044	**
	(0.179)		(0.020)		(0.179)		(0.020)	
Buyer's industry: Capital $goods_t$[a]	0.418	**	0.034	*	0.416	**	0.036	*
	(0.170)		(0.019)		(0.169)		(0.019)	
Buyer's industry: Consumer $goods_t$[a]	0.237		0.051	**	0.260		0.055	***
	(0.199)		(0.021)		(0.198)		(0.021)	
Buyer's industry: Enterprise $services_t$[a]	0.220		0.013		0.232		0.015	
	(0.177)		(0.020)		(0.176)		(0.020)	
N	1,129				1,129			
LR/Wald chi2	231				226			
P-value	0.000				0.000			

* p<0.10, ** p<0.05, *** p<0.01. Standard errors in parentheses.

[a] Dummy variable