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DISCUSSION
PAPER

THE EFFECT OF E-BUSINESS ON CORPORATE PERFORMANCE: FIRM LEVEL EVIDENCE FOR BELGIUM

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Abstract

E-business offers buyers and sellers a new form of communication and provides an opportunity to create new marketplaces. Theoretical studies suggest in general that the development of e-business results in higher firm performance as a result of lower search and head-to-head comparison costs. However, there are a number of recent theoretical studies, which demonstrate that the growth of e-commerce may lead to monopolistic pricing behaviour so that firms engaging in e-commerce need not perform better compared to more traditional enterprises. To date, there exists little empirical evidence on the impact of information technology on economic performance. This paper is the first that uses a large representative data set of Belgian firms to study empirically the impact of e-business on corporate performance.
Our main conclusions can be summarised as follows: (1) The penetration of the Internet in Belgian firms is high, however, the use of e-business is still limited. (2) It is especially the large firms that engage in e-business and mostly in e-procurement. (3) E-business has no effect on total factor productivity in small firms, however, we find positive effects on performance of e-business in large firms.

Key words: new economy, internet, firm performance, e-procurement, e-business

JEL classification: D0, L0, O3, M0

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I. INTRODUCTION

The exponential growth of the Internet and its increasing range of applications has led to a boom of new Internet start-ups and to new marketing strategies for many incumbents who want to be part of the New Economy. The initial belief was that e-commerce should intensify competition – due to lower search costs - and hence lower prices which should benefit economic welfare and growth. It is sometimes suggested that the traditional companies not taking part of this revolution were deemed to failure and exit. However, the recent collapses of share prices of high-tech firms, fears about security on the Internet and the rather low proportion of trade that currently takes place through the Internet casts doubt on the importance of the New Economy. Although the volume of on-line purchases is not yet a significant part of the economy as a whole, the intensity of e-commerce is likely to grow in the near future. In five years from now, e-commerce transactions between businesses and between businesses and customers are expected to account for about 5 per cent of inter-company transactions and retail sales respectively (OECD, 2000). Business to business transactions are generating a lot of interest (Kaplan and Sawhney, 2000) and are expected to experience the most rapid progression (OECD 2000). With respect to business to customer transactions, Cornet, Milcent and Roussel (2000) predict an increase to 35 million European Internet users by 2002, spending an average of 700 USD each three months. This would amount to a turnover of 100 billion Euro on an annual basis.

There are also a number of recent theoretical papers which demonstrate that the growth of the Internet and e-commerce has an impact on the intensity of competition. In most cases, it should intensify competition. However, there are a number of constraints to be fulfilled, if not it can also lead to monopolistic pricing behaviour which may lower economic welfare and firm's efficiency (Lal and Sarvary, 1999; Friberg, Ganslandt and Sandström, 2000; Van Cayseele and Degryse, 2000).

Despite the daily attention the New Economy gets there exists surprisingly little empirical evidence on the impact of e-business on firm performance. Geyskens, Gielens and Dekimpe (2000) is one of the few that studies the financial stock market performance firms in the newspaper industry in response to offering on line newspapers. They have data on 21 different firms representing 87 newspapers and find that on average Internet channel investments are positive net-present-value investments. We take a broader approach in this paper. In particular, the purpose of this paper is to assess whether e-business has on average positive effects on all firms in various industries in the entire economy. Thus, our aim is to generalise the analysis to all types of firms and sectors and to test whether on

average the net effect of e-business is positive or negative. To this end we use a unique data set of 800 Belgian firms with information on e-commerce usage to examine its impact on firm performance. In the next section we give a literature background, section III discusses the data that we collected and provides summary statistics, section IV analyses the impact of the Internet on firm performance. Section V is a concluding one.

II. BACKGROUND

The prospects of important growth in the on-line business are challenging economists by posing questions about the effects of e-commerce on the conventional economy, especially on competition, price levels and firm performance. From the very start, the conventional wisdom predicted an increase in competitive pressure, shrinking profit margins, lower prices and more efficient production as a result of firms setting up their virtual stores on-line. These changes would not only affect the on-line buyers and sellers themselves, but also the more traditional firms who do not buy or sell online since the share of business partners and customers searching for on-line sales is steadily growing.

In general, the competition-enhancing and price-lowering features of e-commerce can be summarised as follows. As a first element, distribution costs will decrease (Lal and Sarvary, 1999; Van Cayseele and Degryse, 2000). Instead of hosting a grid of physical selling outlets, an on-line seller only needs is a small number of big warehouses with employees packing the on-line orders and dispatching them to the trucks that deliver goods. Second, costs of consumer search will be reduced. Transaction costs for buyers and sellers will be reduced because of automation (Kaplan and Sawnhey, 2000). Operational efficiencies can be realised because of fewer stages in the transaction process and a reduction in staff required for transactional processing. Third, e-commerce can lead to shorter supply chains (Wadhwani, 2000; De Prince and Ford, 1999) The conventional supply chain starts with the producer and passes through the distributor (wholesaler) and retailer. E-commerce excludes the retailer and quite often the wholesaler as well. The Amazon bookstore is an example of the former supply chain, while the Dell corporation on-line business refers to the latter supply chain. In both cases significant reductions on the cost side are possible due to the absence of expenditures on the retail outlets and to the reduction of inventory carrying costs (Benjamin and Wigand, 1995). Finally, e-commerce gives the possibility of head-to-head comparisons at low or zero costs. Comparisons of the products' prices and attributes can be performed in a fast and often costless way, increasing

the market transparency and contributing to increased competition and lower price-cost margins. The seller will have maximum choice at lower price (Benjamin and Wigand, 1995).

Bakos (2000) similarly questions the link between higher intensity of e-commerce and a greater extent of competition. In his model, higher competition only results if the costs of searching for prices are lower than the costs of searching for attributes. Otherwise, the extent of competition actually decreases. Finally, Ulph and Vulkan (1999) point out that, while the Internet shopping allows for costless screening on the demand side, on the supply side, the on-line sellers engage in as costless a collection of information about their customers' preferences and profiles. The result is more opportunities for a first-degree price discrimination, which drives price-cost margins to zero. Competition becomes much intenser since the ability to screen customers' preferences means there is competition for every single customer rather than competition for the community of customers as a whole. Firms then might choose to engage in product differentiation, thus securing a market niche where they can continue charging prices above marginal costs or even engage in monopolistic pricing. The insights obtained from the studies cited above suggest that in general, the development of e-commerce results in a higher extent of competition between the on-line sellers, lower prices and hence higher firm performance. However, under a number of assumptions competition intensity may actually decrease, prices become or remain monopolistic and customers get discouraged from searching and stick to one brand. Thus, following this stream of research, firms engaging in e-commerce need not perform better compared to the traditional enterprises.

The existing empirical evidence for Europe and the US appears to confirm the fact that the effects listed above actually are taking place. Beardsley et al. (1999) describe the many ways customers can order and purchase goods without having to physically visit the traditional shops, with a significant number of firms tendering for the right to provide services in these markets. New technologies are constantly under development, making access to virtual shops even easier. The development of WAP (wireless application protocol) mobile phones, for example, is "threatening" to shift the bulk of e-commerce transactions to the wireless domain, especially in Europe where the mobile phone penetration rate is the highest in the world. The fast growing market for cable TV services is another medium through which e-commerce can be done. The evidence of lower prices at the on-line shops in Sweden is found by Friberg et al. (2000) who explore the markets for books and CD-s. The on-line prices are found to be on average 15% lower compared to their physical counterparts. However, this finding comes with a caveat that this 15% gain is offset by the shipping costs in case only one item is purchased.

The above theoretical and empirical contributions suggest that e-business most likely leads to more intense competition. It is only under particular assumptions that it may lead to more monopolistic price setting behaviour. If e-business leads to more intense competition we expect that this will result in higher firm performance and efficiency. There exists a long literature on the effect competition has on firm performance. Although theoretical models do not provide a unique prediction, most of the empirical work suggests that more intense competition leads to better firm performance, usually measured by total factor productivity (e.g. Blanchflower and Machin, 1996; Levinsohn, 1993; Nickell, 1996; Angelucci, Estrin and Konings, 2000). The mechanism at work is one in which increased product market competition squeezes profit margins and increases the threat of bankruptcy. This leads to higher incentives for managers to engage in cost cutting strategies and to increase production efficiency. In the context of the New Economy we may expect that the use of e-commerce allows firms to become more cost competitive and efficient. In particular, the internet provides ways through e-procurement to search for the cheapest supplier and to realise reductions in communication costs with suppliers which then leads to a reduction in total production costs. Likewise, selling through the internet allow firms to provide information on their product in a cheap and fast way, which may reduce distribution and selling costs. In general e-commerce should reduce transactions costs which leads to higher production efficiency. This is the main hypothesis that we seek to test.

III. DATA AND SUMMARY RESULTS

To obtain firm level data on the intensity of e-business and its influence on firm performance we combined information of a postal survey with quantitative information from company accounts. All incorporated enterprises that carry on a commercial activity, whether or not they are listed on a stock exchange, publish full or abbreviated accounts. This means that all small companies, with some minor exceptions, are subject to the accounting law concerning the preparation and publication of accounts. Belgium has indeed gone much further than was required under the terms of the European Union's Fourth Directive. Credit and banking institutions, insurance companies, exchange brokers and hospitals are subject to special rules. Therefore, these industries are not included in the sample. We sent out a survey to 5718 firms, which were randomly taken from published company accounts. We obtained 836 responses, which corresponds to a

response rate of more than 14%. We then merged the survey with the respective company accounts, which allowed us to obtain quantitative information on firm performance.

In general the following conclusions can be derived for the Belgian economy. About 90% of all firms in the sample have an e-mail address and can access the Internet. In global, 57% of these firms have their own web site, but only a much smaller fraction of 15% sell products on-line. This suggests the majority of firms hosting a web site use it for advertising or pure informational purposes, rather than as a virtual shop. Consequently, the potential increase in the number of companies engaging in e-commerce could be large. With respect to e-procurement, 31% of the firms buy some of their products or services online. We also inquired into the shares of turnover and external purchases that are respectively sold and purchased online. For more than 90% of the firms engaged in e-business these percentages are lower than 5%. Furthermore, 34% of the firms that do not sell online at the moment of the questionnaire would consider doing so in the future. This suggest that we may still expect a substantial expansion in the future.

Table 1 reports sectoral differences with respect to the use of e-business. Most companies appear to have an e-mail address (E-mail) and an Internet connection (Internet). There seems to be little variation between industries in case of both kinds of answers. If we look at the fraction of firms hosting their own web site (Web site), there is more variation between the sectors. Industries such as pulp and paper, chemicals, electrical machines, renting of machinery and equipment and computer activities are characterised by a relatively higher fraction of firms with an own web site.

The fifth column of Table 1 reveals interesting information on e-commerce sales (Selling online). Especially in the paper industry, retail trade, air transportation, post and telecom, renting of machinery and equipment and computer activities sales on line are done by more than 30% of the companies. We also investigated the potential use of the Internet for selling products in the future. Results show that 34% of the firms that currently do not sell online would consider doing so in the near future. Especially in sectors such as coke and petroleum products; electricity, gas and water; retail trade, air transport and recreation, the majority of the firms are planning to sell products online in the near future. It is in those sectors that we may expect the first expansion of e-commerce.

The final column of Table 1 gives an indication of the companies that buy products and/or services online (Buying online). The Internet seems to have an impact on corporate purchasing processes for 35% of the companies. Especially in chemicals, electrical machinery, communication, post and telecom and computer activities e-procurement seems

to be successful. In this context, Van Cayseele and Degryse (2000) suggest that e-procurement has especially penetrated the banking world in the last few years. Our survey confirms that the role of the use of the Internet for buying banking products by firms is important: 17% of the firms are currently buying banking products online and more or expected to do so in the near future.

In what follows, we report the same sort of the survey results, focusing on the differences between size classes. Table 2 suggests bigger firms are more eager to exploit the advantages of the Internet compared to the smaller enterprises. In fact, the share of firms within each size class that have an e-mail or/and have access to the Internet, increases monotonically with size, almost reaching 100% in case of the biggest firms.

Table 1: The use of e-business: sectoral differences

Sector	E-Mail	Internet	Web site	Selling online	Buying online
Food and Beverages	84%	94%	43%	8%	20%
Textiles	90%	97%	40%	3%	30%
Pulp and Paper	97%	97%	73%	30%	42%
Printing and Publishing	100%	80%	40%	20%	40%
Coke and Petroleum Products	100%	100%	54%	23%	46%
Chemicals and Products	100%	97%	74%	16%	55%
Rubber and Plastic products	94%	94%	60%	11%	37%
Non-metallic mineral products	86%	86%	64%	8%	31%
Basic Metals	91%	91%	61%	13%	22%
Fabricated Metal products	83%	81%	50%	14%	29%
Machinery and equipment	95%	95%	66%	5%	25%
Electrical Machinery	100%	100%	75%	11%	64%
Radio, TV, Communication Machinery	100%	100%	64%	18%	55%
Medical and Precision Equipment	79%	85%	33%	6%	30%
Motor vehicles	85%	89%	59%	11%	19%
Other Transport Equipment	91%	100%	64%	0%	18%
Furniture	79%	79%	41%	17%	28%
Electricity, Gas, Water	100%	100%	50%	0%	0%
Construction	92%	94%	42%	11%	39%
Wholesale Trade	83%	86%	42%	17%	31%
Retail Trade	78%	78%	59%	26%	37%
Sale, Repair Motor vehicles	88%	92%	58%	15%	31%
Land Transport	87%	87%	54%	15%	26%
Air Transport	100%	100%	50%	50%	0%
Post and Telecom	95%	100%	64%	32%	50%
Renting of Machinery and Equipment	86%	83%	75%	33%	33%
Computer Activities	100%	100%	100%	36%	86%
Other Business Activities	100%	91%	74%	26%	48%
Recreation	90%	100%	52%	14%	33%
Other Services	44%	56%	28%	12%	24%
All Sectors	**88%**	**90%**	**57%**	**15%**	**35%**

Table 2: The use of e-business: size differences

Size class	E-mail	Internet	Web site	Selling online	Buying online
Size class 1	58%	69%	21%	8%	24%
Size class 2	89%	89%	54%	14%	31%
Size class 3	95%	96%	63%	21%	35%
Size class 4	98%	97%	78%	12%	39%
Size class 5	99%	98%	76%	22%	52%

Note: The size classes for the firms are defined as follows:

Size class 1: Value Added< 1 mn EURO
Size class 2: Value Added>= 1 mn EURO & Turnover< 10 mn EURO
Size class 3: 10 mn EURO <= Turnover < 25 mn EURO
Size class 4: 25 mn EURO <= Turnover < 50 mn EURO
Size class 5: Turnover > 50 mn EURO

A substantially smaller fraction of firms within each size class hosts a web site. The bigger firms are more likely to have themselves represented on the Internet. Just as it is the case for the different sectors, the fraction of firms who actually sell online increases with the size of the firms. The biggest firms indeed lead in terms of the extent to which they do commerce on the Internet, but the largest proportion of firms that sell online hardly exceeds the 20% threshold. There is no monotonicity anymore in terms of increasing e-activity with the firms' size. Thus, size class 2 sells online almost as actively as does size class 5. Firms in size class 4, however, do not sell online more intensively compared to the smaller firms in size class 3. The robust tendency (relative to the differences between sectors and tiers) seems to be that the smallest firms are least involved into e-commerce sales and that the biggest firms do business on the Internet most intensively. The fraction of firms that are positive about selling on the Internet in the future does not seem to depend much on the size of the firm and is between 30% and 40%. For the biggest firms the potential increase in firms selling online may be threefold. Indeed, 20% of these firms are already selling electronically. Given that 40% are planning to do so in the future, the fraction of online sales participants may increase to 60%, becoming the majority.

With respect to e-procurement Table 2 indicates that especially the largest firms are very active. In particular, 52% of the firms in the largest size class use the internet to buy products. This compares to only 24% in the smallest size class. Comparing the last two columns of table 2 also indicates that buying online occurs much more frequent than selling on line.

In this section we described the use of e-business by Belgian companies. Whereas most of the companies have an e-mail address and access to Internet, only half of them has an own web site. E-procurement seems to be more successful than e-commerce sales. There are important differences between sectors with respect to the use of e-business and its usage is substantially higher among large firms than small firms. A central question in this respect is the influence of e-commerce on firm performance. This will be studied in the next section.

IV. Estimation Results and Discussion

To test the hypothesis that e-business leads to higher firm performance we estimate a production function which is augmented with indicators of e-commerce or

$$y = \alpha_0 + \alpha_1 n + \alpha_2 k + \beta EB \qquad (1)$$

where y stands for log output, n stands for log employment, k is log capital, which is proxied by the log of total assets and EB is a vector of variables that capture penetration of e-business in the firm. We include three indicators that are taken from the survey to capture e-business. Our first indicator is whether or not the firm has a web site. The presence of a web site does not need to have a direct cost reducing effect, however, a web site may indicate that firms potentially could use the internet at some stage to start engaging in e-business which potentially may lead to better performance. Moreover, a web site can also serve as an advertising tool that may affect performance in a positive way. The two other indicators of e-business refer to sales and purchases that are done on line. We construct a dummy equal to 1 if firms sell products on line and zero otherwise. Likewise, we construct a dummy equal to 1 if the firm purchases products on line and zero else.

Table 3 reports the results of estimating equation (1) for the entire sample for which we have observations on the relevant variables. The estimation takes into account that firms that are operating in the same sector may interact with each other and therefore that the firm level observations within one sector are not independent. We take this potential clustering into account in our estimation procedure. The first column looks at the effect of a web site, the second and third column augment the specification by including sales on

line and purchases on line. From the first column we note that firms that do have a web site are associated with higher total factor productivity, however, this effect vanishes once we control for sales and purchases on line in columns (2) and (3). In column (3) the only e-business variable that is statistically significant at conventional levels is whether the firm sold products online or not. Based on the estimate we can infer that firms that are engaged in online selling have a 13% higher total factor productivity compared to firms that do not engage in selling on line. It is difficult to claim any causality at this stage since we are using cross-section data. So, a careful interpretation of this result is one which claims that e-business is associated with higher firm performance. To test the causality of this effect requires panel data on the use of e-commerce, which we do not have available at this stage.

Table 3: Results for the overall sample

	(1)	(2)	(3)
N	0.60* (0.08)	0.60* (0.08)	0.60* (0.08)
K	0.39* (0.07)	0.39* (0.07)	0.39* (0.07)
Web site	0.08* (0.04)	0.05 (0.04)	0.05 (0.04)
Selling online	-	0.14* (0.06)	0.13* (0.06)
Buying online	-	-	0.02 (0.04)
Adjusted R2	0.92	0.92	0.92

Note: In brackets are robust standard errors, * denotes statistically significant at conventional levels

From table 2 in the previous section we could note that the intensity of e-business was higher in larger firms. This may be the consequence of a scale effect needed before firms can engage in e-business or that firm size is a reflection of investment capacity in information technology. In particular, if investment in information technology to engage in e-business is of a sunk cost nature, then we may expect that especially large firms will be more likely to engage in it since they have more financial means to do so. Then we may expect that it is especially the large firms that also are more likely to benefit from it.

This suggests that the effect of e-business may be different in different sized firms. To test this hypothesis we split our sample into two broad classes of firms. In tables 4 and 5 we make a distinction between small and medium sized firms (SME's) and large ones. SME's are defined as firms that have a total turnover of less than 400 million BF. From Table 4

we can note that none of the e-business variables are statistically significant at conventional levels. This is not surprising given the information in Table 2 where we noted that especially the large firms were engaged in e-business.

Table 4: Results for SME's

	(1)	(2)	(3)
N	0.55* (0.09)	0.55* (0.09)	0.55* (0.09)
K	0.44* (0.09)	0.44* (0.09)	0.44* (0.09)
Web site	-0.01 (0.05)	-0.012 (0.05)	-0.006 (0.05)
Selling online	-	0.11 (0.09)	0.14 (0.10)
Buying online	-	-	-0.10 (0.07)
Adjusted R2	0.87	0.87	0.87

Note: In brackets are robust standard errors, * denotes statistically significant at conventional levels

In Table 5 we show the results for the sub sample of large firms. All three e-business indicators have positive and statistically significant effects on firm performance. They all have similar effects in terms of size. Having a web site, selling online or purchasing online increases total factor productivity by 10% compared to firms that do not do so. Thus large firms can become more efficient by using e-business.

Table 5: Results for Large Firms

	(1)	(2)	(3)
N	0.61* (0.08)	0.61* (0.07)	0.61* (0.07)
K	0.37* (0.08)	0.37* (0.07)	0.37* (0.07)
Web site	0.13* (0.06)	0.10* (0.07)	0.10* (0.07)
Selling online	-	0.15* (0.06)	0.12* (0.06)
Buying online	-	-	0.10* (0.05)
Adjusted R2	0.87	0.88	0.92

Note: In brackets are robust standard errors, * denotes statistically significant at conventional levels

V. CONCLUSION

In this paper we report the results of an empirical analysis that studies the effect of e-business on corporate performance. We combined information on the usage of e-business of a postal survey with quantitative information from annual accounts. About 90% of all firms in the sample have an e-mail address and can access the Internet. The use of e-business however is still limited. Usage of e-business is substantially higher among large firms than small firms and there seem to be important differences between industries. Our estimates show that large firms that are engaged in e-business have a higher total factor productivity than large firms that do not. E-business seems to have no effect on factor productivity of small firms.

This paper also suggests a new research agenda. Ideally we should have panel data to allow to assess the dynamic features of e-commerce on firm performance and to control for potential endogeneity of e-commerce. This paper used data on a cross-section of firms, so we were not able to analyse the dynamic effects of e-commerce on competition and firm performance. As time lapses we expect to obtain more time observations on e-commerce which would allow us perform a dynamic analysis.

Furthermore, this paper focused on the effects of e-commerce on total factor productivity. Little is known about the impact of e-commerce other aspects of performance, such as performance on the labour market. In particular, does e-commerce lead to shifts in the labour market in favour of more skilled workers? What does e-commerce do to wages? These are some research questions which we aim to address in the near future.

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