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Organizational Ambidexterity and Performance: Assessment Approaches and Empirical Evidence

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Abstract

Three approaches are developed for assessment of different types of organizational ambidexterity proposed in the relevant literature. The new model for measurement of organizational ambidexterity using data envelopment analysis (DEA) is introduced. The DEA score based on innovation activity inputs and two different performance outputs acts as a proxy for organizational ambidexterity. Sustainability goals and product ambidexterity are also analyzed as the key characteristics of ambidextrous behavior. The introduced three approaches are tested for their aptness to complement each other as well as to support a strategic decision-making. Empirical examples from energy and pharma sectors associate organizational ambidexterity with firms' performance. We measured the organizational ambidexterity of energy and pharma companies by (1) pursuing long-term versus short-term organizational performance measured as a DEA two-output efficiency score; (2) the share of disruptive products in a company's activities assessed through the proportion of R&D expenditure or sales; and (3) sustainability versus financial performance of the company, where the Green ranking and participation in innovative financing programs were used as proxies for sustainable development. Positive relation between performance and organizational ambidexterity for energy sector are discovered. At the same time, orientation towards sustainability disrupts performance of pharmaceutical companies. Results of the OA impact on performance are highly industry-sensitive and depend on the methods used in empirical assessment. Our findings suggest that the scarcity of data sources make all three approaches complementary and mainly functional for strategic decision-making.

Keywords Organizational ambidexterity · Organizational performance · Innovation strategy · Sustainable development · Data envelopment analysis

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Introduction

The framework of organizational ambidexterity (OA), first introduced by March (1991), considers exploitation and exploration activities of the firms and competition between them. Exploitation activities improve efficiency-oriented and risk-reducing technologies incrementally, and faster. On the contrary, March (1991) posited that exploration refers to new opportunities in the distant future, increasing uncertainty and room for managerial flexibility. Empirical evidence shows that the impact of innovation on growth can be negative in the short term but positive in the long term (Feki and Mnif 2016). At the same time, broad exploration goals may result in negative long-term performance of a firm (Vagnani 2015). An optimal balance or trade-off between exploitation and exploration determines organizational ambidexterity.

Developing March's ideas further, Gupta et al. (2006) argued that exploration and exploitation are mutually enhancing. Many researchers (Gibson and Birkinshaw 2004; Lubatkin et al. 2006; Raisch et al. 2009; Simsek 2009) showed that organizational ambidexterity is beneficial to a firm. By empirically proving that the interaction between explorative and exploitative innovation strategies is positively related to the sales growth rates, He and Wong (2004) revealed that exploration and exploitation reflect different firm behaviors. They provided empirical evidence proving that the interaction between explorative and exploitative innovation strategies is positively related to the rate of sales growth. Yet, it was established that the relative imbalance (absolute difference) between explorative and exploitative innovation strategies negatively affected the revenue growth. Uotila et al. (2009) discovered an inverted-U shaped relationship between a firm's relative exploration orientation and its financial performance measured as Tobin's Q. The effect was even stronger in R&D-intensive industries. Junni et al. (2013) summarized the empirical results of OA estimation and its impact on the firm performance. Two measures of performance, namely profitability and growth, were considered by authors. A positive relationship between OA and performance was only revealed for growth indicators. The authors confirmed that this result is industry specific, especially for high-tech sectors and service companies. At the same time, some studies (Atuahene-Gima 2005; Lavie et al. 2011) documented a negative effect of OA for the firm.

The current paper contributes to the controversial literature concerning the relationship between OA and organizational performance. Three new approaches are introduced to evaluate OA and its impact on performance. Firstly, different performance measures are considered as proxies of distinct strategic goals set to help estimate OA. We consider two organizational performance measures (see for example, Murphy et al. 1996 for a wider list of measures): revenue growth and market-to-book (MB). Those measures can be related to strategic goals that a company strives to achieve. Short-term revenue growth may reveal success of core product performance and be an indicator of exploitative strategy (He and Wong 2004). The market-to-book may serve as an indicator of longer term projected performance of a public company according to investor's expectations (Uotila et al. 2009). Relevant literature (Richard et al. 2009; Maditinos et al. 2011) highlight the plausible properties of MB compared to financial accounting performance measures (profit margins, return on assets, etc.) because it is not only forward-looking but can also be a measure of future growth opportunities. In that sense, exploration is close to the real-option approach in strategic management

practice (Dortland et al. 2014) and MB could serve as a proxy for the firm's growth opportunities.

OA can be characterized for its aiming at both revenue and MB growth, simultaneously. To estimate OA for a firm, the efficiency of pursuing two goals is assessed using data envelopment analysis (DEA). The considerable advantage of DEA stems from the non-parametric nature of efficient frontier, i.e., the functional form of the relationship does not have to be specified. The best practice is identified within a set of comparable decision-makers, which form an efficient frontier and measure the level of efficiency of non-frontier companies according to the relative DEA score (Hoff 2007; Cook and Seiford 2009). DEA is used to measure efficiency of resource utilization and adaption of technologies within organizations (Charnes et al. 1978). The DEA model retains natural heterogeneity, taking into account differences in strategies and management practices (Richard et al. 2009). In this study, the DEA score is obtained by maximization of outputs, namely revenue and MB growth, with the given inputs.

The second approach to assessment of OA is provided through cross-functional ambidexterity across product and market domains. Product ambidexterity simultaneously explores new product capabilities and exploits current product properties, whereas market ambidexterity explores new customer markets and exploits current customers (O'Reilly III and Tushman 2008; Voss and Voss 2013). Product ambidexterity can be estimated as the share of new or disruptive products in the overall activities of a firm. Two indicators, the share of R&D expenditures attributed to new products in total R&D expenditures of a firm and the share of new products sales in total revenue of a firm, can be proxies for new product capabilities as well as for new markets (see for example, Cooper et al. 2003). Hence, the above-described indicators can be applied to product and market ambidexterity estimation, as both help directly measure the impact on performance of disruptive business segment and compare the latter to performance of the core activities (see Coombs and Bierly III 2006, as well as Iversen et al. 2007).

Organizational performance may go beyond financial indicators to include external measures that are not associated with economic valuation for traditional stakeholders: shareholders, managers, or customers (Richard et al. 2009). The Quintuple Innovation Helix approach (Carayannis and Rakhmatullin 2014) suggests that innovation should be considered in a broader meaning of the natural environments of society, which are closely tied to sustainable development goals. The sustainable development of a company implies a shift to green technologies, the introduction of new green products, energy safety and efficiency. In that sense, OA can reflect the ability to be efficient in current operations and simultaneously adaptive and flexible to changes in the environment (Du et al. 2013; Chen et al. 2014; Maletič et al. 2016). For example, Chen et al. (2014) empirically showed that OA increases green radical and incremental innovation performance. Balance between financial and sustainable goals determine the third approach to measuring OA effects.

Here, we provide with empirical case studies from two major economic sectors, to illustrate the methodology of the OA impact estimation on an organizational performance. The choice of energy (mainly oil and gas) and pharmaceutical sectors is justified because innovation activities in those sectors are very capital intensive. Mistakes in strategic decision-making and suboptimal balance between exploration and exploitation innovation processes may cause losses on significant

irreversible investments for firms from those industries. This argument is supported by the conclusions of other researchers. Hagedoorn and Cloodt (2003) indicate that pharmaceuticals need a more sophisticated approaches to capture the multidimensionality of innovative performance compared to high-tech and service industries. An emerging trend of transition from fossil fuels to renewable energy is impairing the traditional source of revenue for companies in the energy sector which requires development of industry specific balanced and adaptive innovation strategy (Shuen et al. 2014). That is why OA analysis for establishing of the appropriate strategic goals is very important for the firms in both considered industries.

The rest of the paper is organized as follows. In Section 2, three approaches to estimation of OA are presented including the new method for OA evaluation based on DEA. Then, a model is developed to assess the impact of OA on performance. Sections 3 and 4 are devoted to empirical examples from energy and pharmaceutical sectors followed by conclusions and implications.

Methodology

The methodology includes two stages. The first stage is built on various applications to estimate OA. The derived estimates are then used in the second stage to assess the impact of OA on the organizational performance.

Stage 1 Approaches Towards Measuring OA

Three approaches to measure OA are developed. In each case, two distinct objectives are considered for the firms: revenue vs. market-to-book growth, core vs. disruptive (for the core business) activities, financial vs. sustainability goals. The firm's motivation contributes in adequate resource distribution to meet both objectives that influence company's strategy development.

OA Assessment Using Revenue and Market-to-Book Growth

Arguments of the introductory section, regarding the first approach of measuring performance via the revenue growth/MB ratio, inform the outputs of the DEA method. To offset annual data fluctuations, the revenue growth rates for year i, $\Delta Revenue_i$, are calculated based on the 3-year moving average (MA) values (as in He and Wong 2004).

Griliches (1981) suggested that innovation has a positive effect on the long-term operating performance and should increase the market value. Empirical evidence has shown a positive impact of innovations measured by R&D expenditures (Coombs and Bierly III 2006), patent counts, patent citations (Narin et al. 1987; Bessler and Bittelmeyer 2008), new product announcements (Iversen et al. 2007) on value, and long-term performance of the firm. Following Vagnani's (2015) and others arguments for the inputs of DEA, the investment intensity $\frac{Capex}{Revenue}$ (which includes broader range of innovative expenditures compared to R&D) and number of patents $\ln\Delta$ *Patent count*

are chosen as proxies of innovative activities of a firm. Hence, the following specification of DEA was considered:

$$Outputs : \Delta Revenue, MB\ ratio; \tag{1}$$

$$Inputs : \frac{Capex}{Revenue}, \ln\Delta\ Patent\ count \tag{2}$$

OA is then measured as the DEA score and illustrates the ability of a company to effectively pursue two goals simultaneously. A high DEA score indicates that the company has ambidexterity motives and efficiently distributes resources and entrepreneurial efforts between exploitation and exploration activities.

Assessment of Organizational Ambidexterity Using Goals in Traditional and New Business Lines

In the second approach of OA estimation, we are looking at the balance between innovation activities of a firm in the traditional line of business and those in the development and production of new or disruptive goods and services. The activities of each firm are measured using one of two indicators: R&D expenditures and revenues. The choice of R&D expenditure indicator can be justified if the large proportion of resources attributed to new products on the development stage and not yet reflected in revenue. To measure OA, we then calculate the ratio of R&D expenditures in the new products division to total R&D investments of a firm for each year. A revenue-based measure (for the share of new products) is more suitable in the case when new and disruptive products have been already accepted by the market and play an important role in the revenue stream. Then, OA is estimated as the share of disruptive products sales in total revenue.

Assessment of Organizational Ambidexterity Using Financial and Sustainability Goals

The third approach to measuring OA is related to companies' sustainable strategy. The two competing objectives are the stakeholders' value of the firm represented by MB ratio and sustainability related goal. In order to estimate the sustainability of firm's development we use two proxies. The first one is the Green ranking index, provided by *Newsweek*[1], which publishes an annual list of the top 500 green companies in the world. The methodology of rank calculation includes eight indicators. We suggest that a company's high green rank means that besides traditional profitability goals, it pursues sustainable goals, and hence, its OA is also higher. The green rank can be an adequate proxy for OA because several of its components directly address the most important environmental industry issues. But some industries are not directly involved in green economy and require alternative proxy for sustainability. The second proxy for sustainability is associated with involvement in innovative financing for development. Innovative financing for development is related to new sources of funding, new methods of fund-raising and disbursement of funds, and

[1] Green ranking 2015: http://www.newsweek.com/green-2015

the adoption of existing mechanisms in new markets in support of international development (World Bank 2010; OECD 2014). Innovative financing is usually used in sectors with high social impact but low financial profitability, such as healthcare, education, and environment protection. We argue that companies participating in such innovative financing initiatives pursue both financial and sustainability goals and express organizational ambidexterity.

Stage 2. Impact of Organizational Ambidexterity on Performance

The second stage of the methodology includes analysis of the impact of OA on organizational performance. Similar to a number of related researches (for example, Vagnani 2015), we conduct a regression analysis according to the model:

$$MB_i = c + \beta_1 OA_i + \beta_2 \ln(size_i) + \beta_3 \ln(\Delta\, patent\ count_i) + e_i \quad (3)$$

where OA_i stands for the value estimated during the first stage for each company in the sample; $\ln(size_i)$ is a natural logarithm of size of a firm measured as its assets value or its revenue; and $\ln(\Delta\, patent\ count_i)$ indicates the log change in companies' patent count. In the model (3), we use MB value as a suitable measure of organizational performance. Patent statistics and size of a company are included as control variables to the model. The result of regression analysis (Antoncic and Hisrich 2001) provides evidence of relationship between company OA strategy and its performance.

Empirical Examples

For illustration of the methodology, we collected data on energy and pharmaceutical companies from two databases, corporate annual reports, financial statements, and sustainability reports. Lack of available data limited the number of observations and forced us to consider different data samples for each approach to OA estimation. Values of revenues, R&D expenditures, and capital expenditures for 2007 to 2015 period for two different sectors were taken from the Compustat database according to their SIC codes: SIC code 13—"Oil and gas extraction" for the energy sector and SIC code 283—"Drugs" for the pharmaceutical industry. The sample was limited to companies with last reported assets higher than US$1 billion to exclude small and start-up firms which exploitative and explorative activities are usually concentrated in the same business units (Lubatkin et al. 2006) and cannot be analyzed separately using information from databases and financial reports. The sample consists of 94 energy companies and 111 pharmaceutical companies (see Appendix Tables 3 and 4). The Orbit database was used to provide information on the number of patent applications during the same period.

Stage 1. OA Assessment in Energy and Pharma Sectors

The First Approach to OA Assessment

Applying the first approach described in the methodology section, we considered the DEA score as a proxy for OA of companies in the energy sector. The DEA score for the

94 energy companies was calculated based on outputs (1) and inputs (2). The average market-to-book for the DEA score above and below the median (0.0549) are 3.0491 and 2.1426 correspondingly which indicates possible differences in performance depending on efficiency. The correlation between market-to-book value ratio and organizational ambidexterity as measured by DEA efficiency score is 15.08% which may indicate a positive relationship between them. We will test this relationship further at stage two of the methodology.

As in the energy sector following to the first approach to estimation of OA, the DEA scores were obtained and correlations between the MB and DEA scores as well as the average MB for the DEA score above and below the median (0.2118) were calculated. The firms from the higher DEA score group exhibited two times higher average market-to-book. The correlation between market-to-book value and OA measured by DEA efficiency score is 26.24%.

The Second Approach to OA Assessment

We indicate two competing activities: traditional or core business (oil and gas extraction, refining and distribution) and renewables. The two objectives compete for companies' resources, customers, and markets. Success in one activity will disrupt the other. Since the revenue from the renewables is still insignificant for the major companies in energy sector, the share of renewables in total R&D expenditures was chosen as a proxy for OA. According to the data from annual reports, only 19 companies from the sample conducted R&D related to renewables in the last reported year (see Appendix Table 3). The correlation between market-to-book value ratio and OA as measured by the share of total R&D expenditure is 19.64%. The average market-to-book for companies that were involved in R&D activities related to renewable energy sources were more than 1.5 times higher than the average MB values for firms concentrated on core product development which supports the hypothesis about positive OA effect on performance.

Implementing the second approach for estimation of OA of pharmaceutical companies, we analyze two competing lines of business: medicine and vaccines as technology response to healthcare priorities. The OA is related to the two different business objectives underlying each activity. A vaccine is considered effective if it prevents certain diseases and, therefore, limits the ultimate demand for treatment products. In the case of pharmaceutical companies, we use the share of revenues from vaccines in total revenues as a proxy for OA. A revenue-based measure is more suitable for the pharmaceutical sector as R&D activities may be connected with both the considered objectives. We discovered that only 13 companies from the sample produced vaccines in the last reported year (see Appendix Table 4). The correlation between market-to-book value and OA as measured by the share of vaccines in total revenue is 30.46%.

The Third Approach to OA Assessment

For the third approach, we narrowed down the sample to 45 energy companies that were included in the list of the Top 500 Green companies ranked by *Newsweek*. Most of energy companies tend to participate in green economy and develop alternative products. That is why we used Green rank values as proxies for OA for these firms. The

correlation between market-to-book value ratio and OA as measured by the Green rank is 19.14%. For the companies in the sample with the Green rank of 40 and higher, the average MB is 1.7047 compared to 1.2866 for those with the lower rank.

For the third approach, we restricted the sample to 32 pharma companies that were included in the Top 500 Green Ranking. The correlation between market-to-book value ratio and degree of sustainability orientation as measured by the Green rank is − 45.27%. Therefore, sustainability-oriented pharmaceutical companies tend to be less efficient.

To further verify the estimates of the third approach to OA estimation in the pharmaceutical industry, we decided to include innovative financing initiatives in our review as a direct indicator of the participation of pharma manufacturers in sustainable initiatives. Since 2015, innovative financing corresponds directly to the global sustainable development goal to promote global health and finance immunization programs in developing countries (United Nations 2015). We reviewed several vaccination programs, which aim to create collaborations between manufacturers, suppliers, and developers of vaccines in order to prevent the spread of disease in epidemic-prone countries. We used a dummy variable for OA proxy, which equals to 1 if the company participates in at least one of the reviewed innovative financing initiatives and 0 otherwise. The following major initiatives were taken into consideration: GAVI the Vaccine Alliance[2]; Medicines for malaria venture[3] (MMV); and Medicines patent pool (MPP).[4] We used a sample of 32 companies from the list of Top 500 Green companies, of which 17 companies participated in at least one of the innovative financing initiatives. The correlation between market-to-book value ratio and sustainability orientation as measured by the dummy for innovative financing is − 47.92%. This result supports the evidence obtained from the Green Ranking indicator above: sustainable pharmaceutical companies tend to have lower market-to-book and hence less growth opportunities compared to other firms.

Stage 2. Assessment of OA Impact in Energy and Pharma Sectors

In order to evaluate the impact of OA on the company's long-term performance in stage two of the methodology the model (3) was tested using panel least squares regression with random period effects as specification with higher explanation power measured by R-squared. The choice of the model specification was supported by the Hausman test and Likelihood ratio tests results. We found that OA as measured by DEA efficiency score has a significant positive impact on market-to-book value (Table 1) for samples from both considered sectors. The regression statistics are consistent with the evidence obtained through correlation analysis.

The OA estimation with second and third approaches, used in the regression analysis of the Energy-group parameters, failed to produce significant results due to the limited dataset. Yet, the correlation analysis supports the conclusion that ambidextrous energy

[2] GAVI, the Vaccine Alliance website: http://www.gavi.org/, last accessed on June 8th 2018

[3] MMV website: http://www.mmv.org/partnering/product-development-partnership-model, last accessed on June 8th 2018

[4] MPP website: http://www.medicinespatentpool.org/, last accessed on June 8th 2018

Table 1 Impact of organizational ambidexterity (DEA score) on the market-to-book for the firms in the energy and the pharma sectors

Dependent variable: *MB*		
Variable	Coefficient for the sample from the energy sector	Coefficient for the sample from the pharma sector
Intercept	− 12.38***	6.63***
OA (DEA score)	4.00*	2.31*
ln (patent count)	3.26***	1.23***
ln (size)	1.50**	0.69**
Adjusted R-squared	0.63	0.59

*Significant at the 10% level, **significant at the 5% level, ***significant at the 1% level. The regression analysis was conducted according to the model 3 for the panel of 94 energy and 111 pharmaceutical firms for 2007–2015 period. Control variables include number of patents and size of a firm

companies tend to be considered as more effective by the financial markets. Lack of significant regression estimates of OA impact on performance for the second and the third approaches, as well as controversial evidence from correlation analysis fail to inform that the high OA is always beneficial for the pharmaceutical companies.

Conclusion

We found that despite different datasets in each case, all three approaches to OA estimation showed a positive relationship between the OA and a company's market-to-book value ratio for the energy sector. In other words, growth opportunities (measured as market-to-book) are higher for the companies with different strategic goals and types of OA in energy sector. Green initiatives and orientation towards renewable resources may create value for the energy sector companies. Hence, the direct public support of such initiatives may be of limited value.

However, the sustainability orientation of pharmaceutical companies had an adverse impact on their performance. In contrast to the oil and gas industry, growth opportunities for pharmaceutical companies appear to be lower if innovative activities are undertaken outside the core business segment. An orientation towards sustainable goals disrupts the market performance of the pharmaceutical industry. Policy makers should continue to stimulate distribution of pharma companies' resources to non-priority segments such as innovative financing initiatives which are dedicated to socially important objectives and may positively challenge the companies' limited vision.

Further data research may improve the quality of analysis. A broader view that includes other economic sectors is also important to justify the methods introduced in this study.

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Appendix

Table 2 Methodology for calculating the Green ranking (2015)

Indicator	Weight (%)	Description
Combined energy productivity	15	Relation of revenue to total energy consumption for the last 3 years
Combined greenhouse gas (GHG) productivity	15	Relation of revenue to total GHG emissions for the last 3 years
Combined water productivity	15	Relation of revenue to total water use for the last 3 years
Combined waste productivity	15	Relation of revenue to total waste generated net of waste recycled/ reused, for the last 3 years
Green revenue score	20	Share of green revenue generated by products and services that contribute positively to environmental sustainability and societal health, out of total revenue
Green pay link	10	Salaries of senior executives linked to corporate environmental performance (yes/no)
Sustainability board committee	5	Committee at the Board of Directors level related to the sustainability of the company (yes/no)
Audited environmental metrics	5	Audit of last environmental metrics by a third party (yes/no)

Note: the data pertaining descriptions of the "Green ranking" industries is restricted for publicity

Table 3 List of oil and gas companies

Energy company	Reported R&D for renewables	Energy company	Reported R&D for renewables
ANADARKO PETROLEUM CORP		CHINA OILFIELD SERVICES LTD	
BG GROUP PLC	x	CONCHO RESOURCES INC	
BP PLC	x	CONTINENTAL RESOURCES INC	
CANADIAN NATURAL RESOURCES		DELEK DRILLING	
CHEVRON CORP	x	DELEK ENERGI SYSTEM LTD	
CHINA PETROLEUM & CHEM CORP		ENCANA CORP	
CHINA SHENHUA ENERGY CO LTD		ENSCO PLC	
CNOOC LTD	x	ETABLISSEMENTS MAUREL & PROM	
CONOCOPHILLIPS		FRED OLSEN ENERGY ASA	
DEVON ENERGY CORP		FUJI OIL CO LTD	
ECOPETROL SA		GULF INTL SERVICES CO	
ENBRIDGE INC	x	HELMERICH & PAYNE	
ENI SPA		INPEX CORP	
EOG RESOURCES INC		JAPAN DRILLING CO LTD	
EXXON MOBIL CORP	x	JAPAN PETROLEUM EX	
GAZPROM OAO	x	KEY ENERGY SERVICES INC	
HALLIBURTON CO		MARATHON OIL CORP	
IMPERIAL OIL LTD	x	MODEC INC (JAPAN)	
LUKOIL OIL COMPANY		NABORS INDUSTRIES LTD	
NATIONAL OILWELL VARCO INC		NOVATEK OAO	
OCCIDENTAL PETROLEUM CORP		OCEANEERING INTERNATIONAL	
OIL & NATURAL GAS CORP LTD		OFFSHORE OIL ENGINEERING CO	
PETROBRAS-PETROLEO BRASILIER	x	OMV AG	
PETROCHINA CO LTD	x	PARAMOUNT RESOURCES LTD	
PTT PLC	x	PARKER DRILLING CO	
RELIANCE INDUSTRIES LTD		PENN VIRGINIA CORP	
REPSOL SA	x	PENN WEST PETROLEUM LTD	
ROYAL DUTCH SHELL PLC	x	PGS-PETROLEUM GEO-SERVICES	
SCHLUMBERGER LTD	x	PIONEER NATURAL RESOURCES CO	
STATOIL ASA	x	PRECISION DRILLING CORP	
TOTAL SA	x	PREMIER OIL PLC	
TRANSCANADA CORP	x	ROWAN COS PLC	
VALERO ENERGY CORP		RPC INC	
WILLIAMS COS INC		SAIPEM SPA	
WOODSIDE PETROLEUM LTD		SALAMANDER ENERGY PLC	

Table 3 (continued)

Energy company	Reported R&D for renewables	Energy company	Reported R&D for renewables
ABAN OFFSHORE LTD		SANTOS LTD	
APACHE CORP		SAVANNA ENERGY SVCS CORP	
ATWOOD OCEANICS		SUBSEA 7 SA	
BAKER HUGHES INC		SUPERIOR ENERGY SERVICES INC	
BASHNEFT OJSC		SWIFT ENERGY CO	
BELLATRIX EXPLORATION LTD		TECHNIP SA	
BONHEUR A/S		TETRA TECHNOLOGIES INC/DE	
CABOT OIL & GAS CORP		TRANSOCEAN LTD	
CALFRAC WELL SERVICES LTD		TRICAN WELL SERVICE LTD	
CANADIAN OIL SANDS LTD		WEATHERFORD INTL PLC	
CGG		WOOD GROUP (JOHN) PLC	
CHESAPEAKE ENERGY CORP		WORLEYPARSONS LTD	

Table 4 List of pharma companies

Company	Reported vaccine sales	Company	Reported vaccine sales
ABBOTT LABORATORIES	X	GRIFOLS SA	
ABBVIE INC	X	GUANGXI WUZHOU ZHONGHENG	
ALEXION PHARMACEUTICALS INC	X	GUANGZHOU BAIYUNSHAN PHARMA	
ALLERGAN INC	X	H LUNDBECK A/S	
AMGEN INC	X	HARBIN PHARMACEUTICAL GROUP	
ASTELLAS PHARMA INC	X	HAW PAR CORP LTD	
ASTRAZENECA PLC	X	HIKMA PHARMACEUTICALS PLC	
BAXTER INTERNATIONAL INC	X	HISAMITSU PHARMACEUTICAL CO	
BAYER AG	X	HOSPIRA INC	
BIOGEN IDEC INC	X	IPSEN SA	
BRISTOL-MYERS SQUIBB CO	X	JIANGSU HENGRUI MEDICINE CO	
CARDINAL HEALTH INC	X	JUBILANT LIFE SCIENCES LTD	
CELGENE CORP	X	KAKEN PHARMACEUTICAL CO LTD	
CSL LTD	X	KISSEI PHARMACEUTICAL CO LTD	
GILEAD SCIENCES INC	X	KRKA DD NOVA MESTO	
GLAXOSMITHKLINE PLC	X	KYORIN HOLDINGS INC	
JOHNSON & JOHNSON	X	KYOWA HAKKO KIRIN CO LTD	
LILLY (ELI) & CO	X	LUPIN LTD	
MERCK & CO	X	MEDA AB	
MERCK KGAA	X	MEDICINES CO	
NOVARTIS AG	X	MITSUBISHI TANABE PHARMA	
NOVO NORDISK A/S	X	MOCHIDA PHARMACEUTICAL CO	
PFIZER INC	X	MYLAN INC	
REGENERON PHARMACEUTICALS	X	NANJING MEDICAL CO	
ROCHE HOLDING AG	X	NICHIIKO PHARMACEUTICAL CO	
SANOFI	X	NIPPON SHINYAKU CO LTD	
SHIRE PLC	X	NORTH CHINA PHARMACEUTICAL	
SUN PHARMACEUTICAL INDS LTD	X	NORTHEAST PHARMACEUTICAL	
TAKEDA PHARMACEUTICAL CO	X	ONO PHARMACEUTICAL CO LTD	
TEVA PHARMACEUTICALS	X	OPKO HEALTH INC	
VALEANT PHARMACEUTICALS INTL	X	ORION CORP	
VERTEX PHARMACEUTICALS INC	X	PATHEON INC	

Table 4 (continued)

Company	Reported vaccine sales	Company	Reported vaccine sales
ACTAVIS PLC		PERRIGO CO PLC	
ACTELION LTD		PIRAMAL ENTERPRISES LTD	
ALERE INC		RANBAXY LABORATORIES LTD	
ALKERMES PLC		RECORDATI SPA	
ALMIRALL SA		SANTEN PHARMACEUTICAL	
ASPEN PHARMACARE HLDGS LTD		SAWAI PHARMACEUTICAL CO LTD	
AUROBINDO PHARMA LTD		SHANGHAI PHARMACEUTICALS HLD	
AUXILIUM PHARMA INC		SHIONOGI & CO LTD	
BEIJING TONGRENTANG CO LTD		STADA ARZNEIMITTEL AG	
BIOMARIN PHARMACEUTICAL INC		SUMITOMO DAINIPPON PHARMA CO	
BIOMERIEUX		SWEDISH ORPHAN BIOVITRUM AB	
BIOTEST AG		TAISHO PHARMACEUTICAL HLDGS	
CADILA HEALTHCARE LTD		TASLY PHARMACEUTICAL GROUP	
CHINA RESOURCES SANJIU MED		TOWA PHARMACEUTICAL CO LTD	
CHONGQING HUAPONT PHARM CO		TSUMURA & CO	
CHUGAI PHARMACEUTICAL CO LTD		UCB SA-NV	
CIPLA LTD		UNITED LABORATORIES INTL	
CUBIST PHARMACEUTICALS INC		UNITED THERAPEUTICS CORP	
DAIICHI SANKYO COMPANY LTD		VIRBAC SA	
DR REDDY'S LABORATORIES LTD		WOCKHARDT LTD	
EISAI CO LTD		YUHAN CORP	
GEDEON RICHTER PLC		ZHEJIANG MEDICINE CO LTD	
GLENMARK PHARMACEUTICALS LTD		ZHEJIANG NHU CO LTD	
GREEN CROSS CORP (KOREA)			

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