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A scientist in the board effect on recognition of R&D outcomes in private firms' reports

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Abstract: The paper aims to identify factors influencing the management decision of private companies regarding the capitalization of expenditures on R&D outcomes in the assets with impact of a scientist in the supervisory versus management board taken into account. Due to the strong impact of tax law on the accounts of private companies, the Polish context provides an interesting field for studies of R&D outcomes recognition since both expensing and capitalization of R&D costs are permitted within tax regulation, whereas Polish GAAP regulation considers R&D capitalization as similar to IAS 38 for successful developmental works. The research analyses data of 15,041 non-financial companies for years 2003-2013 used the logit panel and tobit panel methods. Results confirm that scientists on a supervisory board are more aware of the need to disclose information about the success of commercialization and persuade companies to capitalize expenditures on R&D outcomes. More indebted companies and entities that realize projects co-financed from grants for fixed tangible or intangible assets, are more likely to capitalize higher expenditures on R&D outcomes in their assets. Conversely, private firms with patents, greater growth opportunities or a scientist on the management board are less likely to capitalize spending on R&D outcomes.

Keywords: R&D, capitalization, scientists, patent, grants

JEL codes: M41, G30

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1. Introduction

The internal expenditures on research and development (R&D) in Poland's GDP in 2015 amounted to 1% (as opposed to 0.94% in 2014). Although the largest share of expenditure on internal R&D was made by the corporate sector, this reached only 46.5% of total expenditures (just 2.5 percentage points higher than 2014) (GUS, 25.10.2016). Currently, Poland spends less than half on innovation than the developed countries (OECD average equals to 2.4% of GDP) and business expenditure on R&D amounted to 0.44% of GDP giving Poland 30th place of the 34 OECD countries. Only companies in Slovakia, Greece, Mexico and Chile spend less on R&D. Developed countries on average spend 1.63% of GDP, while the figure for European Union members is 1.23%. The leading R&D spenders are Israel, Japan and Korea, where outlay is 3-4% of GDP (Innovation Union Scoreboard Report, 2015; European Innovation Scoreboard, 2016). Nowadays, an increase in business sector expenditure on R&D is an important aim of innovation policy in Poland, particularly among private firms. Total Poland R&D expenditure aims to reach 1.7% of GDP by 2020, while Polish corporate expenses on R&D should reach 67% of overall R&D costs within 3 years. This is more important when we take into account that only 10% of companies in Poland do bookkeeping and that the Polish GAAP does not require a company to disclose the amount of R&D expenditures in its financial statements. The overwhelming 90% majority register operations solely for tax purpose. This identifies an important role of tax regulations in identifying R&D outcomes among private companies. Besides increasing R&D spending by universities and public research organizations, a more precise measurement of expenditures on R&D activity should be developed for a comprehensive innovation policy approach.

This paper aims to identify factors influencing private companies management decision in terms of capitalization of expenditures on R&D outcomes in the assets, taking into account the impact of scientists on the supervisory or management board. Accounting for R&D costs is an open issue. IAS 38 requires the capitalization of expenditures on R&D outcomes after reaching technical feasibility. SFAS N82 mandates that all R&D costs must be immediately expensed. Because of the strong impact of tax law on the accounting of private companies, the Polish context provides an interesting field for studies of R&D outcomes recognition in their assets since both accounting treatments of R&D costs (expensing and capitalization) are permitted by tax regulation, whereas Polish GAAP regulation considers R&D capitalization as similar to IAS 38 for (successfully) completed developmental works. I investigate whether missing R&D outcomes in financial statements indicate a lack of R&D activity results for commercialization. In order to realise this research aim I use data on patents registered in the Polish Patent Office and link them with legal and financial data of non-financial private limited liability and joint stock companies.

On the one hand, proponents of the capitalization method argue that it enables management to better communicate information about the success of projects and their likely future benefits (Oswald & Zarowin, 2007), and, increases the relevance of financial reporting. While, on the other hand, opponents argue that the expensing method is preferable to capitalization because it eliminates any opportunity for managers to capitalize costs of projects that have a low probability of success. Previous studies (eg. Oswald & Zarowin, 2007) have concluded that higher value relevance is achieved by capitalizing R&D costs, provided they meet certain the criteria for success, rather than just expensing them. In France, where legal enforcement is weaker (La Porta *et al.*, 1998), results to the contrary were received for listed companies (Cazavan-Jeny & Jeanjean, 2006), indicating that capitalization is negatively related to stock prices and market returns.

My research analyzes data of 15,041 non-financial companies for 2003-2013, using the logit panel method of management decision on capitalization of expenditures on R&D outcomes intended to commercialize, and the tobit panel of a share of capitalized expenditures on R&D outcomes in total assets.

IAS 38 requires the capitalization of development expenditures after reaching technical feasibility, that distinguishes the extent to which R&D benefits are realized in the research or the development stage. Likewise, Polish accounting standards differentiate research activity from development work. However, due to the high level of book-tax conformity in Poland, private small and medium companies tend to record expenditures on R&D as costs in their profit and loss statement. In this research I investigate whether only larger firms through their scale efficiencies in commercialization and rent extraction from new innovations, capitalize expenditures on R&D outcomes in the assets. This study takes into account the presence of scientists on the supervisory or management board, corporate and shareholder patents, and, the financing of R&D activity via grants.

The paper has been structured as follows: the literature review and the research hypotheses development are presented in the initial section. Section 3 explains the legal background in terms of accounting standards and tax regulation followed by a description of the sample and research approach in section 4. This section identifies a gap in the recognition of R&D outcomes on the basis of the comparison of corporate patents and capitalization of expenditures on R&D outcomes in their assets. In Section 5, the findings are interpreted and discussed with references to the literature of the subject. The paper ends with conclusions and the directions of future research.

2. Literature review and hypotheses development

2.1 A scientist in the board effect on recognition of R&D outcomes

Prior research provides evidence that mandatory expensing of R&D outlays leads to *under*investment by managers in R&D to meet performance benchmarks (Baber *et al.*, 1991; Cooper & Selto, 1991; Bushee, 1998; Gunny, 2005; Zang, 2008; Wang & D'Souza, 2007; Oswald & Zarowin, 2007). Managers presumably engage in this form of real earnings management because a reduction in R&D spending will cause a dollar-for-dollar increase in pretax income, with R&D capitalization appearing to mitigate such behavior (Oswald & Zarowin, 2007). Conversely, the capitalization of R&D expenditures can lead to *overinvestment* in continuing projects and could destroy firm value to the extent that superior alternative projects are foregone (Entwistle, 1999; Hatfield, 2002). However, under capitalization, abandoning a project necessitates impairment of expenditures capitalized over multiple periods. As a consequence, the motivation to overinvest in continuing projects to avoid impairment given the ease of assignment of responsibility for a failed project can be great. Reputation damage would be unlikely when a manager is not responsible for initiating the project (as the impairment is someone else's fault) or when R&D is expensed (because there is no potential impairment) (Seybert, 2010). Managers who are experienced in dealing with R&D capitalization may be more careful about the projects they select, preferring to avoid future impairment decisions entirely (Entwistle, 1999). They may also be able to negotiate with auditors or exercise their discretion in avoiding impairments without investing additional funds in failing projects (Landry & Callimaci, 2003). Oswald & Zarowin (2007) show that R&D capitalization mitigates the tendency to cut R&D expenditures. Particularly, R&D expensers in the U.K. cut their investment to meet earnings targets, while R&D capitalizers instead manipulate the current-period R&D expense without changing investment levels.

Companies using R&D outcomes in their business appreciate the significance of founder achievements (Białek-Jaworska *et al.*, 2015). A **"star-scientist"** (leading personality in the science world and/or reputable author of numerous publications) in the team of a company's founders increases its credibility, brings contacts from the academic world, and offers itself up as a "brand" attracting business partners to collaborate with the company (Zucker & Darby, 1998). Among factors important for R&D cost reduction, they identify the business location and proximity of university centers and the access to the science and research infrastructure (Zucker & Darby, 1998). Access to sources of finance for R&D activity is crucial the more the R&D project risks, depending on the effectiveness in applying for research grants (Almus & Czarnitzki, 2003; Becker & Pain, 2003; Lee & Hwang, 2003; Klette & Moen, 2012). R&D companies may also establish partnership relationships to undertake joint research. Scientist participation on the supervisory board may be helpful in associating specialist knowledge with the needs of

companies looking for solutions to the products developed by them. The co-operation with partners may also help monetize those R&D results that have not been used internally. Conversely, the formulation of value proposition helps cooperation in international research projects that allow the recognition and establishment of contacts with potential customers (Białek-Jaworska & Gabryelczyk, 2016). A well-known scientist on the board is crucial for establishing such cooperation. In order to separate the impact of scientists on a supervisory board from the decision to capitalize expenditures on R&D outcomes, I compare them to the effect of scientists on the board of management on the aforementioned decisions in the area of accounting policy on R&D. Thus, I can state the following hypothesis:

H1: *Companies with a scientist on their supervisory board are more likely to capitalize expenditures on R&D outcomes in the assets as opposed to firms with a scientist on the board of management.*

2.2 Patents and missing information on R&D in financial statements

Kothari *et al.* (2002) emphasize that although R&D expenditures are more volatile than capital expenditures they, nevertheless provide tangible long-term benefits to a firm. Cumming and MacIntosh (2000) prove that the availability of patent protection leads to higher R&D expenditures. A perusal of a subsample of the 3000 NYSE-listed firms by Koh and Reeb (2015) shows that 1,737 NYSE-listed firms do not report any information on their corporate R&D efforts, while 373 of them report zero R&D. The US Statement of Financial Accounting Standards No. 2 (SFAS2) requires a firm to disclose in its financial statements material R&D expenditures. These authors suggest that a blank R&D field in the financial statement could represent a firm's conscious decision not to separate R&D expenses from other reported expenses, such as expense shifting (e.g. McVay, 2006). Patent records reveal that 10.5% of missing R&D firms file and receive patents, being 14 times greater than zero R&D firms. Although empirical research in accounting usually recoding the blank R&D fields as firms with zero R&D, Koh and Reeb (2015) show that, on the NYSE, missing R&D firms with patent activity demonstrate patent filings analogous to the bottom 90–95% of the corporate population with positive R&D expenditures recognized in the financial statement. However, after an exogenous auditor change, these companies are more likely to report R&D. Pandit *et al.* (2011) report a positive correlation between R&D investment and patent counts and cites, though not all innovative companies apply for patents. Arundel and Kabla (1998) estimate that less than 40% of firms file patents for their technological breakthroughs.

The results of previous studies state that corporate culture increasingly focuses managers on the external reporting consequences of their decisions (Jensen, 2001; Jackson, 2008), and that managers may wish to avoid R&D outcomes

capitalization to prevent future impairments (Entwistle, 1999). Prior research concerning listed companies suggests that the market may react negatively to R&D capitalization when managers are able to choose between capitalizing and expensing (Cazavan-Jeny & Jeanjean, 2006). As a result, managers may prefer to opt for expensing and avoid impairment problems if given the choice. Both GAAP and IFRS require a consistent treatment of R&D expenses and do not allow the manager an explicit choice between expensing and capitalization (Seybert, 2010). Whereas Polish GAAP are consistent with the IFRS approach for positively completed R&D outcomes (developmental works), tax law gives the manager an explicit choice between expensing and capitalization. Taking into account the impact of tax regulation on the accounting and reporting of private firms in Poland (Białek-Jaworska, 2016), the predicted substitution effect is reflected in the following hypothesis:

H2: *Private companies that conduct R&D activity resulting in patents are less likely to capitalize (higher) expenditures on R&D outcomes in the balance sheet.*

2.3 Firm size

Ciftci and Cready (2011) report evidence that R&D productivity (measured as output counts) declines with firm size, suggesting that scale is a particularly potent factor in the post-feasibility stage of the R&D process. Larger firms do not produce more innovations, but they are able to successfully bring such innovations to the marketplace and extract rents from them. Langowitz and Graves (1992) suggest that the market power of larger firms may lead to greater success in the commercialization of innovation as larger firms are likely to have less technical and commercial uncertainty and extract greater rents from innovation.

Plehn-Dujowich (2009) research supports the presence of either declining or non-increasing rates of innovation production and firm size. Cockburn and Henderson (2001) show that scope economies arise in the pharmaceutical and chemistry research setting from internal knowledge spillovers among the different projects when discoveries are relevant to a wide range of applications. Larger firms pursuing multiple lines of inquiry are in a better position to exploit such spillover findings (Kim *et al.*, 2009). Likewise, Quintana-Garcia and Benavides-Velasco (2008) find that in the biotechnology industry technological diversity in R&D positively influences R&D productivity.

The effect of firm size on the intensity of an investment shows a U-inverted relationship, while the effect of market power is found to be quite low in both research and development. For larger firms the effect of size is usually higher on development than on research which could be explained by previous research findings that large firms gain relatively more from incremental and safer projects (Cabral, 2003; Barge-Gila & López, 2014). Therefore, I state the following hypothesis:

H3: *Larger companies are more likely to capitalize expenditures on the R&D outcomes (development works) in the balance sheet.*

However, one could not expect evidence that the expenses of larger companies on R&D recognized in the assets are relatively higher than other firms.

2.4 Subsidization of R&D activity

Howe and McFetridge (1976) show that entities with domestic capital spend more on R&D than they obtain **grants**, contrarily to companies with foreign capital. In the case of German enterprises, Almus and Czarnitzki (2003) prove that R&D expenditures are, on average, 4% higher than the value of their grants obtained. Obtained grants encourage companies to increase their R&D expenditures (Carboni, 2011), in the ICT sector (Lee & Hwang, 2003) and manufacturing sector (Becker & Pain, 2003). Results of the Ali-Yrkkö (2004) study are consistent with findings mentioned above, as grants from the previous year, as well as grants from a given year, have a positive impact on R&D expenditures in a given year. Dugueta (2004), as well as Czarnitzki and Hussinger (2004), confirm that subsidies strengthen the private expenditures on R&D and that a crowding-out effect does not take place. Ali-Yrkkö (2004) stresses that public R&D funding can be seen as lowering the private cost of an R&D project and making an unprofitable project profitable. If any R&D infrastructure is bought with an R&D subsidy, the fixed costs of other R&D projects are lowered. The know-how or knowledge developed in subsidized projects diffuse to other projects, improving their probability of success. Moreover, because of the enforcing role of the R&D costs capitalization in the balance statement to meet material and financial requirements of the project, I expect a positive relationship between expenses on R&D recognized in the assets. I assume that companies capitalize R&D costs in the balance sheet to confirm the realization of all project's aims, products and indicators that were written and promised in the grant application. Therefore, I state the following hypothesis:

H4: *Companies that realize projects co-financed from grants from, for example, the European Union for fixed tangible or intangible assets, are more likely to capitalize (higher) expenditures on R&D outcomes in the balance sheet.*

3. Accounting standards and tax regulation of R&D costs

Fostering R&D investment is a major target of policy makers and the need for more specific policy measures has been highlighted (Tödtling & Trippl, 2005), including a different approach to their two components. Research and development are two distinctive activities that differ in their purposes, knowledge bases, people involved and management styles (Barge-Gil & López, 2014). The main aim of research is to acquire new knowledge, while that of development is directed to the

introduction of new or improved products or processes (OECD, 2005). Research is more theoretical in nature and needs specialized human capital, which works relatively independently from the rest of the organization. Development is essentially applied and based on synthetic knowledge (Asheim & Coenen, 2005). Demand pull shows higher effects in driving development than research as development is more focused on adapting knowledge to user needs and allows for a quicker answer to market demands (Barge-Gil & López, 2015).

Chandra (2011) characterize the accounting treatment of R&D expenditures as conservative, because all R&D is immediately expensed, whereas benefits are realized later. The higher conservatism of technology firms results primarily from lower operating cash flows due to R&D expensing and more income-decreasing accounting accruals linked to litigation risk.

IAS 38 requires the capitalization of development expenditures after reaching technical and commercial feasibility of the sale or use of the asset. This means that the firm must intend and be able to complete the intangible asset and either use it or sell it, and be able to demonstrate how the asset will generate future economic benefits (IAS 38.45). Thus distinguishing the extent to which R&D benefits are differentially realized in the research stage (i.e., planned search or investigation for the discovery of new knowledge) or the development stage (i.e., the translation of research findings into new products and processes) is relevant in evaluating the implications of such a shift in policy. If a R&D project fulfils the above conditions then its capitalization costs are compulsory. In the reliability/relevance trade-off, the international standard-setter clearly comes down on the side of relevance (Cazavan-Jeny & Jeanjean, 2006).

Polish GAAP allows for the capitalization of a completed development project, if: (1) product or production technology is clearly defined and related costs are reliably measured; (2) technical usefulness of a product or technology has been determined and documented and, on that basis, the company has made a decision to manufacture products or implement technology, and, (3) it is predicted that development costs will be covered with the revenues from the sales of products or implementation of the technology. Since the development works completion, they are presented as intangible assets under the item "Costs of completed development works" and measured in accordance with the cost model. They are depreciated on a systematic basis over its useful life (the expected pattern of consumption of the future economic benefits to be received from these assets) (art. 33.3 of the Polish Accounting Act). They are also a subject to write-downs for impairment if there is an unscheduled reduction of the expected benefits from these assets (art. 28.1.1, 33.3 and 28.7 of the Polish Accounting Act). On the other hand, expenditures on research are recognized as period costs (art. 6.1 of the Polish Accounting Act). Due to their innovative nature of exploration, it is difficult to predict whether the benefits of the research works carried out will be possible to achieve. Because of this risk, the legislator pointed to the necessity of relating expenditure record in the

financial result - they do not meet the requirements for recognition of assets (art. 3.1.12 of the Polish Accounting Act). A similar approach is valid in accordance with IAS 38 Intangible assets, except that according to IFRS regulations as yet unfinished, ongoing investments in R&D (development works under construction) are recognized as intangible assets (IAS 38.56-59). If expenditures on development works were financed from external, non-refundable sources (subsidies or grants), this entity should recognize the value of the grant as deferred income and settle parallel to the depreciation of intangible assets in the income (art. 41.1 of the Polish Accounting Act and IAS 20).

The Income Tax on Legal Persons Act (art. 16b.2.3) also points to the treatment of development costs as intangible assets and research costs as period costs (Kubacki, 2014, p. 306). R&D outlays which meet the following criteria, should be treated as depreciable intangible assets: (1) product or production technology are strictly determined, and the corresponding development costs are reliably identified; (2) the technical suitability of the product or technology has been properly documented by the taxpayer and on this basis the taxpayer has decided to manufacture these products or use technology; (3) based on the development works documentation it is possible to conclude that development costs will be covered by the expected proceeds from the sale of these products or the use of technology (art. 16b of the Income Tax on Legal Persons Act (CIT) and art. 22b of the Income Tax on Natural Persons Act (PIT)). However, there are also other ways to tax accounting for R&D outlays. In addition to depreciation (art. 16m.1.3 CIT and respectively art. 22b.1.3 PIT), it is possible for a period of less than 12 months, for example, to derecognize these expenditures as intangible assets, instead recording these costs in the month in which they incurred. It is also possible to record these costs in equal parts over a period not longer than 12 months, starting this month, or once in the tax year in which the R&D outcomes were completed. Generally, in these cases, these investments do not have to be recognized as assets in the accounts (those which are also used for tax purpose in Poland). The sovereignty of the entity in making decisions about how the tax settlement is highlighted by the numerous court rulings (the Supreme Administrative Court judgment of 18 September 2014 ref. II FSK 2070/12, the Administrative Court in Bydgoszcz judgment of 18 December 2012 ref. I SA/Bd/933/12, the Supreme Administrative Court judgment of 23 March 2010 ref. II FSK 1733/08, the Supreme Administrative Court judgment of 21 April 2015 ref. II FSK 427/13).

Conversely, many individual interpretations of Directors of Tax Chambers indicate the possibility of a completely different recognition of these expenses for tax purposes rather than for recognition in the accounts (the individual interpretations: of the Director of the Tax Chamber in Katowice on 20 February 2015 no. IBPBI/2/423-1410/14/MS, of the Director of the Tax Chamber in Katowice on 5 January 2016 no. IBPB-1-2/4510-716/15/AK, of the Director of the Tax Chamber in Poznan on 11 December 2015 no. ILPB4/4510-1-515/15-2/MC, of the Director

of the Tax Chamber of 24 July 2015 no. IBPB-1-2/4510-82/15/MM, of the Director of the Tax Chamber in Katowice on 20 February 2015 no. IBPBI/2/423-1409/14/MS, of the Director of the Tax Chamber in Katowice on 23 December 2014 no. IBPBII2/423-1195/14/AK, of the Director of the Tax Chamber in Katowice on 23 December 2014 no. IBPBI/2/423-1194/14/AK, of the Director of the Tax Chamber in Warsaw on 25 June 2013 no. IPPB5/423-223/13-2/IŚ).

However, as shown by the analysis of empirical data later in this paper, expenditures on development works are rarely presented in financial statements. One of the reasons for this may be the fiscal accountability of such costs. In order to avoid time-consuming double records, and guided by the possibilities of reducing the tax base, the preferred solution seems to immediately expensed. This solution was also preferred by the tax relief on new technologies for the period 2006-2015 in Poland. This allows individuals and entities to deduct the costs of new technologies and technological know-how in the form of intangible assets from their taxable income. However, this relief was limited to the R&D outcomes bought from other firms, which enabled the production of new or improved goods or services and which have not been used worldwide for more than the past 5 years. The basis for deduction was the initial value of new technology bought from external entities. Although a compulsory recognition of this new technology as an intangible asset, both depreciation and deduction from taxable income under art. 18b and 18c of the CIT could effectively reduce the tax base for income tax.

Since 2016, this tax relief was abolished and in its place another solution was introduced consisting of deductibility of the following eligible costs (from the taxable income): (1) wages and social insurance of employees engaged to carry out R&D activity; (2) expenditures on the purchase of materials and raw materials directly related to R&D activity; (3) expenditures on expert advice, opinions, consultancy and the equivalent, and, the acquisition of research results; (4) paid use (rent, lease) of research equipment used exclusively in the R&D activity; (5) depreciation and amortization of tangible and intangible assets used in R&D activity.

The new regulations do not require the recording of the purchased items into the register of fixed assets or intangible assets, rather their inclusion in the accounting records. Therefore, the direct expensing of these R&D expenditures is allowed. In addition, eligible costs include expenditures related to the R&D activity. These initial research activity costs - as before, will be immediately expensed both for the balance sheet and tax purposes. The costs of completed development works (R&D outcomes) will be amortized, as before, or even more cost-settled in accordance with art. 15.4a.1-2 of the CIT. The new tax relief is to encourage innovation and incurring expenditures on R&D activity, but will not cause more frequent recognition of R&D expenditures in the balance sheets of entities. One could expect some benefit to information from more sources of information on

expenditure on R&D, not only from financial statements, but also CIT and PIT tax returns.

4. Sample and research design

In order to identify what determines decisions made by management concerning the capitalization of expenses on development works (the results of research and development activity) recognized as an asset on the balance sheet, I use data retrieved from financial statements of private, nonfinancial capital companies. The database used for the analysis contains financial statements of 30,000 non-public limited liability and joint stock companies for the period 2003-2013. Initially, I focus on sectors with innovative activity to better explain and investigate the management decision to capitalize R&D outcomes. In this analysis I focus on companies belonging to the following industries: manufacturing, electricity, waste management and ICT information & communication (with *pkd1*, *pkd2*, *pkd3* or *pkd6* codes). This analysis includes 14,862 firms and covers 90.8% of private companies that capitalize expenses on R&D outcomes in their assets (model 1). Simultaneously, this subsample covers 92.1% of private firms with patents registered with the Polish Patent Office. Therefore, based on information on patenting activity of firms included in the database and their shareholders, in the second step of the analysis (models 2-5) I include all private companies that own patents and/or their shareholders have patents, or capitalize expenses on R&D outcomes in their assets at least in one year during the time period under analysis. This way I restrict my analysis to 1,380 firms that conduct R&D activity, including capitalizers and expensers (firms with patents that did not recognize the R&D outcomes in the assets). Otherwise there is no choice between capitalization and expensing of R&D outlays.

Table 1 presents industry distribution of my research sample with patent activity and capitalization of expenses on R&D outcomes taken into account. I use data of 15,041 private firms in total in models 1-5, including 14,862 firms belonging to the industries of manufacturing, electricity, waste management and ICT information & communication (PKD 1-3 & 6) and additionally 179 private firms outside this sectors that have patents or capitalize expenses on R&D.

Table 1. Industry distribution consider patents and R&D capitalization

PKD codes	Industry (sector)	Number of firms	%	Firms with patents	R&D capitalizers
10-33	Manufacturing	11,112	37%	87,6%	78,1%
35	Electricity	799	3%	0,9%	1,4%
38-39	Waste management	620	2%	1,9%	0,4%
49-53	Transportation & warehause management	2,346	8%	1,0%	2,0%

PKD codes	Industry (sector)	Number of firms	%	Firms with patents	R&D capitalizers
55-56	Hotels and restaurants	1,207	4%	0,1%	0,7%
58-59	Publishing and broadcasting	926	3%	0,3%	0,6%
60-63	Information & communication	2,005	7%	1,0%	9,3%
68	Real Estate	3,525	12%	0,7%	1,1%
69	Legal, accounting and tax services	1,113	4%	0,0%	0,5%
70-75	Professional, scientific & technical services	4,515	15%	6,1%	5,1%
77-82, 95	Administrative services	1,832	6%	0,4%	0,9%
	Total number of firms	**30,000**		**879**	**1,179**

The explanatory variables base on data from financial statements and data retrieved from linkage of the National Court Register and database of scientists with a scientific title (minimal PhD) in Poland, as well as the data of patents registered in the Polish Patent Office. The explanatory variables are defined in the Table 2.

Among the determinants of R&D activities I consider *scientists on the supervisory board* as a proxy for greater awareness for the need to disclose information about the success of commercialization of research outcomes and knowledge of accounting standards. I compare this factor with the *impact of scientists in management* that proxy authorships or a strong participation in R&D activity outcomes.

Table 2. Definitions of variables used in logit panel and tobit panel analyses

Variable	Definition of variable
R&D outcomes	a dummy variable that takes the value of 1 if in at least one year the company capitalized expenditures on R&D outcomes in the balance sheet
rdexpen	expenditures on development works (R&D outcomes for commercialization purpose) capitalized in the balance sheet (as percentage of fixed assets)
scientists in management board	a dummy variable that takes the value of 1 if in the board sit scientists (variable determined on the basis of linkage of database of the National Court Register and database of scientists), and 0 otherwise
scientists in supervisory board	a dummy variable that takes the value of 1 if in the board of directors (supervisory board) sit scientists (variable determined on the basis of linkage of database of the National Court Register and database of scientists), and 0 otherwise
cash holdings	corporate cash resources measured by the share of cash and short-term financial assets in total assets
debt leverage	debt liabilities to other entities = long-term liabilities and short-term liabilities resulted from loans and borrowings, corporate bonds issue and other financial liabilities to other entities / total assets
firm size_income	company size measured by the natural logarithm of sales volume
growth	growth opportunity measured by a logarithm of a growth rate of sales revenue year to year; $\ln((sales_t - sales_{t-1})/ sales_{t-1})$

Variable	Definition of variable
risk_ operational	operational risk measured by a logarithm of the standard deviation of cash flow from operations for the last three years / total assets
share_issue flag	a dummy variable that takes the value of 1 if a company issues shares, i.e. if share capital in t year - share capital in t-1 year > 0, and 0 otherwise
grants balance share	subsidies for fixed assets and intangible assets recognized in the liabilities in the balance sheet as value of long-term other deferred income / total assets
patent	a dummy variable that takes the value of 1 if a company has got at least one patent registered in the Polish Patent Office (on the basis of the Polish Patent Office's data), and 0 otherwise
patent_ shareholder	a dummy variable that takes the value of 1 if a shareholder of the company has got at least one patent registered in the Polish Patent Office (on the basis of the Polish Patent Office's data), and 0 otherwise
corpgov_ family owned	a dummy variable that takes the value of 1 if a member of the management board and a shareholder has got the same surname (based on data retrieved from the National Court Register's database), and 0 otherwise
corpgov_ business group	a dummy variable that equals to 1 if a company belongs to the business group (has a company among shareholders), based on data retrieved from the National Court Register, and 0 otherwise
joint stock company	a dummy variable that equals to 1 if a legal form of the company is the joint stock company, and 0 otherwise
pkd2	manufacturing industry according to the Polish Activity Classification based on the first digit PKD2
pkd6	ICT information and communication industry according to the Polish Activity Classification based on the first digit PKD6

Patents serve as a proxy for innovativeness activity conducted by the analyzed private companies that tend to record operations in accordance with tax law more than accounting standards. Pandit *et al.* (2011) observe positive correlations between R&D investment and patent counts and cites. Empirical research in accounting usually recoding the blank R&D fields as firms with zero R&D, while 10.5% of 1,737 NYSE-listed non-reporting R&D firms receive patents, with several of these firms receiving dozens of patents each year. Missing R&D firms with patent activity demonstrate patent filings analogous to the bottom 90–95% of the corporate population with positive R&D expenditures recognized in the financial statement (Koh and Reeb, 2015). On the other hand, not all innovative companies apply for patents. According to Arundel and Kabla (1998) less than 40% of firms file patents for their technological breakthroughs. Statistical structure of my research sample confirms that 78.8% of private companies with patents registered in the Polish Patent Office do not capitalize expenses on R&D in the assets (Figure 1). There are also a significant share (84%) of companies that capitalize expenditures on R&D outcomes, although have not filed patents for their technological breakthroughs in Poland (Figure 1). Limitations of my research include a lack of information of the patents registered outside Poland, for intellectual property protection on European, or, the global market.

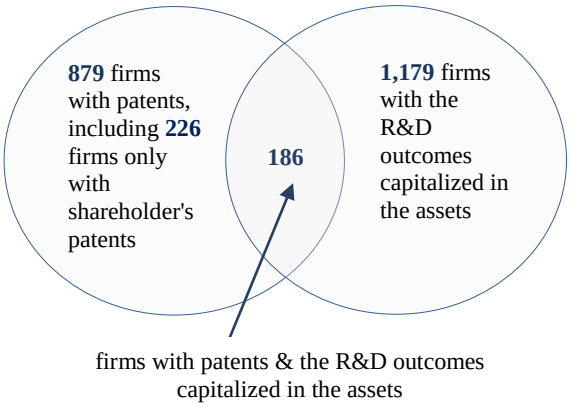

Figure 1. Patent activity versus capitalization of expenditures on R&D outcomes

Firm size measured by income proxies the higher role of accounting standards than tax rules and higher probability of having financial statements audited each year.

Grants as a proxy for enforcing capitalization of R&D costs in the balance statement to meet material and financial requirements of the project and proving of realization of all project's aims, products and indicators. It is required to ensure the eligibility of expenditure on R&D activity within the project financed, for example, by the European Union. I use as a measure of the grants subsidies for fixed tangible and intangible assets purchase or construction, presented in the balance sheet.

Cazavan-Jeny and Jeanjean (2006) find that firms choosing to capitalize (successful) R&D are smaller, more highly leveraged, less profitable and have less growth opportunities. In order to confront these characteristics of R&D capitalizers, I also include in my research the aforementioned variables: *firm size_income*, *debt leverage* and *growth.* Lee and Hwang (2003) and Guariglia (2008) prove that the higher the *growth opportunities*, the higher the expenditures on R&D investment. On the other hand, results received by Brown and Peterson (2011) are not explicit, but they do indicate: a negative relation between growth opportunities and R&D expenditures in the period 1970-1981, particularly for young companies; a positive relationship during 1982-1993, either for young or mature companies, while from 1994-2006 there is a negative relationship in the case of young companies, and a positive relationship for mature companies.

Hyeog and Tomohiko (2013) prove that the internal funds of enterprises (*cash holdings*) have a positive impact on research and development expenditures. Regarding the important role of the ability to self-finance in the case of R&D activity, I also include in this research *operational risk* that measures variability of cash flow from operations and distinguish companies that issue shares (*share_issue_flag*).

Before a logit panel analysis of the management decisions regarding capitalization of expenditures on developmental works (R&D outcomes) in their assets (a dummy variable) and a tobit panel analysis of the level of expenditures on these development works (as percentage of fixed assets), the descriptive statistics of variables has been determined (Table 3) and the correlation between explanatory variables has been estimated.

Table 3. Descriptive statistics of variables in logit and tobit panel analyses

Variable used in model 1	Obs	Mean	Std. Dev.	Min	Max
rdexpen	136,225	0.0031	0.0381	0	1
cash holdings	136,225	0.1369	0.1858	0	0.9995
debt leverage	136,225	0.1591	0.2190	0	0.9999
firm_size_income	131,619	15.4855	2.2024	-0.9163	23.6962
growth	117,455	0.0839	0.7105	-12.1733	12.1155
risk_ operational	113,067	-1.8711	1.1100	-13.1509	7.5147
share_ issue_flag	136,225	0.0894	0.2853	0	1
scientists in management board	136,225	0.1596	0.3663	0	1
scientists in supervisory board	136,225	0.0824	0.2750	0	1
grants_balance_share	136,225	0.0129	0.0534	0	0.9908
patent	136,225	0.0397	0.1953	0	1
joint stock company	136,225	0.0994	0.2992	0	1
pkd2	136,225	0.3705	0.4829	0	1
pkd6	136,225	0.2883	0.4530	0	1
corpgov_business group	136,225	0.1320	0.3385	0	1
patent_shareholder	136,225	0.0078	0.0879	0	1
corpgov_family owned	136,225	0.4288	0.4949	0	1
Variables used in models 2-5	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
rdexpen	16,445	0.0298	0.1162	0	1
cash holdings	16,445	0.1135	0.1520	0	0.9913
debt leverage	16,445	0.1464	0.1765	0	0.9998
firm_size_income	16,307	16.7044	1.9325	5.2983	23.6962
growth	14,698	0.0973	0.5592	-8.6109	11.7662
risk_operational	12,081	-1.9202	0.9781	-6.9827	4.5983
share_issue_flag	16,445	0.1014	0.3019	0	1
scientists in management board	16,445	0.1860	0.3891	0	1
scientists in supervisory board	16,445	0.1175	0.3221	0	1
grants_balance_share	16,445	0.0203	0.0623	0	1.2336
patent	16,445	0.3559	0.4788	0	1
joint stock company	16,445	0.2379	0.4258	0	1
pkd2	16,445	0.5451	0.4980	0	1
pkd6	16,445	0.1008	0.3011	0	1

Detailed outcomes of correlation of these variables are presented in the appendix. Due to the low level of expenditure on R&D (developmental works) capitalized in the balance sheet, I decided to scale it by fixed assets. However, a high number of zero observations resulted in the choice of estimation methods - Gaussian random effects logit panel and tobit panel analyses.

5. Results

Findings of the logit panel analysis of management decision to recognize R&D outcomes confirm that the presence of a *scientist on the supervisory board* is typical for the company that is more likely to capitalize expenditures on R&D outcomes for the purpose of commercialization (results of models (1) and (2) for the *R&D outcomes* explained variable in Table 4), especially in the manufacturing industry (*pkd2*), whereas companies with a scientist on the management board are less likely to capitalize expenditures on R&D outcomes (models 2 and 4). This confirms the *H1 hypothesis*. Moreover, at 10% significance level, a company with a scientist on the supervisory board recognizes the higher expenditure on commercialized results of R&D activity in the form of completed developmental works (on the balance sheet) in the ICT information and communication industry (*pkd6* in model 5), while firms with a scientist on the management board capitalize lower expenditures on R&D outcomes (models 3 and 5). Similarly to Seybert (2010), these results indicate that when R&D outcomes are capitalized, experienced executives expect project abandonment to have a stronger negative impact on the reputation of the manager responsible and future prospects of their firm. Seybert (2010) suggest that managers are held responsible for the external reporting consequences of their projects, such that mandating R&D capitalization may not reduce real earnings management.

The results of the logit panel model (1) for manufacturing industry (*pkd1, pkd2, pkd3*) and the ICT information and communication industry (*pkd6*) in Table 4 confirm significant positive relationships between explained variables and corporate *patents* (and shareholder's patents at a low 20% level of significance). Companies with patents are more likely to capitalize higher expenditures on R&D outcomes in the balance sheet. These results are consistent with Pandit et al. (2011) and Koh and Reeb (2015). However, when I consider only private firms that signal their intent to conduct R&D activity (i.e. companies that capitalized expenditures on R&D outcomes at least in one year under analysis or patented their R&D outcomes (models 2-5)), I could observe the substitution of the recognition of R&D outcomes (and the level of R&D expenses capitalized) in their assets and patenting corporate breakthrough inventions. The results show a significant negative relationship between the corporate propensity to capitalize R&D outcomes in assets and patents (models 2 and 4). These findings are in accordance with the *H2 hypothesis*. The results indicate a significant role of intellectual property protection in companies conducting R&D activity, that could also play a role of a signal to the market (i.e. creditors, shareholders) similar to the recognition of R&D outcomes in their assets.

Based on the results of the logit panel models 1, 2 and 4, *larger enterprises* are more likely to capitalize expenses on the R&D outcomes. This is in accordance with the *H3 hypothesis*. This can be explained by the higher role of accounting standards than tax rules in larger companies, their greater awareness of the need to disclose

information about the success of commercialization of R&D outcomes and, the higher probability of having financial statements audited each year. The cause may also be a wider use of management accounting and international financial reporting standards by larger companies. These results are consistent with Langowitz and Graves (1992), Cabral (2003), and Barge-Gila and López (2014).

The results of the logit panel and the tobit panel analyses (Table 4) confirm a strong positive relationship between capitalization of expenditures on the R&D outcomes and *grants* recognized in the balance sheet (for the construction or purchase of fixed assets or intangible assets). The significant positive relations between the probability of recognition R&D outcomes (models 1, 2 and 4) as well as the level of spending on R&D outcomes intended to commercialize (models 3 and 5) and these types of grants give no basis for rejection of the *H4 hypothesis*. These results confirm the enforcing role of the R&D costs capitalization in the balance statement to meet the material and financial requirements of the project financed by grants for R&D outcomes commercialization.

The decrease in corporate *cash holdings* determines the higher probability of capitalization of expenses on R&D outcomes (models 1, 2 and 4), which results from financing this business from cash resources due to the accompanying high risk. Similar conclusions for R&D costs were drawn by Brown, Martinsson and Petersen (2012). Higher spending on R&D outcomes capitalized in assets is accompanied by higher *debt leverage* (models 3 and 5). Greater indebted companies are more likely to recognize R&D outcomes in assets (models 1, 2 and 4). Companies that have lower *growth opportunities* are more likely to capitalize expenditures on R&D outcomes in assets and also tend to increase spending on R&D outcomes capitalized in assets (Table 4), probably for earnings management. It may be caused by the instability of revenue from sales and problems with sales channels, identification of customer segments or/and building relationships with customers. Higher *operational risk* limits probability of capitalization of R&D outcomes in the assets (results of logit panel models 1, 2 and 4 in Table 4).

The increased probability of spending on R&D outcomes for commercialization, capitalized in the assets (logit panel models 2 and 4) is accompanied by a decision to issue shares or increasing the share capital in a limited liability company. This indicates the importance of the stock exchange (the *share_issue_flag* variable) in financing risky and capital-intensive R&D activity. Białek-Jaworska and Gabryelczyk (2016) indicate the importance of the funding by share issue on the Warsaw Stock Exchange, especially for the R&D activity of biotech start-ups.

Additionally, I show that joint stock companies and members of business groups are more likely to capitalize expenditures on the R&D outcomes. I also identify that among Polish private companies, manufacturing (*pkd2*) and ICT industries (*pkd6*) are more likely to recognize R&D outcomes in the balance sheet in order to

confirm success of commercialization, while companies from ICT industry (*pkd6*) capitalize higher expenses on the R&D outcomes in the assets.

Table 4. Determinants of corporate decisions to R&D outcomes capitalization

	R&D	R&D	rdexpen	R&D	rdexpen
	logit RE	**logit RE**	**tobit RE**	**logit RE**	**tobit RE**
	(1)	(2)	(3)	(4)	(5)
cash holdings	-0.9020**	-1.0078***	-0.0068	-1.1943***	-0.0093#
	(0.3774)	(0.3195)	(0.0067)	(0.3206)	(0.0066)
debt leverage	0.5451**	0.8798***	0.01301**	0.8922***	0.0136**
	(0.2360)	(0.2665)	(0.0061)	(0.2674)	(0.0060)
firm size_income	0.6748***	0.2193***	-0.0014##	0.2667***	-0.0003
	(0.0577)	(0.0386)	(0.0009)	(0.0393)	(0.0009)
growth	-0.2859***	-0.1664***	-0.0038***	-0.1811***	-0.0042***
	(0.0767)	(0.0635)	(0.0013)	(0.0644)	(0.0013)
risk_operational	-0.2008***	-0.3453***	-0.0017	-0.3335***	-0.0012
	(0.0748)	(0.0637)	(0.0014)	(0.0638)	(0.0014)
share_issue_flag		0.2404**	0.0023	0.2294**	0.0022
		(0.1018)	(0.0023)	(0.1020)	(0.0023)
scientists in management(am)	-0.1601	-0.7373***	-0.0116**	-0.7727***	-0.0108**
am#patent 1 0	(0.2819)	(0.1948)	(0.0050)	(0.1965)	(0.0047)
patent	5.1026***	-2.7437***	-0.0276***	-2.5879***	-0.0211***
am#patent 0 1	(0.3885)	(0.1854)	(0.0040)	(0.1864)	(0.0040)
	2.6516*				
am#patent 1 1	(1.5833)				
grants_balance_share	4.7529***	3.7458***	0.0845***	3.8502***	0.0875***
	(0.6511)	(0.5789)	(0.0136)	(0.5826)	(0.0136)
joint stock company (sa)	2.7588***	0.7253***	-0.0006	0.6725***	-0.0033
0 1	(0.4187)	(0.1852)	(0.0050)	(0.1878)	(0.0049)
scientists in supervisory	0.2071				
1 0	(0.3613)				
scientists in supervisory	3.0519***				
1 1	(1.1641)				
corpgov_business group	0.5995**				
	(0.2749)				
corpgov_family owned	-0.0822				
	(0.1999)				
patent_shareholder	1.1733#				
	(0.9398)				
as#pkd2 (pkd6)		**as#pkd2**	**as#pkd2**	**as#pkd6**	**as#pkd6**
0 1		0.7463***	-0.0030	0.3973*	0.0451***
		(0.1593)	(0.0041)	(0.2308)	(0.0060)
1 0		-0.0805	-0.0097	0.1142	0.0013
		(0.3305)	(0.0082)	(0.2545)	(0.0063)
1 1		0.9924***	0.0061	-0.0114	0.0292*
		(0.3431)	(0.0089)	(0.6590)	(0.0169)

	R&D	R&D	rdexpen	R&D	rdexpen
	logit RE	**logit RE**	**tobit RE**	**logit RE**	**tobit RE**
_cons	-	-6.0892***	0.0602***	-6.5438***	0.0343**
	(0.8972)	(0.6067)	(0.0138)	(0.6341)	(0.0141)
/sigma_u	3.4535	1.5456	0.0639***	1.5760	0.0627***
/lnsig2u	(0.0375)	(0.0763)	(0.0015)	(0.0756)	(0.0015)
/sigma_e	5.6223	2.1658	0.0690***	2.1990	0.0690***
sigma_u	(0.1053)	(0.0826)	(0.0005)	(0.0832)	(0.0005)
rho	0.9057	0.5878	0.4621	0.5951	0.4522
	(0.0032)	(0.0185)	(0.0126)	(0.0182)	(0.0126)
Number of obs	98 669	10 786	10 786	10 786	10 786
Number of groups	14 862	1 380	1 380	1 380	1 380
Wald chi2(13)	721.78***	376.95***	120.90***	364.41***	178.67***
Log likelihood	-5571.2269	-4429.3286	11463.239	-4441.3876	11490.61
Likelihood-ratio test	8576.16***	2019.62***	3002.32***	2117.36***	2926.47***

Significant at 20% - #, 15% - ##, 10% - *, 5% - **, 1% - ***. Integration method: mvaghermite Integration points for logit panel models: 12, for tobit panel models: 25

6. Conclusions

Prior research suggests that the market may react negatively to R&D capitalization when managers have the option to choose between capitalizing and expensing (Cazavan-Jeny & Jeanjean, 2006). As a result, managers may prefer to opt for expensing in order to avoid overinvestment and impairment problems. Both GAAP and IFRS require a consistent treatment of R&D expenditures and do not allow the manager an explicit choice between expensing and capitalization. This paper sheds new light on this issue from the perspective of the private firm's accounts that are strongly influenced by tax regulation. Nowadays, most emerging economies face the problem of underreporting R&D expenditures in the business sector. This is particularly important, not least in countries like Poland where only 10% of active companies do bookkeeping and neither accounting act nor tax law require the reporting of expenditures on R&D that are expensing. In 2015, the corporate expenditures on R&D constituted 0.46% of GDP in Poland, while the target for the business sector is 1.14% of GDP by 2020 (67% of overall R&D outlays expected to reach 1.7% of GDP).

This paper identified the missing R&D outcomes in financial statements in the case of 78.8% of private companies with patents registered in the Polish Patent Office. Among the factors influencing the management decision of private companies in terms of capitalization of expenditures on R&D outcomes in their assets, this research indicates the positive impact of a scientist on the supervisory board as opposed to the management board. In accordance with conclusions from Oswald and Zarowin (2007), in the case of private firms with a scientist on the supervisory

board, the capitalization method enables management to better communicate information about the success of projects and their probable future benefits.

For private firms with a scientist on the management board the expensing method is preferable to capitalization as it eliminates any opportunity for managers to capitalize costs of projects that have a low probability of success. Similar findings for listed companies received by Cazavan-Jeny and Jeanjean (2006) confirm that capitalization is negatively related to stock prices and market returns.

More indebted companies and entities that realize projects co-financed from grants for fixed tangible or intangible assets are more likely to capitalize higher expenditures on R&D outcomes in their assets. The last findings are consistent with Carboni (2011) and Ali-Yrkkö (2004). Conversely, private firms conducting R&D activity resulting in patents, or, with higher growth opportunities, are less likely to capitalize spending on R&D outcomes. Larger companies are more likely to capitalize higher expenditures on development works on the balance sheet. Likewise, joint stock companies, members of business groups, private manufacturing and ICT companies are more likely to capitalize spending on the R&D outcomes intended for commercialization.

The results show that companies are more likely to capitalize expenditures on R&D outcomes when issuing shares or increasing share capital in another way. Additionally, I confirmed that important sources of financing R&D activities are corporate cash holdings, also highlighted by Hyeog and Tomohiko (2013).

Furthermore, companies with lower growth opportunities are more likely to capitalize expenditures on R&D outcomes in their assets and also tend to increase spending on R&D outcomes capitalized in their assets. Moreover, higher operational risk decreases the probability of capitalization in their assets. On one hand, this may be caused by the instability of revenue from sales, problems with sales channels, the identification of customer segments or/and building relationships with customers. On the other hand, their decision could be supported by the possible management of earnings via such an accounting policy regarding R&D costs.

Future research could be concentrated on income conservatism for private companies that commercialized their R&D outcomes. These companies provide an interesting opportunity to gather evidence on Polish income conservatism, as they face greater operational risks and are affected to a greater degree by conservative tax regulation, high book-tax conformity and accounting standards with different solutions in terms of recognition of expenditures on R&D activities.

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Appendix

The correlation matrix of explanatory variables used in the logit panel analyses (models 2, 4) and the tobit panel analyses (models 3, 5)

models 2-5	rdexpen	cash holdings	debt leverage	firm size_ income	growth	risk_ operational	share_ issue_flag
rdexpen	1.0000						
cash holdings	0.0349***	1.0000					
debt leverage	-0.0075	-0.3195***	1.0000				
firm size_income	-0.1459***	-0.1746***	0.0464***	1.0000			
growth	-0.0115	-0.0050	0.0280***	0.0845***	1.0000		
risk_operational	0.0582***	0.1462***	-0.0445***	-0.3245***	0.0510***	1.0000	
share_issue_flag	0.0266***	-0.0279***	0.0417***	0.0048	0.0877***	0.0299***	1.0000
scientists in management	-0.0330***	0.0174**	0.0184**	-0.0793***	-0.0160*	0.0535***	0.0149*
scientists in supervisory board	-0.0078	0.0014	-0.0175**	0.0366***	-0.0184**	-0.0182**	-0.0019
grants_balance	0.0640***	-0.0707***	0.0509***	-0.0535***	-0.0002	-0.0249**	0.0363***
patent	-0.1212***	-0.0817***	0.0463***	0.1150***	0.0223***	-0.0161*	0.0022
joint stock company	-0.0281***	-0.0647***	-0.0186**	0.2823	-0.0304***	-0.0813***	0.0474***
pkd2	-0.0385***	-0.1700***	0.0341***	0.2216***	0.0030	-0.0732***	-0.0385***
pkd6	0.1583***	0.1368***	-0.0591***	-0.2323***	0.0186**	0.0883***	0.0240***

	scientists in management board	scientists in supervisory board	grants_ balance share	patent	joint stock company	pkd2	pkd6
scientists in management board	1.0000						
scientists in supervisory board	0.1016***	1.0000					
grants_balance share	-0.0028	0.0347***	1.0000				
patent	-0.0704***	0.0205***	0.0445***	1.0000			
joint stock company	-0.0652***	0.0351***	0.0167**	0.0148*	1.0000		
pkd2	-0.0711***	-0.0071	0.0132*	0.1491***	0.0587***	1.0000	
pkd6	0.0013	-0.0225***	-0.0387***	-0.2084***	0.0098	-0.3665***	1.0000

Significant at 10% - *, 5% - **, 1% - ***. Number of observations: 16,445

The correlation matrix of explanatory variables used in the logit panel analysis (model 1)

model 1	rdexpen	cash holdings	debt leverage	firm size_ income	growth	risk_ operational	share_ issue_flag	scientists in management board
rdexpen	1.0000							
cash holdings	-0.0092***	1.0000						
debt	-0.0020	-0.2883***	1.0000					
firm size_ income	0.0111***	-0.1972***	0.0260***	1.0000				
growth	-0.0012	-0.0226***	0.0424***	0.1587***	1.0000			
risk_ operational	0.0057**	0.1448***	-0.0589***	-0.2236***	-0.0248***	1.0000		
share_issue_flag	0.0111***	-0.0416***	0.0347***	0.0278***	0.0749***	0.0034	1.0000	
scientists in management board	-0.0046**	-0.0175***	-0.0006	0.0382***	-0.0105***	-0.0077***	0.0064***	1.0000
scientists in supervisory board	0.0077***	-0.0274***	-0.0069***	0.0774***	-0.0082***	-0.0138***	0.0060***	0.1029***
grants_ balance share	0.0300***	-0.0692***	0.0167***	0.0236***	0.0023	-0.0538***	0.0338***	0.0171***
patent	0.0428***	-0.0538***	0.0078***	0.1387***	0.0073***	-0.0211***	0.0089***	-0.0046**
joint stock company	0.0262***	-0.0592***	0.0031	0.2365***	-0.0099***	-0.0592***	0.0344***	0.0022
pkd2	0.0370***	-0.1347***	-0.0098***	0.2377***	0.0071***	-0.0472***	-0.0130***	0.0066***
pkd6	0.0168***	0.0659***	0.0714***	-0.2645***	0.0054**	-0.0190***	0.0029	-0.0187***
corpgov_ business group	0.0067***	-0.0507***	-0.0146***	0.1346***	-0.0026	-0.0135***	0.0243***	0.0222***
patent_ shareholder	0.0032##	0.0036##	-0.0032##	0.0059***	-0.0039##	-0.0010	-0.0017	0.0667***
corpgov_ family owned	-0.0016	0.0089***	-0.0235***	-0.0008	-0.0068***	0.0251***	0.0103***	0.1225***

	scientists in supervisory board	grants_ balance share	patent	joint stock company	pkd2	pkd6	corpgov business group	patent_ shareholder
scientists in supervisory board	1.0000							
grants_ balance share	0.0172***	1.0000						
patent	0.0308***	0.0370***	1.0000					
joint stock company	0.0532***	0.0745***	0.0973***	1.0000				
pkd2	0.0357***	-0.0095***	0.1585***	0.0475***	1.0000			
pkd6	-0.0243***	-0.0009	-0.0768***	-0.0074***	-0.2794***	1.0000		
corpgov_ business group	0.0178***	-0.0068***	0.0213***	-0.0098***	0.0071***	-0.0159***	1.0000	
patent_ shareholder	0.0202***	-0.0045**	-0.0137***	-0.0064***	-0.0038*	-0.0070***	0.0154***	1.0000
corpgov_ family owned	-0.1030***	-0.0137***	-0.0019	-0.0287***	-0.0029	-0.0101***	0.0390***	0.0778***

Significant at 10% - *, 5% - **, 1% - ***. Number of observations: 136,225