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Does Marginal Cost Pricing of Public Sector Information Spur Firm Growth?

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Abstract

The firm-level data concerning re-users of geographical information (GI) active in architectural and engineering activities and related technical consultancy sector from 15 countries during the year 2000–2007 suggests that the pricing of public sector GI strongly relates to the firms' sales growth. Firms functioning in the countries in which public sector agencies provide fundamental geographical information either freely or at maximum marginal costs have grown, on average, about 15 percent more per annum than the firms in the countries in which public sector GI is priced according to the cost-recovery principle. The difference-in-difference estimations further show that positive growth impact materializes already one year after switching to the marginal cost pricing scheme but a stronger boost to the firm growth takes place with a two year lag. Interestingly, marginal cost pricing has not generated notable growth among the large firms; it has been SMEs benefiting most from cheaper geographical information. It seems credible that switching to marginal cost pricing of public sector information (PSI) substantially lowers SMEs' barriers to enter new market areas in the provision of GI-based products and services.

Key words: Public sector information, pricing, firm growth, technology policy

JEL: L25, L84, O38

Tiivistelmä

Maantieteellistä tietoa hyödyntäviin teknisen palvelun toimialan yrityksiin keskittyvä aineistoanalyysi vuosilta 2000–2007 osoittaa, että julkisen tiedon hinnoittelu vaikuttaa selvästi yritysten liikevaihdon kasvuun. Yritykset maissa, joissa julkinen maantieteellinen tieto on ollut ilmaista tai enintään rajakustannusten perusteella hinnoiteltua ovat kasvaneet vuositasolla keskimäärin 15 prosenttia enemmän kuin yritykset maissa, joissa julkisen maantieteellisen tiedon hinnoittelu on ollut kustannusperusteista. Rajakustannushinnoitteluun siirtymisen jälkeen on havaittavissa positiivinen kasvuvaikutus jo seuraavana vuonna, mutta selvästi voimakkaampi kasvusysäys nähdään kahden vuoden päästä hinnoittelumuutoksesta. Julkisen maantieteellisen tiedon rajakustannushinnoittelu ei ole kuitenkaan vaikuttanut merkittävästi suurten yritysten kasvuun; PK-yritykset ovat hyötyneet eniten halvemmasta maantieteellisestä tiedosta.

Asiasanat: Julkinen tieto, hinnoittelu, yritysten kasvu, teknologiapolitiikka

1 Introduction

The fundamental importance of public sector information for the economy is acknowledged both in the academic and practical policy oriented documents[1]. Spatial information and socio-economic data form the most valuable databases held by public sector agencies. According to the assessment of the European Commission (2004)[2], *spatial data, i.e., information that combines geographical location with other data and spatial information are embedded in up to 80% of all the data held in public sector institutions*. The major value and potential of spatial information lies, however, in the private sector that has increasingly become also its holder. Particularly geographical information systems (GIS), navigation and location-based services (e.g. information on the local attractions and events) and geomarketing (e.g. real estate consulting) are among potential high-growth business services utilizing spatial information[3].

It is argued that public sector policy lines, particularly those concerning the pricing of public sector information (PSI), still hinder the development and growth of private markets for information services and products generated by the re-users of public sector information. Scarce government budgets have led to the implementation of partial or full cost-recovery pricing of PSI, and even profit maximizing behaviour and competition with private sector companies – typically agencies providing PSI receive part of their funding from the government budget and partly covered their costs via PSI sales – in various countries. Quite recently, since the inception of the Directive 2003/98/EC of The European Parliament and of the Council that states "*... the Member States should encourage public sector bodies to make documents available at charges that do not exceed the marginal costs for reproducing and disseminating the documents.*" some countries such as the United Kingdom and Netherlands have adopted PSI pricing policies following the marginal cost rule. In many countries, such as in Finland, pros and cons of the change towards marginal cost pricing of PSI are still disputed.

There are currently very few reported quantitative analysis on the economic impacts of pricing of PSI to advice decision makers. Newbery et al. (2008) provides an exception by analysing the welfare impacts of different pricing policies of PSI provision by the six largest trading funds in the UK. Their data suggest that moving from cost-recovery pricing to marginal cost and/or zero pricing of basic data products is a preferable solution. This paper provides, to the best of my knowledge, the first reported systematic or econometric analysis using firm-level data concerning the economic consequences of the adoption of different PSI pricing policies.

This paper contributes to the literature by using data from countries that have implemented different pricing schemes for public geographical information (GI); it empirically analyses the impacts of (maximum) marginal cost pricing on the re-user firms' growth performance. The database comprises about 14 000 firms being active in architectural and engineering activities and related technical consultancy sector (i.e. Standard Industrial Classification 7420) in

[1] For instance, Pollock (2008) writes as follows: "*... just as the supply of basic physical infrastructure – power, transport, telecommunications – is essential to the traditional economy, so the supply of basic information 'infrastructure' – core datasets in the major areas of geography, weather, transport etc – is essential to the 'information' economy".*

[2] Commission of the European Communities (2004). Proposal for a decision of the European Parliament and of the Council establishing a multiannual community programme to make digital content in Europe more accessible, usable and exploitable. Brussels 13.2.2004.

[3] Prior studies assess that the most important categories of geographical information for re-users are topographic data, cadastral information (including address coordinates) and aerial photography (see. e.g., Fornefeld et al., 2009).

15 different countries during the years 2000–2007 to investigate whether marginal cost pricing of GI has contributed to the firms' sales growth, as opposed to the different cost-recovery pricing schemes.

Though this paper provides a novel contribution to the empirical analysis of the economic impacts of PSI, it links closely to a vast and well-established empirical literature exploring the determinants of firm growth (see Coad, 2007, for an excellent survey on the topic). The existence of Gibrat's Law – i.e. the independence of a firm's growth rate on its size – has attained plenty of attention, with the preeminent conclusion that smaller firms tend to grow faster than the larger ones (see, e.g., Lotti et al., 2003; Stam, 2010). Also, the theory-based hypothesis of positive relationship between innovation and sales growth (see, e.g., Aghion and Howitt, 1992; Klette and Kortum, 2004) has inspired various empirical researchers but often the reported studies fail to confirm strong, or any, relationship between innovation and growth (Coad, 2007). Some recently published studies such as that of Corsino and Gabriele (2011) suggest that not only problems related to the measurement of innovation activities but also the level of observation at which empirical analysis is conducted may affect the estimated relationship between innovation and sales growth, possibly hiding the truly positive innovation-growth link.

There are also various studies focusing on the growth opportunities and the performance of firms. Different regulatory, legal and financial systems may generate differences in firms' growth rates across countries (see, e.g., Beck et al, 2005; Bena and Jurajda, 2011). Also, as addressed by Cassia et al. (2009), various characteristics of regional or country-specific innovation system may affect business growth. According to their empirical study, university-based knowledge production in certain regions is likely to create new ideas and economic opportunities and to further generate faster sales growth of firms. This study expands prior empirical analysis concerning firms' growth opportunities to those arising from the utilization of public sector information.

The rest of the paper is organized as follows. Section 2 formulates the hypothesis to be tested in the empirical part of the study. Section 3.1 presents the econometric models, 3.2 introduces the data used in the empirical analysis and 3.2 reports and discusses the estimation results. Section 4 concludes.

2 Pricing of PSI and firm growth

2.1 Demand for geographical information

Various previous reports emphasize the importance of public sector information particularly for the industrial sectors using geographical information in their activities and further developing and offering digital information products themselves (see, e.g., Fornefeld et al., 2009). The economic literature does not provide systematic empirical analysis on the elasticity of demand for public sector information but the reported examples suggest that change from cost-recovery based pricing of GI to marginal cost pricing increases dramatically the use of GI by firms. In this section, we highlight some country-level cases concerning provision of public sector GI at maximum marginal cost prices with the interest in the changes in demand for information after switching to the new pricing regime.

In 2006, Austria employed the Austrian Act of Surveying enabling change from the cost recovery pricing to the marginal cost pricing model for the geographical data offered by the public sector agencies. The prices of various key data sources of the Austrian National Mapping and Cadastral Agency such as digital cadastral maps reduced up to 97 percent, and were followed by substantial increases in orders and subscriptions of data (Schennach, 2008). For instance, demand for digital cadastral maps increased over 250 percent and for digital landscape models over 1000 percent. An increase in the demand for data arose particularly from the small and medium sized firms, and also new user groups such as geomarketing and health services firms emerge as the users of geographical data (Fornefeld et al., 2008). Interestingly, the total turnover of the Austrian National Mapping and Cadastral Agency obtained from the data of which price was substantially reduced remained, due to the strong growth in demand, quite stable (Fornefeld et al., 2008).

In Spain, key geographical data is widely available free of charge via "Virtual Office of Cadastre", OVC, established in March 2003 to provide different organizations better access and use of cadastral data and services. In June 2004, the access to geographical data in Spain was improved via the launch of an Internet portal IDEE offering free access to essential geographical data. The usage statistics available on the web page of OVC[4] show a dramatic increase in the use of geographical data. For instance, the number of cartography data consultations increased from the year 2004 to 2005 about 700 percent, from over million consultations to over 41 million consultations. In 2010, the corresponding number was over 124 millions indicating over 2300 percent growth in usage compared to that of 2004.

Australia is also among the advanced countries in the adoption of PSI pricing policies enabling free of charge use of various key public sector data sources. Australian focus in promoting access and re-use of PSI has largely focused on spatial data and publicly funded research data and publications (Fitzgerald, 2010). In the autumn of 2001, Australian Government introduced Spatial Data Access and Pricing policy requiring relevant public sector agencies to offer their data free of charge online and at the marginal cost of transfer for packaged data products (i.e. data provided in CD format). The Office of Spatial Data Management in Australia implemented the new pricing policy by February 2002. Since the end of 2005, the Australia Bureau of Statistics has provided all publications, spreadsheets and Census data on its web pages free of charge. According to Australian Bureau of Statistics (2009), "it took about 5.5 years for page views to double from 30 million pages in mid 1999 to 60 million pages in end 2005, but only two years to double again to 120 million pages in end 2007".

The public sector pricing policies of PSI may have not only drastic implications for the demand for PSI but also for the size of the markets utilizing PSI. Pettifer (2009) argues that the fundamental reason for the size difference between the US and European meteorological markets are the different PSI pricing schemes adopted in the US and in Europe. He states that freely available data in the USA resulted in $1.4 billion market in 2006 in value-added meteorological products of all types in the USA, while the corresponding market size in Europe with costly PSI was $372 million. The annual growth of meteorological markets in the US and Europe were – measured since 2000 – 17 and 1.2 percent, respectively.

[4] For details, see http://www.sedecatastro.gob.es/OVCInicio.aspx.

2.2 GI pricing and growth

The reported examples suggest that the price elasticity of demand for public sector information is high: public sector agencies in various countries have witnessed a strong growth in demand for information they provide after switching from cost-based pricing of PSI to free or maximum marginal cost priced information (see also, e.g., Newbery et al., 2008; Pollock, 2008). Firms using public sector GI as a raw material for their products and/or services are likely to benefit most from the maximum marginal cost pricing practices. The availability of PSI at maximum marginal cost price is further likely to promote innovation among the re-users of PSI and facilitate use of PSI for developing new products and services. Innovation is the key engine of firm growth and particularly product innovation is often regarded as the most important strategy for market expansion (see, e.g., Hay and Kamshad, 1994). Our first hypothesis is thus the following:

Hypothesis 1: *Firms tend to grow more when PSI is available at maximum marginal cost than they do when PSI is priced using cost-recovery principle.*

The switch towards marginal cost pricing of PSI may not only promote innovation and generate generally more growth but it may also affect competition in the markets for information products and services. When public sector GI is offered using the cost-recovery pricing principles, firms may either buy GI from the public sector agency or, in some cases, collect it themselves. High price of data or substantial collection costs may become a barrier to access to GI[5] – this applies particularly for SMEs with more limited resources than large firms – and consequently a barrier to entry, particularly for SMEs', to the new markets for GI products and services. Large firms may thus be in a relatively more favourable position when public sector authorities use full or partial cost recovery model, and benefit less from the switch to the marginal cost pricing of GI than the SMEs. Our second hypothesis is thus:

Hypothesis 2: *Particularly SMEs benefit from the marginal cost pricing of PSI and grow more than large firms when PSI is available at maximum marginal cost.*

Next section introduces data and reports the results of the empirical analysis testing the two hypotheses.

3 Econometric analysis

3.1 Econometric models

We measure growth (i.e. the dependent variable) by a firm's real sales growth between time t and t-1. This measure was chosen primarily as it is the most commonly used and generally acknowledged measure of entrepreneurial growth performance. We explore the impacts of maximum marginal cost pricing of essential public sector GI of a country on firms' sales growth by two models, the random effects model (RE) and the difference-in-differences (DID) model. The random effects model is chosen as it utilizes both cross-sectional and time-series dimen-

[5] For instance, in 2009, National Land Survey of Finland charged up to 244 000 Euros for some of its digital products covering geographical data from the entire country of Finland. (Source: *www.finlex.fi/data/normit/31638-Hinnasto_liitteet_010509.pdf*)

sions of the database, and captures well the contemporary relationship between marginal cost pricing and firm growth, while the difference-in-differences method detects the growth contribution of different pricing schemes after the change in the pricing regime has taken place. The RE method also enables the inclusion of observations to the analysis concerning firms coming from several countries that have adopted the marginal cost pricing at different times. Instead, the before-after policy change approach of the DID method restricts the analysis to the firms that have faced the change in the pricing scheme at the same time against those firms in which home countries the pricing of PSI has followed full or partial cost-recovery pricing principles during the all sample years of analysis.

First, we employ the following RE models:

$$SALES\_GR_{it} = \alpha_0 + \alpha_1 MCPRICE_{it} + \sum_j \beta_j C_{it} + u_i + \varepsilon_{it}\,, \qquad \text{(MODEL 1)}$$

where the variable MCPRICE gets value 1 if a firm i's home country at time t provides essential public sector GI at maximum marginal cost prices, and 0 otherwise. Vector C denotes j control variables used in the estimated equations. We further estimate Model 1 separately for the SMEs and large firms to investigate whether the growth dynamics are different for small and large firms.

The second econometric approach is the difference-in-differences method that has certain advantages in evaluating the effects of policy changes on firms' performance. The DID method removes biases that could originate from the permanent differences between the firms in countries that employed new policy and in those that didn't.[6] Our data provide us with best opportunity to evaluate the performance impacts of 2004 GI pricing policy change in Spain as our database comprises a sufficiently large population of Spanish firms (i.e. about 13 percent of all observations) and as we have sufficient data concerning firms' growth both before (i.e. in 2003) and after (i.e. in 2005 and 2006) the policy change.[7] The dependent variable of the estimations is the (log) level of turnover of a firm (variable TURNOVER). The equation that is estimated for two cross-sections, before- and after-subsidy year, can be written as follows (after dropping the firm-specific i-indicators for simplicity):

$$TURNOVER = \alpha_0 + \alpha_1 MCPRICE + \alpha_2 T2 + \alpha_3 MCPRICE * T2 + \sum_j \beta_j C_j + u\,, \qquad \text{(MODEL 2)}$$

where coefficient a_1 captures the difference in firms' turnover level between the Spanish and other firms in 2003, i.e. before Spanish GI policy change. The time dummy T2 measures the time-related changes (due to certain aggregate factors) in the firms' turnover that had taken place without the policy change. Coefficient a_3 is the focus of interest here as it captures the effect of policy change in Spain after policy implementation, at year T2.

[6] However, there might be systematic differences in the firms' growth across countries – e.g., due to the differences in macroeconomic conditions – affecting the growth of firms. We use the variable capturing the change in GDP of a country to control for these differences.

[7] From Australia and Austria, which also witnessed GI pricing policy change, we have only tens of observations, and data from the US firms cannot be used for DID analysis as the United States have employed marginal cost pricing policy through all sample years. Firms, except the Spanish ones, from those countries that have already employed MC pricing policy are removed from the data for the DID analysis.

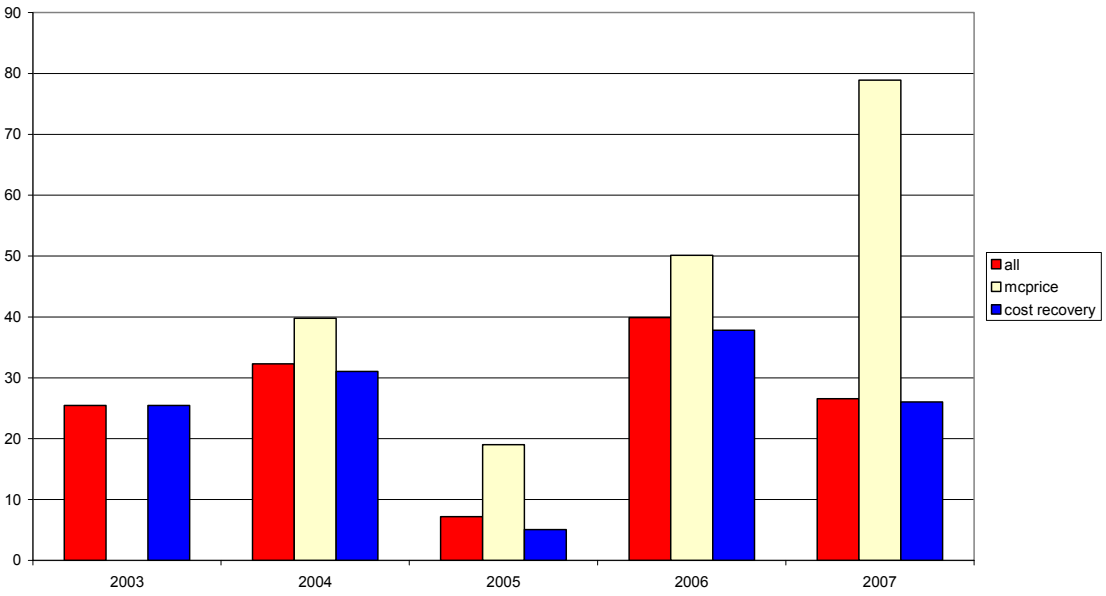
3.2 Data

We use firm-level data from the architectural and engineering activities and related technical consultancy sector (SIC 7420[8]) from 15 countries extracted from the Orbis database (see Table 1 for the list of sample countries). This sector is chosen for the empirical analysis as firms active in SIC 7420 sector are the major utilizers of geographical information and comprise suppliers of GI-based products and services (such as digital mapping, navigation and map data solutions). The used database consists of firm-level financial data from the years 2000–2007 but, for the number of missing observations, the data used for the estimations concentrate for the years 2003–2007.

Figure 1 suggests that there has been an increasing trend in firms' sales growth – despite a more moderate growth in 2005 – in the architectural and engineering activities and related technical consultancy sector during the sample years. The average annual growth rate has been higher among the firms located in countries in which public sector agencies provide GI at maximum marginal costs prices than when GI is priced according to the partial or full cost recovery principle.

The major explanatory variable in the estimated model is the variable *MCPRICE* that gets value 1 if a firm's home country has a national geoportal – i.e. a web site providing geographic or geospatial data, information and services – offering spatial data at no charge or at maximum marginal costs, and 0 otherwise. Typically, in most countries during sample years geographical information has been available at prices based on a partial cost recovery (i.e. direct govern-

Figure 1 Sample countries and their GI pricing policy 2003–2007



[8] The SIC 7420 sector comprises architectural consulting activities (such as building design and drafting, supervision of construction, town and city planning, and landscape architecture), various engineering and technical activities related to construction, geological and prospecting activities, weather forecasting activities, and geodetic surveying.

Table 1 Sample countries and their GI pricing policy 2000–2007

Country	*Nobs*	*Percent*	*(Dominant) pricing policy for public sector GI**
Australia	13	0.07	Free of charge online, MC of transfer for packaged data products since 2002**
Austria	23	0.12	Full or partial cost recovery until 2006. Marginal cost pricing model since 2006.
Czech Republic	767	4.14	Full or partial cost recovery
Denmark	218	1.18	Full or partial cost recovery
Finland	853	4.6	Full or partial cost recovery
France	6 895	37.19	Full or partial cost recovery
Germany	896	4.83	Full or partial cost recovery
Italy	2 591	13.98	Full or partial cost recovery
Netherlands	135	0.73	Full or partial cost recovery
Norway	1 473	7.94	Full or partial cost recovery
Poland	317	1.71	Full or partial cost recovery
Portugal	238	1.28	Full or partial cost recovery
Spain	2 388	12.88	Free online access to essential GI since 2004
Sweden	569	3.07	Full or partial cost recovery
United Kingdom	969	5.23	Full or partial cost recovery
United States of America	195	1.05	Free or MC pricing

Note: nobs after firms RE model estimation.

* Information on the GI pricing policies of sample countries is gathered from the annual INSPIRE 'Spatial Data Infrastructures: State of Play" reports from the years 2003–2010.
Source: http://inspire.jrc.ec.europa.eu/index.cfm/pageid/6/list/4.

** ADD details on Australian Government's Spatial Data Access and Pricing Policy here.

ment funding combined with sales revenue). Unfortunately, data do not allow us to evaluate to what extent PSI prices charged according to partial or full cost-recovery principles in different countries deviate from the marginal cost prices. Table 1 summarizes the sample countries and their geographical information pricing policies in 2000–2007.

Not only the price of public sector geographical information but also its availability and coverage is likely to affect its utilization among potential re-users. Variable *NATIONAL_SDI* gets value 1 if the approach and territorial coverage of the spatial data infrastructure (SDI) in a firm's home country is truly national, and 0 otherwise. The SDI is defined to be 'truly national' if "*there is a clear initiative with a name, structure and organization responsible and/or legislation/strategy at the national level*". This variable is formed on the basis of INSPIRE & NSDI State of Play Summary Report (Spring 2010).

We also control for various other factors previous studies argue to possibly matter for a firm's growth (see Table 2 for a list of variables and descriptive statistics measures). The economic literature suggests that both firm size and age may relate to its growth (see, e.g., Coad, 2007, for a detailed discussion). The dummy variable SME gets value 1 for those firms that have less than 250 employees, and 0 otherwise. This proxy for the small and medium-sized firms follows the EU definition for SMEs. The variable AGE measures the number of years passed since the establishment of a firm. We further control for the financial performance of a firm by vari-

Table 2 Variable descriptions

Description of variable	*Variable name*	*Mean (S.D.)*
Dependent variable: (Turnovert – Turnovert-1)/Turnovert-1 where Turnover = firm's turnover (1 000 USD)* at a given year deflated by consumer price index.****	SALES_GROWTH	0.2825 (0.782)
Explanatory variables: Dummy variable that gets value 1 if a firm's home country has national geoportal offering spatial data at no charge or at maximum marginal costs, and 0 otherwise.**	MCPRICE	0.151 (0.358)
Dummy variable that gets value 1 if the approach and territorial coverage of the spatial data infrastructure (SDI) in a firm's home country is truly national, and 0 otherwise.**	NATIONAL_SDI	0.967 (0.178)
Dummy variable that gets value 1 if a firm has less than 250 employees, and 0 otherwise.*	SME	0.950 (0.219)
Firm's age.*	AGE	14.796 (11.482)
Return on total assets.*	PROFITABILITY	2.397 (8.984)
Number of a firm's subsidiaries.*	SUBSIDIARIES	1.232 (11.666)
Number of firms (100 000 firms) functioning at SIC74, other business activities, in a firm's home country.***	COMPETITION	3.603 (1.959)
(GDPt – GDPt-1)/GDPt-1 where GDP = real gross domestic product (1000 USD, constant prices, constant PPPs)****	GDP_GROWTH	0.028 (0.011)
+ year dummies		

* Source: ORBIS database.
** Source: The annual INSPIRE 'Spatial Data Infrastructures: State of Play" reports from the years 2003–2010, and INSPIRE & NSDI State of Play Summary Report (Spring 2010).
*** Source: OECD SDBS Structural Business Statistics.
**** Source: OECD.Stat: National Accounts of OECD Countries.

able PROFITABILITY measuring a firm's return on its total assets, one of the commonly used measures of firm profitability. The economic literature builds a link between link between firm growth and profitability – 'growth of the fitter' – suggesting that only firms with superior financial performance are likely to gain additional market share (see, e.g., Dosi, et al. 2008).

Also, the ownership structure and whether the firm is with or without subsidiaries may matter for a firm's growth: for instance Dunne et. al. (1989) find that large multi-unit plants tend to grow faster than large single-unit plants and that small plants owned by multi-plant firms grow faster in terms of their employment than those owned by singlbe-plant firms. The vari-

able SUBSIDIARIES captures the number of a firm's recorded subsidiaries.[9] Firms' growth opportunities may also depend on the intensity of competition. The number of firms functioning at the other business activities sector (i.e. SIC 74) in a firm's home country at a given year, the variable COMPETITION, provides a proxy for cross-country differences in the order of magnitude of competition the firms face in their home country. The variable GDP_GROWTH, a percentage change in the Gross Domestic Product of a firm's home country, captures the differences in the general economic trends or business cycles – possibly also generating cross-country differences in the growth of sample firms across countries – in the home country of a firm.

3.3 Estimation results

The estimation results of the random effects model indicate that the marginal cost pricing of geographical information is, indeed, positively related to the sales growth of firms active in architectural and engineering activities and related technical consultancy sector (see Table 3). Interestingly, the estimated coefficient of the variable MCPRICE is positive and statistically significant in the estimations for all sampled firms and for the sample of small and medium sized firms but not when estimated among the sample of large firms only. The estimated order of magnitude of the coefficients for MCPRICE suggest that firms located to countries with marginal cost pricing of public sector GI have annually grown, on average, about 15–16 percent more than those located to the countries using cost-recovery principles in the pricing of GI. These empirical finding indicate that the marginal cost pricing of GI has substantially contributed to the sales growth of SMEs, while it didn't have a notable effect on the sales growth of large firms.

The estimation results of the difference-in-differences models further indicate that the change from the cost-recovery based principle to the (maximum) marginal cost pricing of geographical information has facilitated firm growth. This applies both one and two years after the price scheme change – there are not enough observations to estimate the impacts of price scheme change three years after. The order of magnitude of estimated coefficients of the variable MCPRICE*T2 for the sample of all firms (SMEs) suggests that the annual growth of sales one and two years after switching to maximum marginal cost pricing was, respectively, 7 and 19 (7 and 21) percent higher than among SMEs in countries using full or partial cost recovery principles in the pricing of GI. Again, the estimated coefficient for the variable measuring the impact of marginal cost pricing of GI is not statistically significant when estimated among the large firms only. Altogether, these findings hint that SMEs benefit from the change to marginal cost pricing of GI already one year after the change in the pricing scheme but a stronger growth impact follows with a two year lag.

The empirical findings concerning the control variables are quite like expected on the basis of prior studies. It seems that younger firms tend to grow more than the older ones, and that a larger network of subsidiaries increases firms' growth. The growth dynamics of SMEs and large firms also seems to differ in that more competition hinders the average growth among all sample firms and among small firms but does not significantly affect the growth of large companies.

[9] Subsidiary is defined to be a company in which the parent company holds more than 25 percent of the shares.

Table 3 The estimation results of the random effects model for sales growth

Sample	*All*	*SME*	*Large*
Model	**Model 1**	**Model 1**	**Model 1**
MCPRICE	0.150 ***	0.156 ***	-0.086
	(0.024)	(0.025)	(0.057)
NATIONAL_SDI	0.029	0.041	-0.097
	(0.048)	(0.051)	(0.072)
SME	0.007		
	(0.028)		
AGE	-0.009 ***	-0.010 ***	-0.002 ***
	(0.001)	(0.001)	(0.001)
PROFITABILITY	-0.001	-0.000	-0.001*
	(0.001)	(0.000)	(0.001)
SUBSIDIARIES	0.002 **	0.001	0.001
	(0.001)	(0.002)	(0.001)
COMPETITION	-0.025 ***	-0.026 ***	0.027
	(0.005)	(0.005)	(0.017)
GDP_GROWTH	-1.148	-1.455 *	7.666 **
	(0.765)	(0.787)	(3.652)
Year_2002	-0.096	-0.117	
	(0.208)	(0.217)	
Year_2003	0.215 ***	0.189 ***	0.437
	(0.050)	(0.054)	(0.410)
Year_2004	0.230 ***	0.209 ***	0.469
	(0.034)	(0.036)	(0.406)
Year_2005	-0.010	-0.043	0.394
	(0.050)	(0.054)	(0.403)
Year_2006	0.292 ***	0.263 ***	0.590
	(0.050)	(0.053)	(0.409)
Year_2007	0.223 ***	0.183 ***	0.789*
	(0.065)	(0.069)	(0.418)
Constant	0.297 ***	0.353 ***	-0.469
	(0.043)	(0.035)	(0.428)
Observations	15 017	14 261	756
Firms	11 418	10 936	513
R^2	0.06	0.06	0.09

The robust firm cluster-specific standard errors are reported in the parentheses. Significance levels are reported on superscripts, where *** denotes significance level of 1%, ** significance level of 5% and * significance level of 10%.

Table 4 **The estimation results of the difference-in-differences models for sales**
Dependent variable: log (turnover)

	ALL FIRMS		*SME*		*LARGE*	
	T2=2005	*T2=2006*	*T2=2005*	*T2=2006*	*T2=2005*	*T2=2006*
	Coef./S.E	*Coef./S.E*	*Coef./S.E*	*Coef./S.E*	*Coef./S.E*	*Coef./S.E*
T2	0.211***	0.338***	0.208***	0.357***	0.335**	0.221**
	(0.025)	(0.026)	(0.024)	(0.026)	(0.151)	(0.114)
MCPRICE	-0.473***	-0.553***	-0.487***	-0.572***	-0.463***	-0.545
	(0.036)	(0.040)	(0.036)	(0.040)	(0.160)	(0.196)
MCPRICE*T2	0.070***	0.192***	0.074***	0.210***	-0.022	-0.042
	(0.028)	(0.034)	(0.028)	(0.034)	(0.123)	(0.151)
Observations	14 278	13 698	13 640	13 095	638	603
Firms	8 253	8 068	7 943	7 775	373	358
Wald (Model)	427.38***	551.68***	110.60***	163.78***	9.32***	24.32***
Adj. R^2	0.36	0.39	0.12	0.11	0.23	0.37

* Control variables: Constant, NATIONAL_SDI, SME, AGE, SUBSIDIARIES, COMPETITION and GDP.
The robust firm cluster-specific standard errors are reported in the parentheses. Significance levels are reported on superscripts, where *** denotes significance level of 1%, ** significance level of 5% and * significance level of 10%.

4 Conclusions

This study focusing on the relationship between the pricing of public sector information and firm performance provides one of the first systematic empirical explorations on the economic impacts of PSI pricing practices. The reported empirical findings clearly show that the PSI pricing scheme does matter for the firm growth particularly from the perspective of small and medium sized enterprises. The firm-level data concerning potential re-users of geographical information in business services sector from 15 countries during the years 2000–2007 suggests that the pricing of GI strongly relates to the firms' sales growth. Firms functioning in the countries in which public sector agencies provide fundamental geographical information either freely or at maximum marginal costs have grown, on average, 15 percent more per annum than the firms in the countries in which public sector GI is priced according to the cost-recovery principles. The difference-in-difference estimations further show that positive growth impact materializes already one year after switching to the marginal cost pricing scheme but a stronger boost to the firm growth takes place with a two year lag.

Interestingly, marginal cost pricing has not generated notable growth among the large firms; it has been SMEs that have benefited most from cheaper geographical information. It seems credible that higher PSI prices create a barrier for SMEs using geographical information to develop new information products and services and to enter new market areas. The switch to the marginal cost pricing may thus not only result in growing markets but also intensify competition and challenge the large incumbent companies. Cheaper public sector GI is thus likely to benefit consumers by producing more product variety and also cheaper prices.

One caveat of the reported study is that it is not possible to distinguish the actual re-users of public sector information, and with no doubt, the sample comprises also firms that are neither using PSI nor offering information products and services themselves. Due to this, the order of magnitude of estimated coefficient of MCPRICE variable rather tells the average growth contribution of marginal cost pricing of public sector GI among all firms active in architectural and engineering activities and related technical consultancy sector than the average growth contribution of the adoption of marginal cost pricing scheme among the PSI re-users in that sector. The estimated approximately 15 percent higher growth of firms in countries using marginal cost pricing, as opposed to cost-recovery pricing principles, is thus a downward estimate of the firm-level growth impacts that a change from cost-based pricing to marginal cost pricing would likely result among PSI re-users. The empirical evaluation of this question is left for future work requiring more detailed firm-level information on the PSI reuse.

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