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PUBLIC SUPPORT FOR RESEARCH AND DEVELOPMENT INVESTMENT AND THE IMPACT ON CORPORATE PERFORMANCE

DOCTORAL DISSERTATION

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The undersigned Dejan Ravšelj, a student at the University of Ljubljana, School of Economics and Business (hereinafter: the SEB LU), the author of this written final work of studies with the title **Public Support for Research and Development Investment and the Impact on Corporate Performance**, prepared under the supervision of Professor Aleksander Aristovnik, PhD and co-supervision of Professor Sergeja Slapničar, PhD

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SUMMARY

The doctoral dissertation examines the role of public support in research and development (R&D) investment, the full range of its effects on companies, along with the implications it holds for their performance. Namely, the global economy is exposed to new challenges associated with globalisation, the emergence of new technologies and the transition to a knowledge-based economy. This is producing challenging business conditions reflected in fast-growing and ever-changing markets with increasingly tougher competition that is forcing companies to adjust their business and investment strategies so as to provide value-added products, processes and services and retain their competitive market position. One solution for addressing these modern economic challenges and ensuring the long-term viability of companies may entail R&D investment.

However, private R&D investment in the business sector is often subject to market failures (positive externalities, information asymmetries, uncertainty and risk), making it often less than socially desirable. This is the primary reason that governments promote private R&D investment. Many modern governments around the world provide different public policy instruments to stimulate private R&D investment in the business sector. The most common instruments of public support for R&D investment are R&D subsidies as a way of direct funding and R&D tax incentives as a way of indirect funding. The existence of R&D subsidies and R&D tax incentives and their different characteristics means their impact on firms' R&D investment is still not well established. Moreover, the growing importance of R&D investment in contemporary economies also concerns its accounting treatment. This especially holds for economies that apply accounting standards which allow a discretionary choice of R&D accounting. Since public policies are often considered some of the main drivers of companies' business decisions, it is important to understand the relationship between R&D public policy and companies' accounting policy. Finally, the sheer existence of market failures (positive externalities, information asymmetries, uncertainty and risk) brings the impact of R&D investment on corporate performance into question. For the purposes of understanding the aforementioned complex issues, a systematic, in-depth and comprehensive insight into the topic is needed.

The overall objective of the doctoral dissertation is to investigate the role of public support for R&D investment in terms of the comprehensive economic and accounting implications it holds for corporate performance. The principal research question concerns the impact of public support for R&D investment on corporate performance. Since public support for R&D investment affects corporate performance indirectly via different channels, it is vital to identify and understand the channels via which companies enhance their performance. Accordingly, firms' R&D expenditures and their accounting treatment, which may be influenced by various public policy instruments, can be good representatives of the channels through which corporate performance is affected. Firms' R&D spending as well as their accounting treatment may thus be seen as an intermediate phase on the path from public support for R&D investment to corporate performance.

This dissertation is structured in the form of three interrelated, main chapters that are preceded by an introduction and discussed in the conclusion. The first chapter investigates the impact of public support for R&D investment on firms' R&D expenditures in Slovenia. Its core research question asks whether different public policy instruments for R&D investment stimulate firms' R&D spending. The empirical results show that public support for R&D investment plays an important role in firms' R&D expenditures. As to R&D subsidies, the empirical results reveal they are generally ineffective since they displace firms' R&D expenditures. Yet they do become effective when used in combination with R&D tax incentives and received by companies that are growing. On the contrary, the empirical results also show that R&D tax incentives are always effective when companies have a sufficient tax base.

The second chapter examines the impact of public support for R&D investment on the accounting treatment of R&D expenditures. Its primary research question is how public support for R&D investment influences the accounting treatment of R&D expenditures. The empirical results show that earnings management is present after public support has been received in the form of R&D tax incentives. Given that R&D tax incentives relieve the tax burden on companies, they aim to maximise the accounting profit by way of R&D capitalisation. With respect to R&D subsidies, the accounting rules align their accounting treatment with the accounting treatment of R&D expenditures, implying that R&D subsidies are tax-neutral. Therefore, they cannot be the main driver of the R&D accounting treatment decision.

Finally, the third chapter examines the impact of R&D spending on corporate performance. Its central research question is concerned with how R&D expenditures influence the operating and market corporate performance. The empirical results for Slovenia and world R&D companies show that R&D spending adversely impacts current operating performance and positively impacts future operating performance. Moreover, the empirical results for world R&D companies reveal that R&D spending improves market performance, although this effect becomes not significant with respect to market performance in the following year.

The comprehensive and systematic research presented in the doctoral dissertation aims to contribute to the general economic and accounting literature by providing new and interesting empirical evidence for Slovenia and beyond. It adds to both academic and practical knowledge and may be seen as useful for different stakeholders like policymakers, managers, investors and accounting-standard setters. The obtained empirical evidence may help illuminate certain ambiguities related to public support for R&D investment, R&D investment itself, its accounting treatment and the implications for corporate performance since it is expected that R&D investment will be one of the crucial investments in the future.

Keywords: R&D subsidies, R&D tax incentives, R&D expenditures, accounting treatment of R&D expenditures, corporate performance, Slovenia, OECD.

POVZETEK

Doktorska disertacija proučuje vlogo državne spodbude za vlaganja v raziskave in razvoj (RR) ter njene celovite učinke na podjetja z implikacijami na njihovo uspešnost. Svetovno gospodarstvo je namreč izpostavljeno novim izzivom, ki so povezani z globalizacijo, pojavom novih tehnologij in prehodom k na znanju temelječem gospodarstvu. To je privedlo do zahtevnih pogojev poslovanja, ki se odražajo v hitro rastočem in vedno spreminjajočem se trgu z vse ostrejšo konkurenco, ki podjetja sili, da prilagodijo svoje poslovne in naložbene strategije na način, da zagotavljajo izdelke, postopke in storitve z dodano vrednostjo in ohranjajo konkurenčni položaj na trgu. Eno od možnih rešitev za reševanje teh sodobnih gospodarskih izzivov in za zagotavljanje dolgoročne sposobnosti preživetja podjetij je mogoče prepoznati v vlaganju v RR.

Vendar so privatna vlaganja v RR v poslovnem sektorju pogosto predmet tržnih nepopolnosti (pozitivne eksternalije, informacijske asimetrije, negotovost in tveganje), zaradi česar je njihova raven nižja od ravni, ki je družbeno zaželena. To prestavlja glavni razlog za državno spodbujanje privatnih vlaganj v RR. Številne sodobne države po svetu ponujajo različne instrumente javne politike za spodbujanje privatnih vlaganj v RR v poslovnem sektorju. Najpogostejši instrumenti državne podpore za vlaganje v RR so subvencije za RR kot način neposrednega financiranja in davčne olajšave za RR kot način posrednega financiranja. Ker obstajajo med subvencijami in davčnimi olajšavami za RR različne značilnosti, njihov vpliv na vlaganja podjetij v RR ni dobro ugotovljen. Poleg tega vedno večji pomen vlaganj v RR v sodobnih gospodarstvih zadeva tudi njihovo računovodsko obravnavo. To velja zlasti za gospodarstva z računovodskimi standardi, ki omogočajo diskrecijsko izbiro pri računovodstvu za RR. Ker se javne politike pogosto obravnavajo kot eden glavnih dejavnikov poslovnih odločitev podjetij, je pomembno razumeti razmerje med javnimi politikami za RR in računovodsko politiko podjetij. Ne nazadnje obstoj tržnih nepopolnosti (pozitivne eksternalije, informacijske asimetrije, negotovost in tveganje), postavlja pod vprašaj vpliv vlaganj v RR na uspešnost podjetij. Za razumevanje omenjenih kompleksnih vprašanj je potreben sistematičen, poglobljen in celovit vpogled v to tematiko.

Splošen cilj doktorske disertacije je raziskati vlogo državne spodbude za vlaganja v RR v smislu njenih celovitih ekonomskih in računovodskih implikacij, ki vplivajo na uspešnost podjetij. Glavno raziskovalno vprašanje se nanaša na vpliv državne podpore za vlaganja v RR na uspešnost podjetij. Ker državna podpora za vlaganja v RR posredno vpliva na poslovanje podjetij preko različnih kanalov, je zato pomembno opredeliti in razumeti te kanale, skozi katere podjetja povečujejo svojo uspešnost. Skladno z omenjenim, lahko izdatki podjetij za RR in njihova računovodska obravnava, ki so lahko pod vplivom različnih instrumentov javne politike, predstavljajo kanale, skozi katere se občuti vpliv na uspešnost podjetij. Izdatke podjetij za RR ter njihovo računovodsko obravnavo je zato mogoče obravnavati kot vmesni fazi na celotni poti od državne podpore za vlaganja v RR do uspešnosti podjetij.

Doktorska disertacija je sistematično strukturirana v obliki treh, med seboj povezanih glavnih poglavij, obdanih z uvodom in zaključkom. Prvo poglavje obravnava vpliv državne podpore za vlaganja v RR na izdatke podjetij za RR v Sloveniji. Njegovo temeljno raziskovalno vprašanje je, ali različni instrumenti javne politike za RR spodbujajo izdatke podjetij za RR. Empirični rezultati kažejo, da ima državna podpora za vlaganja v RR pomembno vlogo v smislu izdatkov podjetij za RR. Za subvencije za RR empirični rezultati kažejo, da na splošno niso učinkovite, saj izpodrivajo izdatke podjetij za RR. Vendar pa le-te postanejo učinkovite, ko se uporabljajo v kombinaciji z davčnimi olajšavami za RR in ko jih prejmejo rastoča podjetja. Nasprotno pa empirični rezultati kažejo, da so davčne olajšave za RR učinkovite v vsakem primeru, ko imajo podjetja zadostno davčno osnovo.

Drugo poglavje obravnava vpliv državne podpore za vlaganja v RR na računovodsko obravnavo izdatkov za RR. Njegovo temeljno raziskovalno vprašanje je, kako državna podpora za vlaganja v RR vpliva na računovodsko obravnavo za raziskave in razvoj. Empirični rezultati kažejo na prisotnost uravnavanja dobička po prejemu državne spodbude v obliki davčnih olajšav za RR. Glede na to, da davčne olajšave za RR razbremenjujejo davčno breme podjetij, si le-ta prizadevajo maksimirati računovodski dobiček s kapitalizacijo izdatkov za RR. Kar zadeva subvencije za RR, računovodska pravila usklajujejo njihovo računovodsko obravnavo z računovodsko obravnavo izdatkov za RR, kar pomeni, da so subvencije za RR davčno nevtralne. Zato ne morejo predstavljati glavnega gonila odločitve glede računovodske obravnave RR.

Končno, tretje poglavje obravnava vpliv izdatkov za RR na uspešnost podjetij. Njegovo temeljno raziskovalno vprašanje je, kako izdatki za RR vplivajo na poslovno in tržno uspešnost podjetij. Empirični rezultati za Slovenijo in svetovna podjetja na področju RR kažejo, da izdatki za RR negativno vplivajo na tekočo poslovno uspešnost in pozitivno vplivajo na prihodnjo poslovno uspešnost. Poleg tega empirični rezultati svetovnih podjetij na področju RR kažejo, da izdatki za RR izboljšujejo tržno uspešnost podjetij, pri čemer pa je ta učinek neznačilen za tržno uspešnost podjetij v naslednjem letu.

Celovita in sistematična raziskava, zajeta v doktorski disertaciji, poskuša prispevati k splošni ekonomski in računovodski literaturi z zagotavljanjem nekaterih novih in atraktivnih empiričnih dokazov za Slovenijo in širše. Prispeva k akademskemu in praktičnemu znanju in je koristna za različne interesne skupine, kot so: oblikovalci politik, poslovodstvo, investitorji in oblikovalci računovodskih standardov. Pridobljeni empirični dokazi lahko pomagajo osvetliti nekatere dvoumnosti, povezane z državno spodbudo za vlaganja v RR, samimi vlaganji v RR, njihovo računovodsko obravnavo in implikacijami za uspešnost podjetij, saj se pričakuje, da bodo vlaganja v RR predstavljala eno izmed ključnih vlaganj v prihodnosti.

Ključne besede: subvencije za RR, davčne olajšave za RR, izdatki za RR, računovodska obravnava izdatkov za RR, uspešnost podjetij, Slovenija, OECD.

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AJPES – (sl. *Agencija RS za javnopravne evidence in storitve*); Agency of the Republic of Slovenia for Public Legal Records and Related Services
BERD – (sl. *poslovni izdatki za RR*); business enterprise R&D expenditure
CAP – (sl. *kapitalizacija izdatkov za RR*); capitalisation of R&D expenditures
CEI – (sl. *intenzivnost investicijskih izdatkov*); capital expenditure intensity
EC – (sl. Evropska komisija); European Commission
EU – (sl. *Evropska unija*); the European Union
FORM – (sl. *pravno-organizacijska oblika*); legal form
FURS – (sl. *Finančna uprava RS*); Financial Administration of the Republic of Slovenia
GDP – (sl. *bruto domači proizvod*); gross domestic product
GERD – (sl. *bruto domači izdatki za RR*); gross domestic expenditure on R&D
IAS – (sl. *mednarodni računovodski standardi*); international accounting standards
IASB – (sl. *Upravni odbor za mednarodne računovodske standarde*); International Accounting Standards Board
IFRS – (sl. *mednarodni standardi računovodskega poročanja*); international financial reporting standards
INT – (sl. *interakcijska spremenljivka*); interaction variable
LEV – (sl. *finančni vzvod*); financial leverage
LIQ – (sl. *likvidnost*); liquidity
NRDI – (sl. *neto RR intenzivnost*); net R&D intensity

NACE – (sl. *statistična klasifikacija gospodarskih dejavnosti*); the statistical classification of economic activities
NSG – (sl. *neto rast prodaje*); net sales growth
OECD – (sl. *Organizacija za gospodarsko sodelovanje in razvoj*); Organisation for Economic Co-operation and Development
PSR – (sl. *razmerje med ceno in prodajo*); price-to-sales ratio
R&D – (sl. *raziskave in razvoj*); research and development
RDI – (sl. *RR intenzivnost*); R&D intensity
ROA – (sl. *donosnost sredstev*); return on assets
ROE – (sl. *donosnost kapitala*); return on equity
ROS – (sl. *donosnost prodaje);* return on sales
SAS – (sl. *Slovenski računovodski standardi*); Slovenian accounting standards
SIZE – (sl. *velikost podjetja*); company size
SORS – (sl. *Statistični urad Republike Slovenije*); Statistical Office of the Republic of Slovenia
SPIRIT – (sl. *Javna agencija RS za spodbujanje podjetništva, internacionalizacije, tujih investicij in tehnologije*); Public Agency for Entrepreneurship, Internationalisation, Foreign Investments and Technology
SRA – (sl. *Javna agencija za raziskovalno dejavnost RS*); Slovenian Research Agency
SUB – (sl. *intenzivnost subvencij za RR*); R&D subsidy intensity
SUP – (sl. *vektor neodvisnih spremenljivk za državno spodbuda za vlaganja v RR*); a vector of independent variables for public support for R&D investment
TAX – (sl. *davčne olajšave za RR*); R&D tax incentive intensity
TAXD – (sl. *upravičenci do davčnih olajšav za RR*); beneficiaries of R&D tax incentives
TAXR – (sl. *obseg davčnih olajšav za RR*); the extent of R&D tax incentives
USA – (sl. *Združene države*); the United States of America
YEAR – (sl. *letna spremenljivka*); year dummy variable

INTRODUCTION

Purpose and objective of the research

The global economy is currently faced with a series of challenges brought by the emergence of new technologies. Hence, ever-greater emphasis is being placed on research and development (R&D) at the country and company levels. Traditionally, companies have mainly focused their business operations on physical assets, yet this has dramatically changed in the past few years. Namely, in the period of industrialisation it was tangible assets that represented the primary source of value creation, whereas in the knowledge-economy era R&D investment holds greater potential for value creation than tangible assets (Sullivan & Sullivan, 2000). Since R&D investment is a key determinant of economic growth, from society's point of view potential underinvestment is considered an explanation for government intervention seeking to stimulate this kind of investment (Czarnitzki & Hottenrott, 2011). Therefore, many governments create and implement various public policies that promote R&D investment in the business sector and thereby encourage companies to develop new knowledge, skills and innovation in order to facilitate their stronger competitiveness, job creation, and spur economic development.

The fundamental economic rationale for the government promotion of R&D activity chiefly relies on the existence of market failures (positive externalities, information asymmetries, uncertainty and risk), which make the extent of private R&D investment in the business sector less than what is socially desirable (Arrow, 1962). The main question is therefore whether public support for R&D investment can increase firms' R&D spending to a socially desirable level, thus bringing benefits for corporate performance as well. On the path from R&D public support to corporate performance, besides firms' R&D expenditures, it is how they are treated in accounting that holds important implications. Namely, the accounting treatment of R&D expenditure is often considered a tool for use in earnings management (Markarian et al., 2008). Accordingly, understanding how public support for R&D investment affects the way in which R&D expenditures are treated in accounting facilitates the analysis of corporate performance because it answers the question of potential earnings management. Moreover, R&D investment is often subject to high uncertainty and information asymmetry, casting doubt on their impact on corporate performance (Aboody & Lev, 2000; Moehrle & Walter, 2008). It is therefore crucial to examine the role of R&D spending in terms of corporate performance.

The overall objective of the doctoral dissertation is to investigate the role of public support for R&D investment in terms of its comprehensive economic and accounting implications for corporate performance. The primary research question hence concerns the impact of public support for R&D investment on corporate performance. Since R&D public policy instruments affect corporate performance indirectly via different channels, it is vital to

identify and understand the channels via which companies enhance their performance. Accordingly, firms' R&D expenditures and their accounting treatment, which can be impacted by different government support mechanisms, may be good representatives of the channels through which corporate performance is affected. On this basis it can be argued that firms' R&D expenditures together with their accounting treatment function as an intermediate phase on the overall path from public support instruments to corporate performance.

Contemporary governments around the world provide various R&D public policy mechanisms to stimulate a desirable level of investments in R&D activities. The most common instruments of public support for R&D investment are R&D subsidies as a way of direct funding and R&D tax incentives as a way of indirect funding. While R&D subsidies have been available to companies for some time, R&D tax incentives have gradually become an important form of public support for boosting firms' R&D spending in many countries (Busom et al., 2014). The main purpose of these public policy instruments is to overcome certain market failures and encourage companies to increase their R&D spending, which can consequently improve corporate performance. In the literature, one finds an ongoing debate on what is more effective for stimulating firms' R&D investment: R&D subsidies or R&D tax incentives? Yet there is no agreement on the issue because various results suggest different public policies and different solutions (Becker, 2015; Dimos & Pugh, 2016; IMF, 2016). In general, there appears to be a broad consensus that direct support through R&D subsidies is better suited to supporting long-term, high-risk R&D activities and for targeting specific areas that generate public goods or hold particularly large potential for spillovers. In contrast, indirect support via R&D tax incentives is better suited to encouraging R&D activities oriented to developing applications that can be introduced to the market in a reasonable period of time (OECD, 2016).

Regardless of the favourable effects of both forms of public support for R&D investment on firms' R&D expenditures, there is also a debate on their accounting treatment. Corporate performance is commonly measured with accounting measures provided by the financial statements and prepared in line with current accounting and tax legislation. One must thus recall that accounting and tax rules themselves or their loose provisions sometimes provide an environment for earnings management. This especially applies to R&D expenditures in connection with the existing accounting standards in the European Union (EU) and Slovenia since they allow a discretionary choice of the accounting treatment of R&D expenditures (Markarian et al., 2008). In this context, public support for R&D investment may be important by having crucial consequences in the form of promoting value-relevant accounting policy decisions (Anagnostopoulou & Ballas, 2014).

Since R&D investment is often considered to be highly uncertain and a major contributor to information asymmetry, there is another debate underway on whether such investment actually improves corporate performance (Aboody & Lev, 2000; Moehrle & Walter, 2008). The literature to date does not provide clear conclusions on this issue. This is particularly

due to the differences between individual economies, including their business environment and institutional background.

In order to facilitate understanding of the above complex issues, a systematic, in-depth and comprehensive insight into the topic is needed. Therefore, the doctoral dissertation integrates the following elements in an original way so as to address: 1) the complex issues surrounding R&D public policy and private R&D investment; 2) the accounting perspective on the relationship between R&D public policy and firms' R&D accounting policy; and 3) the ambiguous relationship between R&D expenditures and corporate performance. The integration of different yet complementary elements makes the study presented in the doctoral dissertation distinct in comparison with the current economic and accounting literature. The study is described in three interrelated chapters.

The first chapter investigates the impact of public support for R&D investment on firms' R&D spending and relies on the most common theoretical justification of governments promoting private R&D investment. That is, the existence of market failures (positive externalities, information asymmetries, uncertainty and risk) leads to a situation where the level of private R&D investment is less than socially desirable (Arrow, 1962). The aforementioned represents the main rationale for why governments should encourage firms to make R&D expenditures. This can be achieved by introducing suitable public policy instruments that help cut the cost to the public of riskier but socially valuable R&D investment. Accordingly, many modern governments provide different public policy instruments to stimulate private R&D expenditure in the business sector, whereby the major public R&D policies are R&D subsidies and R&D tax incentives. However, the public financial pressures arising from the high-debt/low-growth combination in the recent financial crisis coupled with economic austerity have stimulated the debate on the efficiency of different forms of public support for R&D investment.

The main aim of the first chapter is therefore to answer the primary research question of whether different public policy instruments for R&D investment stimulate firms' R&D spending. Namely, Slovenia may be seen as a natural environment for evaluating the impact of different forms of public support for R&D investment on firms' R&D expenditures since both of these public policy instruments are currently available to Slovenian companies. This chapter therefore complements the existing empirical studies because the vast majority of them consider only a single public policy instrument, i.e. R&D subsidies or R&D tax incentives. Given that governments in many modern economies provide both direct and indirect public support for R&D investment, estimates that do not consider the simultaneous impact of both public policy instruments might be biased. Moreover, empirical studies often focus on advanced or large economies, typically leaving smaller ones overlooked. Similarly, many studies consider in their empirical analysis only larger and listed companies, while smaller and non-listed ones remain without sufficient attention.

Since two different instruments of public support for R&D investment are available in Slovenia, two different research hypotheses are developed. The first research hypothesis concerns R&D subsidies, which are considered as direct public support for R&D investment. In general, it is expected that R&D subsidies should enhance firms' R&D expenditures. Yet the specific nature of R&D subsidies in terms of eligibility, magnitude, certainty and timing may hold important implications for their effectiveness. Given this discussion, the following research hypothesis is proposed:

- **Hypothesis 1.1:** *Direct public support for R&D investment in the form of R&D subsidies stimulates R&D expenditures, with its specific nature making it less effective as an instrument of indirect public support in the form of R&D tax incentives.*

Another important instrument of public support for R&D investment is R&D tax incentives, which are regarded as indirect support for R&D investment. Like with the case of R&D subsidies, R&D tax incentives are often expected to have a beneficial effect on firms' R&D expenditures. However, due to the broader or more general nature of R&D tax incentives it can also be expected that they are an effective instrument for a wider population of companies. According to this discussion, the following research hypothesis is proposed:

- **Hypothesis 1.2:** *Indirect public support for R&D investment in the form of R&D tax incentives stimulates R&D expenditures with its general nature making it an effective instrument for a wider population of companies.*

The second chapter examines the impact of public support for R&D investment on the accounting treatment of R&D expenditures. It is based on the Positive Accounting theory which states managers hold discretionary power to choose the accounting and valuation methods. The methods can be chosen for either the purposes of pursuing their own interest or for corporate performance. This theory was developed by Watts and Zimmerman (1986) and represents an early attempt to empirically explain companies' accounting practices. In this theory, the accounting methods companies adopt are systematically related to their specific characteristics. Due to the potentially opportunistic behaviour of managers in companies, this theory can help to predict and understand which accounting method a company will adopt. As a result, this chapter considers public support for R&D investment as a possible determinant of R&D accounting treatment given that public policies are often perceived to be one of the main drivers of companies' business decisions (National Research Council, 2005). This also refers to the decisions made with respect to companies' accounting policy since they believe that the information provided in the financial statements can affect the perception and decision-making of companies' external stakeholders (Tzovas, 2006).

Therefore, the prime aim of the second chapter is to answer the central research question of how public support for R&D investment influences the accounting treatment of R&D expenditures. The chapter seeks to answer this question by illuminating issues that touch on

the accounting treatment of R&D expenditures through the perspective of the conflicting goals of profit maximisation and tax minimisation. Namely, Slovenia may be seen as a natural environment for evaluating the impact of public support for R&D investment on the accounting treatment of R&D expenditures since, according to the IFRS and SRS, both accounting methods (i.e. capitalisation and expensing) are available for Slovenian companies. Moreover, many existing empirical studies focus on economies considered to be advanced and large, while smaller economies have been largely neglected. Further, the vast majority of existing studies only considers larger and listed companies, thereby excluding smaller and non-listed ones. The aforementioned is especially the case in the accounting literature.

Therefore, two different research hypotheses are developed. The first research hypothesis only concerns whether companies which benefit from indirect public support for R&D investment in the form of R&D tax incentives are more inclined to capitalise their R&D expenditures. Since companies which apply for R&D tax incentives have a generally lower effective tax rate, it is expected that they are more inclined to treat R&D expenditures as intangible assets on the balance sheet. Accordingly, the following research hypothesis is proposed:

- **Hypothesis 2.1:** *The beneficiaries of indirect public support for R&D investment in the form of R&D tax incentives are more likely to treat R&D expenditures as intangible assets on the balance sheet.*

In addition to the use of R&D tax incentives, their extent may also hold important implications for the accounting treatment of R&D expenditures. Namely, companies which benefit from higher R&D tax incentives have a much lower effective tax rate than their counterparts. It is thus expected that the extent of R&D tax incentives may have important consequences for companies' decision on the accounting treatment of their R&D expenditures. The following research hypothesis is thus proposed:

- **Hypothesis 2.2:** *The extent of indirect public support for R&D investment in the form of R&D tax incentives positively impacts companies' decision to treat R&D expenditures as intangible assets on the balance sheet.*

The third chapter investigates the impact of R&D spending on corporate performance. It is based on the following theoretical foundations. According to the Resource-based theory, companies possess strategic resources that provide them with an exceptional opportunity to develop competitive advantages over their competitors (Barney, 1991; Penrose, 1959). This implies that investment activity should be one of the most important activities because it is central to the functioning of any company. In this context, the Knowledge-based theory considers R&D investment as the most critical and a unique resource of the company (Grant, 1996). This promotes the role of R&D investment in creating competitive advantage and improving operating performance. Finally, the Efficient Market theory, which assumes

perfect information in the marketplace, is a theoretical foundation for explaining the relationship between companies' investment activity and their market performance (Malkiel & Fama, 1970).

Accordingly, the aim of the third chapter is to answer the primary research question of how R&D expenditures influence corporate performance. In this setting, this chapter tries to empirically verify whether the conflicting results observed in the existing literature reflect the fact that the impact of R&D expenditures depends on: 1) different measurements of corporate performance; 2) different characteristics of companies; and 3) different economy-specific legal framework and financial environments. For these purposes, an empirical analysis is performed on a sample of Slovenian companies by utilising different indicators for operating performance. Further, an additional empirical analysis is performed on a sample of world R&D companies, i.e. companies heavily investing in R&D and operating in the EU, the USA, China and Japan, in order to reconfirm the results and to obtain additional insights in terms of market performance. Moreover, the use of two different datasets allows the factors associated with different characteristics of companies and economies to be isolated, which may have important implications for corporate performance. Finally, the utilisation of the two databases provides a unique opportunity to discover comprehensive and relevant findings and implications of R&D expenditures with regard to corporate performance from the perspective of operating and market performance.

Therefore, two different research hypotheses are developed in the context of the third chapter. As concerns the relationship between R&D spending and operating performance, it is established a considerable lag effect appears between R&D spending and operating performance. This implies that R&D expenditures made in the current period are effective in the long term rather than in the short term (Asthana & Zhang, 2006). According to this discussion, the following research hypothesis is proposed:

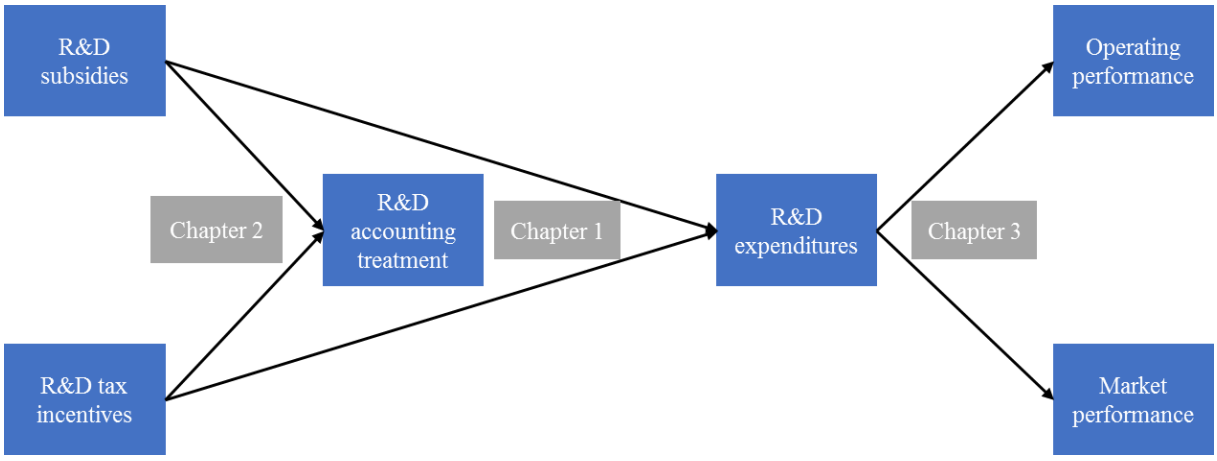
- **Hypothesis 3.1:** *R&D expenditures deteriorate the current operating performance and improve the future operating performance.*

Moreover, the second research hypothesis covers the implications R&D expenditures have for market performance. Generally, it is established that R&D expenditures have a negative impact on corporate performance in the short term (operating performance) and a positive one in the long run (market performance) (Vithnessonthi & Racela, 2016). Namely, R&D investment is often considered as a long-term investment in different R&D projects that are usually estimated to have a positive net present value. In the short run, the cash flows associated with R&D projects are negative and consequently harm corporate performance in profitability terms. Yet, in the long term, assuming that the R&D projects' expected net present values are positive, R&D investment should increase market value. Further, competitive companies with innovative products, processes and services can attract investors' attention and increase their market share (Usman et al., 2017). In line with this discussion, the following research hypothesis is proposed:

- **Hypothesis 3.2:** *R&D expenditures improve the current and future market performance.*

The relationships between the research topics covered in the three interrelated chapters may be summarised, as presented in Figure 1. The first chapter examines the impact of public support for R&D investment on firms' R&D spending in Slovenia. It investigates whether different public policy instruments for R&D investment stimulate firms' R&D expenditures in Slovenia. The second chapter looks at how public support for R&D investment influences the accounting treatment of R&D expenditures. Finally, the third chapter explores how R&D expenditures influence the operating and market corporate performance in Slovenia and beyond.

Figure 1: Graphical presentation of the relationships among the research topics



Source: Own presentation.

Data and research methods

Throughout the doctoral dissertation, the role of public support for R&D investment and its comprehensive economic and accounting implications affecting corporate performance is examined by using different datasets and applying different methodological approaches. The aforementioned varies depending on the chapter or research question. Nevertheless, in the empirical analysis it is ensured that the research sample and research methods are relevant to a certain chapter.

In all three chapters, a comprehensive empirical analysis is performed on a unique dataset of Slovenian companies. The dataset is obtained from three main different sources provided by the Statistical Office of the Republic of Slovenia (SORS). The first source refers to the database containing information on the R&D activity of Slovenian companies. It covers all companies that are: 1) registered for performing R&D activity (NACE 72 classification) and have more than two employees; 2) not registered for performing R&D activity but are recipients of R&D subsidies; 3) eligible for general and regional R&D tax incentives; and

4) reporting about R&D investments in a survey on innovation activity (SORS, 2018). It provides crucial and wide-ranging data regarding R&D activity in a certain company. The second source provides data from corporation tax forms. It includes all relevant data on a company's tax status, including the use of R&D tax incentives. Finally, the third source gives data from the financial statements of companies, including data from the balance sheet and income statement. All three data sources are merged to form a unique and comprehensive dataset of Slovenian companies. Further, the nature of the empirical analysis requires a research period that encompasses stable operating conditions. The research period for the sample of Slovenian companies is therefore restricted to the five-year period 2012–2016 in all chapters.

In order to confirm the empirical results obtained for the Slovenian sample of companies and establish additional insights, the empirical analysis in the third chapter is extended to companies operating in major world economies, namely, the EU, the USA, China and Japan. The dataset for world R&D companies comes from the EU Industrial R&D Investment Scoreboard 2017 and 2018, which provides economic and financial information on the top R&D corporate investors extracted directly from companies' annual reports for the three-year period 2015–2017 (European Commission 2017, 2018). The EU Industrial R&D Investment Scoreboard actually provides two datasets, with the first including 2,500 companies at the world level and the second covering 1,000 companies at the EU level. Since there is some overlap between these two data sources, they are both combined into a single dataset by eliminating overlapping companies. Due to some missing relevant information for companies in the previous years, the research period for the sample of world R&D companies is restricted to the three-year period 2015–2017.

As regards research methods, two main methodological approaches are employed in the doctoral dissertation. The first methodological approach is multiple regression analysis. However, regression models can be estimated using different econometric specifications. There are generally three main different alternative econometric specifications of regression models for panel data, namely the pooled regression model, the random effects model and the fixed effects model. First, by gathering together all of the observations, pooled OLS regression overlooks the data's cross-section and time-series nature and, by grouping the observations, heterogeneity bias may arise. The random effects model assumes the individual-specific effect or variation among entities is a random variable and thus uncorrelated with the model's independent variables. Third, the fixed effects model controls for all time-invariant differences across entities, implying the omitted time-invariant characteristics mean the coefficients of fixed effects models are unable to be biased. One key difference between random and fixed effects is whether the unobserved individual effect encompasses elements which are correlated with the model regressors (Greene, 2008; Nwakuya & Ijomah, 2017; Torres-Reyna, 2007).

In order to determine statistically which econometric specification is most suitable for the data used in the empirical analysis, a three-step procedure is applied. First, the LM test is

used in order to decide between the random effects and the pooled regression models. Second, the F test is applied to compare the pooled regression and fixed effects models. Third, the Hausman test is conducted to choose between a random effects and a fixed effects model (Hausman, 1978). Homoscedastic regression disturbances including the same variance across individuals are assumed by standard panel regression models where, because company sizes entail vast differences, the assumption is restrictive for company-level panel data(Lee, 2018). A serious consequence of heteroscedasticity is seen in the bias of standard errors. Since standard errors represent a central parameter for conducting significance tests, their bias leads to inappropriate statistical inferences (Washington et al., 2010). In order to check the presence of heteroscedasticity, a modified Wald test for groupwise heteroscedasticity is performed (Baum, 2001). Given that the results of a modified Wald test show a positive sign for all multiple regression models ($P < 0.001$), the heteroscedasticity-robust (White) standard errors are employed in the multiple regression models so as to alleviate the heteroscedasticity problem. This methodological approach is employed in the first and third chapters of this doctoral dissertation.

The second methodological approach is logistic regression analysis. Namely, when the outcome variable is discrete, binary choice models such as logistic regression models are among the most frequently used statistical techniques (Hosmer et al., 2013). For the purposes of evaluating the probability of companies' membership in a certain group, a binary logistic regression analysis uses the maximum likelihood estimation. Moreover, a binary logistic regression analysis does not assume normality, linearity or homoscedasticity, thereby making this research method more attractive (Starkweather & Moske, 2011). The reasons for using a logistic regression model in the empirical analysis are accordingly as follows: 1) it allows easier interpretation of the empirical results; 2) it allows the characteristics of two groups of companies to be compared; and 3) it removes deficiencies in dealing with outliers (Lee, 2019). This methodological approach is employed in the second chapter of this dissertation.

Scientific contribution and practical implications of the research

The doctoral dissertation addresses several economic and accounting issues related to the relationship between public support for R&D investment and corporate performance. Given that the area of R&D concerns different economic and accounting aspects, a single theoretical field is often incapable of resolving certain essential problems. This limitation calls for the use of new, innovative and interdisciplinary approaches to obtain a broader view of the area of R&D. Therefore, the doctoral dissertation includes, combines and draws knowledge from many different theoretical fields. Aspects of public, business and financial economics along with accounting aspects are synthesised in a logical and reasonable manner to enable understanding of both the connections between various areas and the research topic over and beyond the boundaries of these distinct areas. This constitutes a new, innovative

and interdisciplinary approach, one mostly neglected in the literature and thereby represents the overall value added of the doctoral dissertation.

R&D is a contemporary research topic, as also reflected in the literature that addresses this topic from the perspective of individual different theoretical fields. Yet, the area of R&D is still subject to many ambiguities, especially due to the lack of an interdisciplinary approach, which would in turn offer an exceptional opportunity for further in-depth examination of this research topic. Thus, the comprehensive and systematic research presented throughout the doctoral dissertation provides several novelties, scientific contributions as well as practical implications.

The biggest novelty of this dissertation stems from the ability to examine the wide-ranging effects of two main policy instruments for promoting R&D investment in one country simultaneously, namely R&D subsidies and R&D tax incentives. This is potentially very important since many companies often do not only benefit from a single instrument of public support for R&D investment. There is also no simple answer to the question of what is more effective because the different results suggest different public policies and different solutions. The doctoral dissertation therefore seeks to address the issues presented regarding the relationship between public support for R&D investment and firms' R&D spending.

Moreover, besides the economic perspective, the doctoral dissertation incorporates the accounting perspective. Namely, public policy instruments may hold important consequences for not only for companies' investment patterns but also their accounting policy. In this context, the dissertation helps understand the determinants driving the R&D accounting treatment decision with an emphasis on public support for R&D expenditures. The doctoral dissertation accordingly aims for a deep understanding of the relationship between R&D public policy and companies' accounting policy.

Another important contribution of the dissertation is its examination of the impact of overall R&D expenditures on corporate performance from the perspective of operating and market performance by considering two completely different data sources covering Slovenian and world R&D companies. In the context of the relationship between R&D expenditures and corporate performance, time lag is also considered. Therefore, the dissertation tries to examine the path from R&D spending to current and future corporate performance and to establish whether Slovenian companies are distinct from world R&D companies with respect to the relationship between R&D expenditures and corporate performance.

In the broader sense, the doctoral dissertation mainly focuses on Slovenia, which is a small open economy characterised by a bank-driven financial system, high book-tax conformity, and a high proportion of smaller and non-listed companies. Such characteristics make the Slovenian business environment quite different from other Western economies, which are characterised by a market-driven financial system, low book-tax conformity and have a bigger proportion of large and listed companies. In this setting, one overall contribution

made by the doctoral dissertation is the utilisation of a unique and comprehensive database for Slovenian companies created by merging different data sources. This database for Slovenia has not yet been analysed, bringing an exceptional opportunity to gain additional insights into the impact of public support for R&D investment and the impact on corporate performance. Briefly, the combination of two contemporaneous R&D policy instruments, the incorporation of both the economic and accounting perspectives, the consideration of the implications of R&D expenditures on different aspects of current and future corporate performance, the focus on specific characteristics of the Slovenian business environment together with the uniqueness and extensiveness of the database for Slovenian companies and world R&D companies all make the doctoral dissertation unique with respect to the existing economic and accounting literature.

The comprehensive and systematic research covered in this dissertation aims to add to the general economic and accounting literature by providing some new and attractive empirical evidence for Slovenia and beyond. In terms of the results obtained, the research contributes to both academic and practical knowledge. From the academic perspective, the research provides additional empirical support for the main theoretical foundations and may be seen as an important contribution to existing empirical studies and thus to the ongoing debate on the role of public support for R&D investment at the company level. From the practical perspective, the research gives some in-depth insights into the relationship between public support for R&D investment and corporate performance, which are useful for different stakeholders like policymakers, accounting-standard setters, managers and investors. In general, the empirical evidence may help illuminate certain ambiguities related to public support for R&D investment, its impact on R&D expenditures and the way in which they are treated in accounting as well as the overall implications for corporate performance.

Structure of the research

The doctoral dissertation is systematically structured in the form of three interrelated main chapters, preceded by an introduction and discussed in the conclusion. The introductory part covers the purpose and objective of the research covered by the doctoral dissertation, where the broad research topic is presented along with the main research hypotheses. This part also describes the data used and research methods applied as well as the expected scientific contribution and practical implications of the research. In the continuation of the dissertation, each chapter introduces its own research topic and addresses it in a systematic, in-depth and comprehensive way. The first chapter investigates the impact of public support for R&D investment on firms' R&D spending. Further, the second chapter examines the impact of public support for R&D investment on the accounting treatment of R&D expenditures. Finally, the third chapter investigates the impact of R&D expenditures on corporate performance. The doctoral dissertation ends by presenting the conclusion where the main findings, policy recommendations and practical implications as well as limitations and further research are summarised.

1 THE IMPACT OF PUBLIC SUPPORT FOR R&D INVESTMENT ON FIRMS' R&D EXPENDITURES

1.1 Introduction

The global economy is currently facing new challenges associated with globalisation, the emergence of new technologies, and the transition to a knowledge-based economy. This has resulted in fast-growing markets with ever tougher global competition that is forcing companies to provide value-added products, processes and services. This has also affected companies' investment structure and the importance of certain types of investment (Ahuja, 2011). This explains why the role of R&D investment is becoming increasingly important since it is often seen as the key driver of innovative outcomes and keeping a competitive position in the market. R&D investment therefore is an important factor in the long-term viability of modern companies, especially in the conditions of an ever-changing business environment.

Accordingly, companies should today be motivated for R&D investment in order to develop their competitive advantages. This is emphasised in the Knowledge-based theory, which views R&D investment as the most critical and unique resource of the company (Grant, 1996). In this context, the role of the government is also stressed since it can affect the investment structure of companies by introducing certain policies. This is especially important for R&D investment, widely recognised as the main driver of competitiveness on the company and national levels. Government awareness of the beneficial effects of R&D investment has triggered the development and implementation of various public policy instruments aimed at stimulating private R&D spending in the business sector.

The theory provides a good justification for the government promotion of private R&D investment by pointing to the existence of market failures (positive externalities, information asymmetries, uncertainty and risk), leading to a situation where the level of private R&D investment is lower than the socially desirable level (Arrow, 1962). The aforementioned gives the primary rationale of why governments should encourage firms' R&D expenditures. This can be achieved by introducing suitable public policy instruments, which may help cut the cost of riskier yet still socially valuable R&D investment. Accordingly, many modern governments provide different public policy instruments to stimulating private R&D expenditure in the business sector, with the biggest public R&D policies being R&D subsidies and R&D tax incentives. Yet, the public financial pressure created from the high-debt/low-growth combination in the recent financial crisis and the economic austerity have brought forward the debate on the efficiency of various forms of public support for R&D investment.

Increasing interest in the efficiency of public support for R&D investment saw the emergence in the literature of several different empirical studies trying to establish the

relationship between various instruments of public R&D support and firms' R&D expenditures. Empirical studies addressing R&D subsidies reveal they have a beneficial effect by stimulating firms' R&D expenditures. Similar findings concerning R&D tax incentives have also emerged. Some rare empirical studies addressing both forms of public support for R&D investment show the simultaneous use of both public policy instruments is more effective than using just one instrument (Bérubé and Mohnen, 2009). Moreover, it is also established that R&D tax incentives are often more effective than R&D subsidies (Carboni, 2011). On the contrary, for the case of SMEs it is argued that R&D subsidies are more effective than R&D tax incentives (Radas et al., 2015).

This chapter therefore aims to answer the main research question of whether different public policy instruments for R&D investment stimulate firms' R&D spending. Namely, Slovenia may be seen as a natural environment for evaluating the impact of different forms of public support for R&D investment on firms' R&D expenditures since both of these public policy instruments are currently available to Slovenian companies. The chapter therefore complements existing empirical studies because the vast majority of them consider only a single public policy instrument, i.e. R&D subsidies or R&D tax incentives. Since governments in many modern economies provide both direct and indirect public support for R&D investment, estimates that do not consider the simultaneous impact of both public policy instruments may easily be biased. That is to say, companies often benefit from different R&D public policy instruments at the same time, implying the combination of these two instruments can also hold important implications for firms' R&D expenditures. Moreover, many empirical studies focus on advanced or large economies, leaving smaller ones generally neglected. Similarly, many studies consider in their empirical analysis only larger and listed companies and overlook smaller and non-listed ones.

Accordingly, this chapter makes several contributions. First, it examines the impact of both public policy instruments on firms' R&D spending. There is namely no unequivocal answer to the question of what is more effective because different results suggest different public policies and different solutions. Second, it presents an empirical study for Slovenia, a small open economy. Smaller countries are often characterised by different properties than larger ones, especially in their financial systems. Finally, it examines the relationship between public support for R&D investment and firms' R&D expenditures on a sample of chiefly smaller and non-listed companies given that smaller and non-listed companies often have different needs in funding their business activities than larger and listed ones. The mentioned contributions make this study unique in the economic literature.

In terms of the expected results, this study adds to theoretical and practical knowledge. Theoretically, this study provides further empirical support for the theoretical rationale for government intervention in the context of private R&D investment in the business sector. Practically, the study results may in particular benefit governments or policymakers that, like in Slovenia, face various challenges in supporting smaller and non-listed companies in small open economies.

This chapter is structured as follows. The second section describes the theoretical definition and overview of R&D activity in selected economies. In the third section, recent trends of public support for R&D investment are presented, whereas the fourth section addresses the theoretical considerations and literature review. In the fifth section, data and research methods are set out. The sixth section provides the empirical results. At the end, a discussion unfolds while the implications are summarised.

1.2 Theoretical definition and overview of R&D activity in selected economies

1.2.1 Theoretical definition of R&D activity

The universal source concerning the definition of R&D activity refers to the OECD Frascati Manual, as also recognised by the economic literature (Djellal et al., 2003). Accordingly, R&D activity covers work that is creative and systematically engaged in with the goal of improving the stock of knowledge, including what is known about humankind, culture and society, and where that knowledge is made available for use to establish novel applications. Given this general definition of R&D activity, it is difficult to separate R&D from other activities. The fundamental criterion for identifying R&D activities and distinguishing them from other related activities refers to the possibility to present a substantial novelty and the ability to resolve scientific and technological uncertainties. Yet some general guidelines exist which may help determine whether a particular activity is an R&D activity or not. To be classed as an R&D activity, an activity must typically be novel, creative, uncertain, systematic, transferable and/or reproducible. The term R&D is very broad and covers three types of activity: basic research, applied research, and experimental development (OECD, 2015).

Basic research covers experimental or theoretical work conducted with the main aim of acquiring fresh knowledge concerning the basic fundaments of phenomena and observable facts, although no specific application or use in practice is provided. It concentrates on the analysis of properties, structures and relationships so as to formulate and test hypotheses, theories or laws. The fact that basic research does not provide any particular application view means the individual researcher is unaware of potential applications while conducting the research. Basic research is therefore not used for commercial purposes in the sense that its outputs in terms of the obtained results are not sold to third parties, but published in relevant scientific journals or circulated to other interested groups of individuals. The higher education sector and partly the government sector account for most of this research. Basic research can be performed to explore a general idea, coupled with the clear future goal of developing several applications. Besides the higher education and government sectors, the business sector may also be interested in conducting basic research despite the absence of any expected specific commercial applications in the near future. Although some companies, especially ones with short-term goals, may not be interested in basic research, some long-term-oriented companies also exist in the private sector that may be interested in such

research as they expect that it will bring certain benefits in the future. The abovementioned reveals some of the differences in basic research stem from whether it has a specific direction or not. Basic research can therefore be divided into pure basic research and oriented basic research. On one hand, pure basic research is conducted for the purposes of advancing knowledge, while the economic or social benefits are neglected and no attempt is made to use the results for resolving actual problems or to ensure that those in sectors likely to use them become aware of them. On the other hand, oriented basic research is conducted with the expectation of producing a wide knowledge base which is inclined to form the foundation of a solution to problems or possibilities recognised in the current period or expected in the future (OECD, 2015).

Applied research includes an original examination aimed at acquiring new knowledge. The primary characteristic arises from pursuing a specific and practical aim or objective. It can be undertaken in two distinct ways. The first refers to the determination of possible applications of the basic research findings, while the second relates to the identification of novel methods or ways of accomplishing specific and pre-set objectives. It takes into account the available knowledge and its possible extension for the purposes of resolving actual problems. The chief intention of the results obtained from the applied research is for them to be applicable in possible applications to products, operations, methods or systems. Applied research is concerned with giving ideas their operational form. Applications that are the outcome of applied research may be protected by various intellectual property instruments (OECD, 2015).

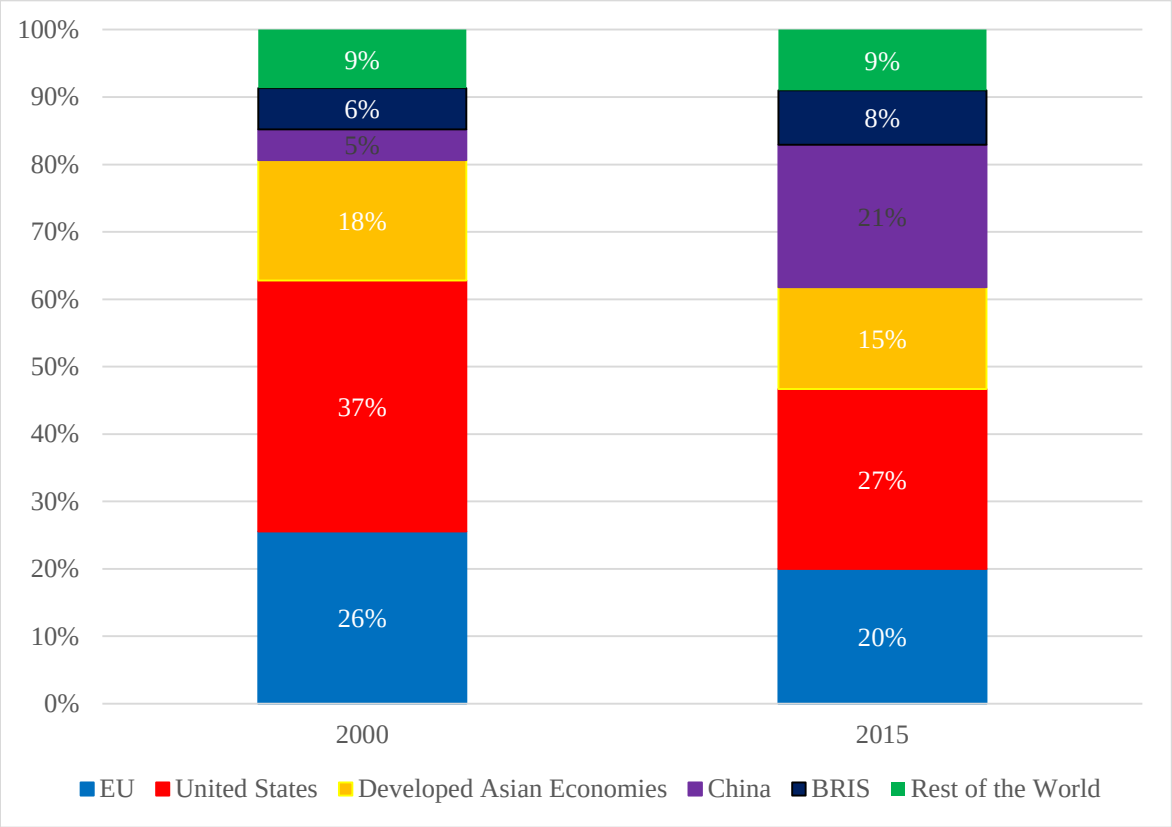
Experimental development refers to systematic work based on knowledge that flows from practical experience and research, and the creation of further knowledge arising from the basic impulse for creating products or processes or improving existing ones. The concept of experimental development is often confused with product development or pre-production development. The concept of product development represents the overall process comprising formulation of the idea through to commercialisation for the purposes of providing new products, goods or services to the market. In general, experimental development is often considered a possible phase in the process of product development. This refers to the phase when generic knowledge is put to the test with respect to particular applications, which is necessary for the successful completion of such a process. In the experimental development phase new knowledge is created, while this phase is completed as soon as the criteria for R&D activity (novelty, uncertainty, creativity, systematic, and transferability and/or reproducibility) no longer apply. The concept of pre-production development covers non-experimental work on certain products or systems prior to the start of the production phase. Since it is very difficult to distinguish between experimental and pre-production development, an engineering judgement is often needed to properly make the distinction (OECD, 2015).

1.2.2 Overview of R&D investment and related challenges in selected economies

In past decades, considerable changes have occurred in the pattern of economic growth in countries around the world. Recent improvements in productivity and employment are seen as part of a movement towards a knowledge-based economy in which R&D investments are widely accepted to be the main driver of long-term sustainable economic growth. In the last few years, many EU member states have pursued ambitious R&D policies aimed at fostering R&D spending with a view to greater competitiveness and economic growth. The EU recognised the importance of R&D investment already in 2000 by adopting the Lisbon Strategy in order to increase the European economy's competitiveness and set an ambitious objective of raising R&D spending to 3% of GDP by 2010. Accordingly, a substantial share of two-thirds of that total was to be financed by companies in the business sector. This objective reflected the widespread concern that the European economy is lagging behind two other Triad economies: the USA and Japan, mainly due to a shortage of R&D activity in the business sector (Uppenberg, 2009). Despite the efforts of many EU member states, the Lisbon Strategy objective of investing 3% of GDP in R&D was not achieved. Thus, this objective was restated in its successor called Europe 2020 strategy, which highlights the importance of R&D investment on the national level.

Total R&D expenditures on the global level have been on a rapid upward trend, having more than doubled since 2000 when they accounted for EUR 630 billion up until 2015 when they accounted for EUR 1,435 billion. Nevertheless, from the perspective of world R&D investment, there have always been some important economies or subgroups of different countries that have represented the biggest drivers of overall world R&D activity. In 2000, overall R&D activity was driven by the USA, the EU and developed Asian economies, which together represented 80.6% of world expenditure on R&D. However, the distribution of global R&D expenditures has changed dramatically especially due to the stronger role of globalisation in recent years. The share of world R&D expenditures rose significantly increased in China from 5% in 2000 to 21% in 2015, which elevated China as a major global R&D competitor. In the same period, the USA's share dropped by 10 percentage points from 37% to 27% while the EU's share fell 6 percentage points from 26% to 20%. The economic development of Asian developing countries, particularly China, has led to a more even distribution of world R&D expenditures. The distribution of total world R&D expenditures is presented in Figure 1.1.

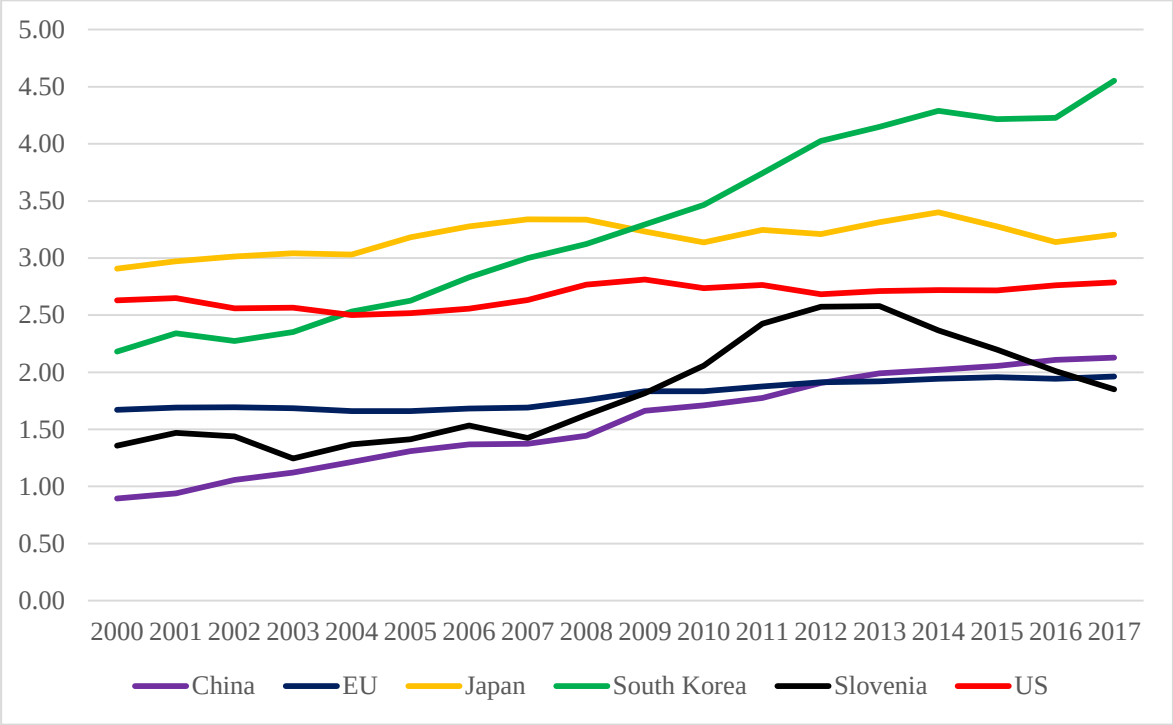
Figure 1.1: Distribution of total world R&D expenditures for 2000 and 2015 (in %)



Source: European Commission, 2018; own presentation.

As mentioned, in the past decade China has become a leading economy in terms of R&D spending. Figure 1.2 presents the evolution of R&D intensity in recent years, and shows that China's progress has been so rapid that it overtook the EU regarding R&D expenditures in both relative and absolute terms. In the 2000–2017 period, R&D intensity in China rose by 1.24 percentage points from 0.89% to 2.13%. Yet two other Asian countries recorded an increase in R&D expenditures: South Korea whose R&D intensity rose by 2.37 percentage points from 2.18% to 4.55%; and Japan whose R&D intensity grew by 0.30 of a percentage point from 2.91% to 3.2%. When taking other world economies into account, R&D intensity in the USA rose by 0.16 of a percentage point from 2.62% to 2.79% and in the EU it rose by 0.29 of a percentage point from 1.67% to 1.96%. Moreover, Slovenia also exhibits growth in R&D intensity because it rose by 0.50 of a percentage point from 1.36% to 1.85%. Interestingly, although Slovenia invests less in R&D activity than the average EU country and the USA, it exhibits a greater trend of growth when the whole period 2000–2017 is considered. Nevertheless, a comparison of the trends and evolution of R&D intensity between Eastern and Western economies reveals that R&D expenditures continue to move towards Eastern ones. Western economies such as the EU and the USA therefore face mounting pressure in terms of sustaining their positions as the prominent R&D players on the global level.

Figure 1.2: Evolution of R&D intensity for the period 2002–2016 (in % of GDP)



Note: R&D intensity is defined as gross domestic expenditure on R&D (GERD) as a % of gross domestic product (GDP). It includes expenditure on R&D by business enterprises, government, higher education institutions and private non-profit organisations.

Source: OECD, 2019; own presentation.

One cannot deny that the world is moving rapidly and economies around the world are thus encountering various long-term challenges related to globalisation, growing international competitiveness, pressure on resources, and demographic problems. Apart from these challenges, a long period of economic and social progress has been lost due to the recent economic crisis that, in the process, revealed the structural deficiencies of certain economies. It is therefore important for the EU to pursue the Europe 2020 strategy. Namely, the main aim of pursuing this strategy is to lift the EU's competitiveness in the global market while also retaining the social values that are essential for EU citizens. In terms of pursuing a general objective, one may expect the EU to become the most competitive and dynamic economy in the world based on knowledge, thereby permitting the trading bloc to develop in a setting of sustainable economic growth while ensuring higher employment and greater social cohesion (Stec & Grzebyk, 2018). To achieve this objective, the EU emphasises the importance of R&D investment which should significantly contribute to the achievement of key priorities, thereby leading to the enhanced economic growth and competitiveness of the EU economy as a whole. By pursuing such strategies and similar ones, the EU could realise its endeavours to create economic dominance in the global market and compete with other global economies like the USA and Japan.

All of the mentioned challenges affecting selected world economies put a spotlight on the role of public support for R&D investment and open up numerous debates on its comprehensive economic and accounting implications for corporate performance. That is, by putting appropriate R&D public policy instruments in place, governments around the world can significantly improve the conditions for R&D investment and thereby pave the way in the desired direction of becoming a knowledge-based economy, as specifically emphasised in the EU's current development strategies.

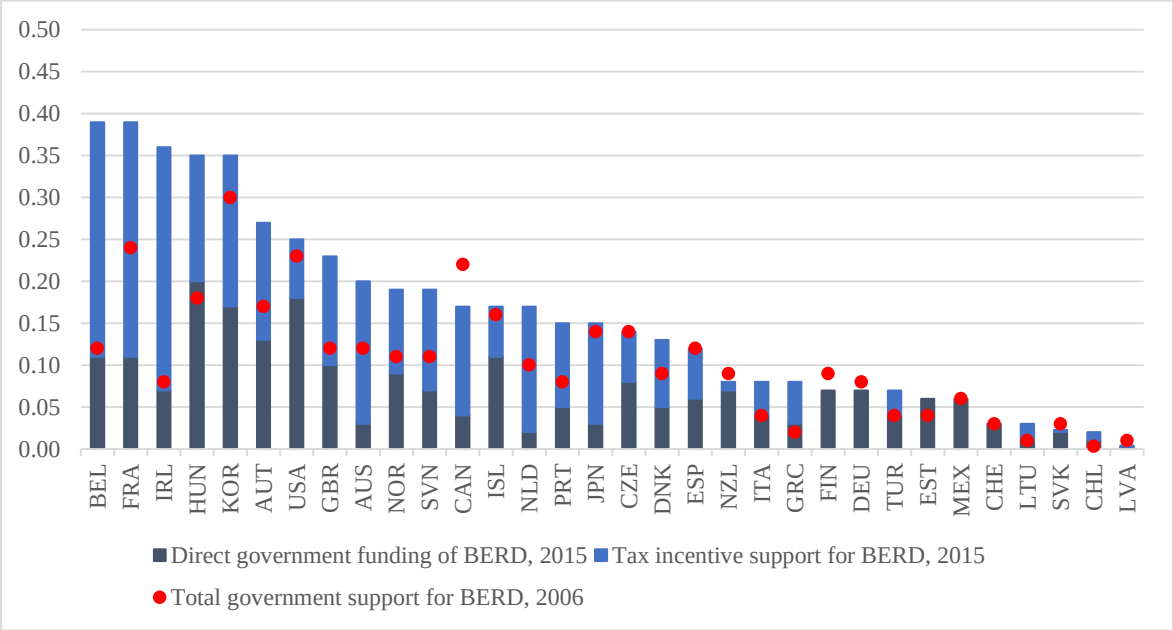
1.3 Public support for R&D investment

Many modern governments are aware of their role in promoting private R&D spending in the business sector. In general, governments establish many different regulations and policies with the aim to guide companies in a business environment within a certain country. Accordingly, the appropriate implementation of different forms of public support for R&D investment can significantly improve the conditions for R&D investment, eventually bringing benefits to companies and thus to national economies. Governments should therefore be able to identify what companies need regarding the funding of R&D activities and to detect the problems companies face. In this way, governments can design an R&D public policy that will suit the needs of companies and eventually yield optimal results.

1.3.1 Overview of public support for R&D investment in OECD countries

Governments in many countries around the world use different tools of public support in order to encourage companies to invest their surplus private funds in R&D activities. In addition to providing direct R&D support through R&D subsidies, many governments also incentivise firms' R&D expenditures indirectly through R&D tax incentives. While R&D subsidies have already been available to companies for a longer period, R&D tax incentives have gradually become an important form of public support for boosting firms' R&D expenditures in several countries (Busom et al., 2014). In this respect, Figure 1.3 presents the use of R&D subsidies and R&D tax incentives in the business sector for selected OECD countries for 2006 and 2015.

Figure 1.3: R&D subsidies and R&D tax incentives in the business sector for 2006 and 2015 (in % of GDP)



Note: 1) Data for business enterprise R&D expenditure (BERD) for Israel, Luxembourg, Poland and Sweden are unavailable or insufficient and these countries are therefore not included in the presentation. 1) Where data for 2006 or 2015 are unavailable, the nearest year is considered.

Source: OECD, 2017; own presentation.

Figure 1.3 reveals that Belgium and France provided the highest total public support for R&D investment in the business sector as a percentage of GDP in 2015 among the OECD countries presented. A comparison between 2006 and 2015 shows an increase in public support in 22 OECD countries with the biggest increase seen in Ireland and Belgium. Moreover, it is also evident that Hungary and the USA have the largest share of GDP for direct support, while Ireland and Belgium have the largest share of GDP for indirect support. In general, R&D tax incentives in 2015 accounted for nearly half of total government support for business R&D in the OECD area, up from one-third in 2006 (OECD, 2017). Considering the dynamic aspect of the development of both tools of public support for R&D investment, it is obvious there is a shift towards indirect public support through R&D tax incentives in OECD countries. This suggests that R&D tax incentives are gaining more importance and have become a major tool for promoting private R&D in the business sector in OECD countries.

1.3.2 Overview of public support for R&D investment in Slovenia

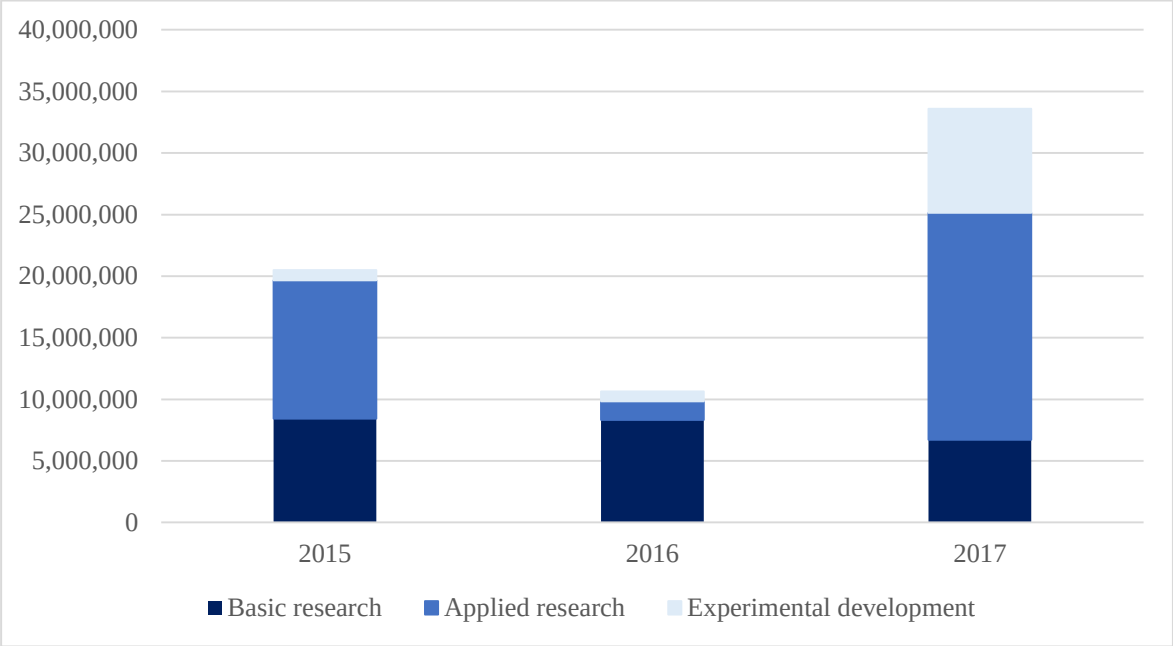
The Slovenian government attempts to promote R&D activities in the business sector and thus enhance its competitiveness by giving two different forms of public support for R&D investment. The first one refers to R&D subsidies as a form of direct public support, while

the second refers to R&D tax incentives as a form of indirect public support (Ravšelj & Aristovnik, 2017). While R&D subsidies have already been available to Slovenian companies for a longer period, R&D tax incentives represent a relatively new push for R&D activities of the Slovenian companies since they appeared in 2005. Nevertheless, the provision of both mentioned public policies to promote firms' R&D expenditures facilitates the performance of R&D activities in Slovenian companies (Deloitte, 2016a).

In Slovenia, R&D subsidies are defined in the Public Finance Act (Official Gazette of RS, No. 11/11 – official consolidated text, 14/13 – corr., 101/13, 55/15 – FISP, 96/15 – ZIPRS 1617 and 13/18), which entered into force in 2000. They are defined as expenditures and reduced revenue of the state or the municipality, which represents a benefit for recipients and thus provides them with an advantage over their competitors and are intended to finance and co-finance programmes in institutional units engaged in the market production of goods and services. In terms of providing R&D subsidies for the business sector in Slovenia, different Slovenian and EU institutions are responsible. The authority has different ministries, the Slovenian Research Agency (SRA), the Public Agency for Entrepreneurship, Internationalisation, Foreign Investments and Technology (SPIRIT), various local authorities etc. Companies can also obtain R&D subsidies from the resources of foreign governments as well as from various EU institutions like the European Commission.

In general, public support for R&D investment in the form of R&D subsidies may be available for three different categories, namely basic research, applied research or experimental development. Considered altogether, EUR 10.65 million or 3% of the total public support granted in Slovenia was allocated to stimulate private R&D expenditures in the business sector in Slovenia for 2016. However, this figure follows the negative trend from previous years because the amount of R&D subsidies in 2015 was EUR 20.49 million. In 2017, the trend of R&D subsidies turned upwards when they amounted to EUR 33.60 million. The increased volume of R&D subsidies may be attributed to the major disbursement of funds from the European Cohesion Policy programmes for the period 2014–2020. While R&D subsidies for applied research and experimental development have increased, R&D subsidies for basic research, which are largely funded by national funds, have slightly decreased (Ministry of Finance, 2017, 2018). R&D subsidy amounts by the type of R&D activity are shown in Figure 1.4.

Figure 1.4: Amount of R&D subsidies by type of R&D activity for the period 2015–2017 (in EUR)



Source: Ministry of Finance, 2018; own presentation.

Tax incentives for R&D investment represent another important instrument of public support and are primarily aimed at successful and profitable companies. By investing in R&D activities, which are in their nature risky and not fully predictable, companies can reduce their tax liability. By doing so, the beneficiaries of R&D tax incentives can simultaneously achieve two beneficial effects, namely competitive advantage by investing a certain amount of funds in R&D activities and a tax-base reduction for the same amount. R&D tax incentives were introduced in Slovenia in order to pursue the Lisbon Strategy objective of investing in R&D activities and thereby to improve the Slovenian economy's competitiveness and to attract foreign investors.

R&D tax incentives were introduced in Slovenia in 2005 when the then applicable Corporate Income Tax Act (Official Gazette of RS, Nos. 117/06, 56/08, 76/08, 5/09, 96/09, 110/09 – ZDavP-2B, 43/10, 59/11, 24/12, 30/12, 94/12, 81/13, 50/14, 23/15, 82/15, 68/16, 69/17 and 79/18) introduced a R&D tax allowance that allowed companies to deduct 10% of their expenditures on the acquisition of equipment for R&D. With an amendment to the Corporate Income Tax Act in 2006, a new substantially altered general R&D tax incentive was introduced to replace the then existing R&D allowance, which referred only to an investment related to the acquisition of equipment for R&D.

Simultaneously with introducing a new R&D tax allowance, the Rules on claiming tax relief for investments in research and development (Official Gazette of RS, No. 75/12) were issued (the Rules). The Rules precisely determine the way of claiming R&D tax incentives, provide guidelines for identifying which R&D expenditures are eligible for R&D tax allowance, and

give the forms for specifying R&D expenditures that companies must submit as an annex to their tax return. The Rules also set out the criteria for separating R&D from other activities. According to the Rules, R&D investments subject to R&D tax allowance refer to internal and external R&D activities involving: 1) expenditures for internal R&D activity representing the costs incurred in R&D projects performed within the company, including the purchase of R&D equipment that is exclusively and permanently used in the implementation of R&D activities; and 2) investments in external R&D activity representing the purchase of R&D services provided by other companies.

The new general R&D tax allowance introduced in 2006 allows companies to deduct 20% of their expenditures made on internal and external R&D activity. There were no significant changes to the R&D tax incentives in Slovenia before 2010, when the percentage of R&D expenditures which can be deducted rose to 40%. The latest major change came in 2012 when a much higher R&D tax allowance was introduced and represented a deduction from the tax base of 100% of the amount invested in internal and external R&D activities. Moreover, during the period 2006–2012 companies located in less developed regions in the country were allowed to claim an additional so-called regional R&D tax allowance. Companies in regions where GDP per capita was up to 15% below the national average were allowed to additionally deduct 10% of the amount invested in R&D activity. On the other hand, companies located in regions where GDP per capita was more than 15% lower than the national average were allowed to additionally deduct 20% of the amount invested in R&D activity. This implied that the total rate of R&D tax allowance for companies located in certain less developed regions was 30% (20% + 10%) or 40% (20% + 20%) in the period 2006–2009 and 50% (40% + 10%) or 60% (40% + 20%) for the period 2010–2011. With the latest change to the R&D tax allowance rate to 100% in 2012, the regional R&D tax allowance was abolished. An overview of changes in R&D tax allowances and their rates is shown in Table 1.1.

Table 1.1: Overview of R&D tax allowance changes in Slovenia

Year	Type of R&D tax allowance		Total R&D tax allowance rate for companies in less developed regions
	General	Regional	
2005	10%	/	10%
2006	20%	10% or 20%	30% or 40%
2010	40%	10% or 20%	50% or 60%
2012	100%	/	100%

Source: Corporate Income Tax Act, 2018; own presentation.

Regardless of the type of R&D tax allowance (general or regional); companies may claim it only up to the amount of the tax base. In the case of an insufficient tax base, unused R&D tax allowances can be carried-forward for 5 years, whereby the tax base is first reduced by the unused part of R&D tax allowances from previous years. Therefore, although the regional R&D tax allowance was abolished in 2012, companies were able to benefit from their unused part up until 2016. Further, the current Corporate Income Tax Act states a

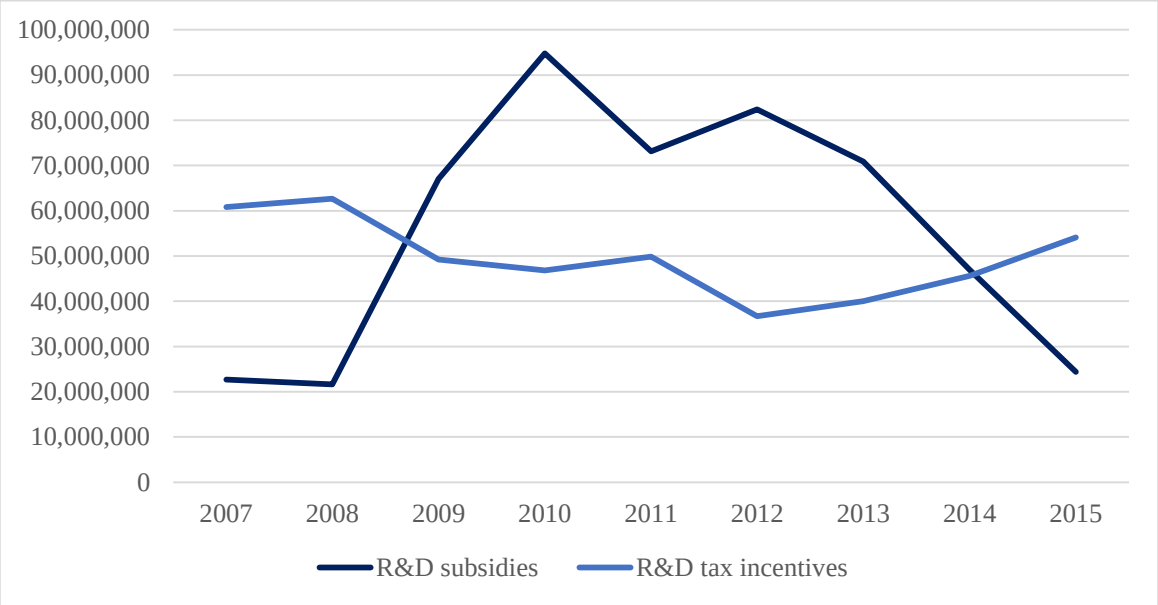
taxpayer cannot claim R&D tax allowances for R&D investment in the part financed from the budgets of local authorities, the Budget of the Republic of Slovenia, or the EU budget if these funds are non-refundable. Although there are also some cases of R&D investment being only partly financed from the aforementioned sources, the R&D tax allowance can be claimed only for this part, which is not financed from these sources.

In the past period, some radical changes were made to the field of R&D tax incentives in Slovenia. This refers especially to 2012 when companies were allowed to reduce their tax base by the total amount of their R&D-related expenditures, which ultimately led to a significant reduction of their tax liability. Since R&D investments are often subject to uncertainty, they are likely to bring certain risks into companies' business operations. In this sense, one can understand that the introduction of R&D tax incentives actually represents the transfer of the entire risk of R&D investment over to the government, which consequently should also encourage companies to invest in R&D activities.

However, in practice it can be observed that companies encounter some problems related to the claiming of R&D tax allowances. The first problem stems mainly from the fact that certain companies experience difficulties in defining R&D expenditures, especially those made within the company. Namely, companies are often not certain whether some of the activities they conduct meet the eligibility requirements for being classified as an R&D activity (Deloitte, 2016a). The next problem is the administrative barriers and bureaucracy related to R&D tax allowances. The Slovenian regulation prescribes that a project plan must be prepared up-front by the company that decides to claim an R&D tax allowance. In this context, practitioners observe that the preparation of all of the required documentation is often in the domain of the tax or finance department of the company (Deloitte 2015). Yet, it is often the case that accountants do not possess sufficient knowledge to be able to make the right judgements and decisions in this area and it is therefore recommended that here companies try to cooperate with internal or external experts (Ravšelj & Aristovnik, 2018a). This practice is well established in larger companies, especially in those with their own R&D departments. Problems arise particularly in smaller companies where preparing the documentation required to claim an R&D tax allowance is expected to be the task of accountants. Still, despite the current generosity of the R&D tax allowance, claiming it has become increasingly complex. Good insight into this area helps companies claim an R&D tax allowance without problems or to avoid possible inconveniences with the tax authority.

The Slovenian government provides public support for R&D investment in the forms of both R&D subsidies and R&D tax incentives. A comparison of these policy instruments over time reveals that they behave as substitutes. The trends of R&D subsidies and R&D tax incentives (presented in Figure 1.5) show that, when R&D subsidies are increasing, R&D tax incentives are decreasing and vice versa, namely, these two public policy instruments are mutually exclusive.

Figure 1.5: Comparison of the volume of R&D subsidies and R&D tax incentives in the period 2007–2015 (in EUR)



Note: The amount of R&D tax incentives is normalised since they were subject to significant changes over time.

Sources: Ministry of Finance, 2016; Financial Administration of the Republic of Slovenia 2016; Ravšelj & Aristovnik, 2017.

A comparison of R&D subsidies and R&D tax incentives shows that the total amount of R&D subsidies saw a steep decrease after 2012, while R&D tax incentives were increasing. The first reason is the fact that most support schemes expired and new ones had not yet been announced, which is associated with the presence of public financial pressures (Ministry of Finance, 2015; Ravšelj & Aristovnik, 2016, 2017). As mentioned, the situation is improving since the trend for R&D subsidies turned upward in 2017. The second reason refers to companies' familiarity with certain instruments of public support for R&D investment. Namely, Deloitte (2016b) observes that companies are more familiar with R&D tax incentives than with R&D subsidies. Recent data on R&D subsidies and R&D tax incentives nevertheless indicates that the Slovenian government is largely focused on providing favourable tax treatment for companies investing in R&D activities through R&D tax incentives.

1.4 Theoretical considerations and literature review

1.4.1 Theoretical foundations

The business environment is witnessing rapid changes in the market, caused by rapid economic growth and the greater competition experienced by companies. Moreover, these trends are nowadays becoming more obvious than in the past (Ahuja, 2011). This explains

why R&D activity is consequently gaining in importance in the context of companies retaining their competitive position in the market. Therefore, R&D expenditures represent an important determinant of the long-term viability of modern companies. That is, companies must continually improve their existing products, processes and services in order be sufficiently competitive and stay ahead of their competitors. These improvements may bring companies and eventually national economies certain benefits in the future. In this setting, public support for R&D investment may therefore be considered not only as an instrument for enhancing companies' competitiveness but also as an instrument for increasing the competitiveness of the overall economy (Radas et al., 2015). This is why stimulating private R&D investment in the business sector has always been considered an important goal of public policy.

According to the theory (see Figure 1.6), the main rationale for public support for R&D investment is often represented by the concept of market failure, typically considered to be the core reason for market inefficiency. In this context, market failure refers to the market underinvesting in private R&D, which implies that the level of private R&D investment is below the socially desirable level (Arrow, 1962). The reasons for such underinvestment stem from the existence of conditions that prevent companies from fully realising the benefits of their R&D investment (Link & Scott, 2013). The biggest market failures relevant to R&D activity relate to positive externalities, information asymmetry, and uncertainty and risk.

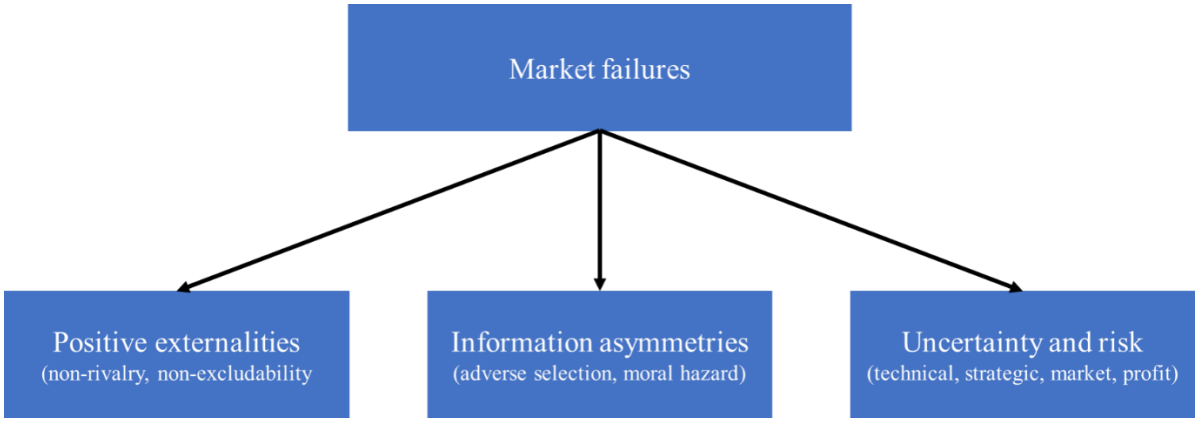
The first important market failure concerns positive externalities. Namely, R&D investments are often subject to considerable spillovers, implying it is relatively easy for other companies to take advantage of R&D investments they themselves do not make (Haskel & Westlake, 2018). Knowledge or ideas created by R&D activity are essentially a public good characterised by non-rivalry and non-excludability. On one hand, non-rivalry means the results of an R&D activity can be used by several entities at the same time at zero cost. On the other hand, non-excludability relates to the fact that it is almost impossible to exclude entities from using new knowledge or ideas created by the R&D activity once they have been supplied to certain other entities (Oosterbaan et al., 2000). Due to the existence of different legal intellectual protection mechanisms such as patents and copyrights, R&D investment may be considered to be partially non-excludable, whereby is it still very difficult for companies to fully protect all of the knowledge gained through R&D activity and to prevent other companies from using this knowledge. Summing up, the benefits of non-rival and (partially) non-excludable R&D investment are likely to spill over beyond the companies that make them. Therefore, where companies are unable to benefit fully from their own R&D investment and prevent their competitors from taking advantage of from spillovers, this will cause much lower private R&D investment than is socially desirable.

Another market failure refers to information asymmetry. In this context, one encounters two main obstacles to R&D financing which largely result from information asymmetries between borrowers/companies and lenders/financiers. These refer to adverse selection and moral hazard. The issue of adverse selection relates to hidden information. Namely,

financiers are often unable to objectively establish the successfulness of an R&D project since the companies performing R&D activities possess better information regarding a certain R&D project. Consequently, this implies that, on average, R&D projects offered for external finance are more likely to be less successful. In addition, the issue of moral hazard refers to hidden action. That is to say, companies might ex-post take on a higher level of risk than originally agreed with the financier and generate larger profits if a certain R&D project is successful. Yet, in this case, the financiers would bear the additional risk of bankruptcy (Bakker, 2013). The aforementioned issues of information asymmetry may therefore narrow the financial opportunities available for companies to perform R&D activities.

The third market failure is associated with uncertainty and risk, which together represent an important issue for R&D activity (Czarnitzki, 2006). In this perspective, four different types of uncertainty can be identified: technical, strategic, market and profit uncertainty. Technical uncertainty relates to the situation when companies are unsure whether R&D expenditures will lead to a useful and working innovation. Moreover, even if the opposite occurs, there is the question of whether this innovation is what was originally expected. Strategic uncertainty refers to the uncertainty that depends on the actions of one's competitors. Namely, companies often face the question of whether the competitors are doing similar R&D activities and, if so, whether the competitors are able to launch their product first on the market. Market uncertainty is related to uncertainty about whether the market of the innovation remains the same as it was expected to be when the particular R&D activity commenced. Finally, profit uncertainty refers to whether companies' business models are able to capture the benefits of R&D activity (Bakker, 2013). All of the above-mentioned uncertainty and risk perceptions may result in underinvesting in R&D.

Figure 1.6: The concept of market failure as the theoretical rationale for the government promotion of private R&D investment



Source: Own presentation.

Briefly, the existence of the above market failures cause market mechanisms to deteriorate as they fail to provide a socially desirable level of private R&D investment in the business sector. This implies that public support for R&D investment should play an important role

in addressing certain market failures since their appropriate introduction can help cut the cost of R&D investment. From a theoretical perspective, the main channel via which public support for R&D investment can affect companies' investment in R&D activities is the reduction of the user cost of the R&D investment, meaning that otherwise too expensive R&D activities are also performed (Bloom et al., 2002; Hud & Hussinger, 2015). This holds for both R&D subsidies and R&D tax incentives. On one hand, R&D subsidies lower the demand for funding through external sources, implying a lower cost of debt. This is then reflected in the lower overall cost of financing R&D activity (Takalo et al., 2013). On the other hand, R&D tax incentives reduce the cost of R&D activity by lowering the tax liability (Liu, 2013). Yet, the benefits of R&D tax incentives depend on the existence of a positive tax base, which is a necessary precondition to claim them (Bernstein, 1986).

Both forms of public support for R&D investment are provided in order to correct particular market failures. Direct public support through R&D subsidies is considered to be neutral from the perspective of the company's tax position. Generally, they are focused on R&D projects with a higher social rate of return. Thereby, R&D subsidies allow the government to maintain control over the desired type of R&D investment (Bérubé & Mohnen, 2009). Compared to R&D tax incentives, which are designed in such a way as to allow public support to be provided to a large population of companies, R&D subsidies are only given for specific R&D projects. On the contrary, indirect public support through R&D tax incentives is neutral in terms of companies' characteristics (Czarnitzki et al., 2011). This implies that it does not depend on the industry in which the beneficiaries of R&D tax incentives operate or on the nature of their business. Compared with R&D subsidies, R&D tax incentives do not allow governmental control over them. Companies will consequently first be motivated to finance those R&D projects that have a higher private rate of return (Hall & Van Reenen, 2000). Further, it is also established that direct public support in the form of R&D subsidies can be better measured than indirect public support in the form of R&D tax incentives (Bérubé & Mohnen, 2009). There is nevertheless still no clear agreement on which of these public policy instruments is more effective because various results suggest different public policies and different solutions (Becker, 2015; Dimos & Pugh, 2016; IMF, 2016).

Several ambiguities about the role of public support in R&D investment have triggered discussions in the academic and professional community that have led to different varieties of empirical studies that addressing either the effectiveness of R&D subsidies or the effectiveness of R&D tax incentives. One also finds some rare attempts in the literature that address the combined effect of both public policy instruments.

1.4.2 Literature addressing the effect of R&D subsidies

Many empirical studies in the economic literature try to examine the impact of R&D subsidies on firms' R&D expenditures, where the main concern is given over to the question

of whether R&D subsidies complement or substitute firms' R&D spending. Some empirical studies also emphasise the indirect effect of R&D subsidies in terms of enhancing corporate performance.

The empirical evidence from Germany shows that companies which received R&D subsidies on average exhibit higher R&D and innovation intensity than companies which did not benefit from such subsidies. The conclusions remain the same regardless of the sector, size and region in which companies operate (Almus & Czarnitzki, 2003; Czarnitzki & Fier, 2002; Hussinger, 2008; Czarnitzki & Delanote, 2015). A study performed on a sample of German small and medium-sized enterprises also reveals the overall positive effect of R&D subsidies on firms' R&D investment, with the impact of R&D subsidies being greater in the time before economic crisis than in the time of economic recovery. That is, the study provides evidence that a crowding-out effect appears in the middle of the crisis in 2009. Later, in 2010, when the German economy was in the recovery phase, the effect of R&D subsidies was positive but smaller than in the years prior to the crisis. The study attempts to explain the crowding-out effect in 2009 by investigating two potential causes, namely, countercyclical innovation policy and the different investment behaviour of R&D subsidies' beneficiaries. The empirical results reveal the temporary crowding-out effect seen during the crisis was due to the R&D subsidy beneficiaries' hesitant innovation investment behaviour more than the countercyclical innovation policy (Hud & Hussinger, 2015). Nevertheless, the unfavourable economic conditions have affected the efficiency of R&D subsidies. The aforementioned might be even worse in the presence of austerity measures, which most countries introduced during the recent crisis.

A study from Ireland shows that R&D subsidies increase firms' R&D spending only when granted in smaller amounts (up to EUR 55,000) while larger amounts of R&D subsidies (above EUR 55,000) may crowd out firms' R&D spending (Görg & Strobl, 2007). Regarding France, Duguet (2004) notes that, on average, R&D subsidies enhance R&D expenditures in companies, rejecting the crowding-out effect of R&D subsidies. A similar finding is also made for a sample of Spanish manufacturing companies (González et al., 2005; González & Pazó, 2008). Both of these empirical studies were performed in Spain and suggest that R&D subsidies do not crowd out firms' R&D expenditures. They also provide evidence that certain companies, especially small ones and those operating in low-technology sectors, may not perform R&D activities in the absence of R&D subsidies. A study by Kaiser (2006) performed on a sample of Danish companies from the manufacturing and service sectors that are involved in export activities reveals some evidence of the presence of a positive impact of R&D subsidies on private R&D intensity.

A cross-country comparison between certain EU member states (Belgium, Germany, Luxembourg and Spain) and the Republic of South Africa based on a sample of innovative companies operating in the manufacturing and service sectors reveals that non-subsidised companies would invest more in R&D activities if they were to receive an R&D subsidy (Czarnitzki & Lopes Bento, 2012). A recent study from China shows that receiving R&D

subsidies enhances firms' R&D spending in the manufacturing sector. Further, the study provides empirical evidence that although state-owned companies can obtain more R&D subsidies than privately-owned companies, the latter use them more efficiently. This implies that the impact of R&D subsidies on firms' R&D expenditures is stronger in private-owned companies than in state-owned companies (Jin et al., 2018).

In addition, a study by Bayona-Sáez and García-Marco (2010) examines the issue of taking part in a Europe-wide public initiative to bolster market-oriented R&D (the Eureka Programme) and whether it has a positive effect on the performance of the participating companies. Using a sample of European companies, the results show the programme participants achieve a better corporate performance compared with companies that did not participate in this programme. The comparison of different sectors also reveals that in the case of the manufacturing sector an increase in performance becomes observable after 1 year of completion of the R&D project, while for the non-manufacturing sector it becomes observable in the current year. Similarly, for a sample of Spanish companies Duch et al. (2007) establish that companies which benefited from R&D subsidies had changed their business practices and improved their performance.

Although recent studies performed in different countries with various institutional backgrounds tend to confirm the positive impact of R&D subsidies on firms' R&D expenditures and thus on their performance, one can find other studies that do not provide encouraging results with respect to R&D subsidization. In the context of the USA, Wallsten (2000) provides empirical evidence for publicly traded companies that R&D subsidies do not increase the R&D activities companies perform. The study suggests that R&D subsidies fully crowd out company-financed R&D spending. Similar results emerge from a study in Spain which shows there are some companies in the Spanish sample for which the full crowding-out effect of R&D subsidies can be confirmed (Busom, 2000). A study from Germany shows that, although R&D subsidies generally enhance companies' R&D expenditures, there is a crowding-out effect of R&D subsidies during economic crisis (Hud & Hussinger, 2015). A summary of the key literature addressing the effect of R&D subsidies is systematically presented in Table 1.2.

Table 1.2: Summary of the key literature on the effect of R&D subsidies

Authors	Countries	Findings
Almus and Czarnitzki (2003); Czarnitzki and Fier (2002); Hussinger (2008); Czarnitzki and Delanote (2015)	Germany	Recipients of R&D subsidies on average exhibit a higher R&D and innovation intensity regardless of the sector, size and region.
Hud and Hussinger (2015)	Germany	The impact of R&D subsidies is greater in the time before economic crisis than during the economic recovery.
Görg and Strobl (2007)	Ireland	R&D subsidies increase firms' R&D spending only when granted in smaller amounts while larger amounts of R&D subsidies may crowd out firms' R&D spending.
Duguet (2004)	France	R&D subsidies enhance R&D expenditures in companies, rejecting the crowding-out effect of R&D subsidies.
González et al. (2005); González & Pazó (2008)	Spain	R&D subsidies do not crowd out firms' R&D expenditures. Moreover, the evidence suggests that certain companies, especially small ones and those operating in low-technology sectors, might not perform R&D activities in the absence of R&D subsidies.
Kaiser (2006)	Denmark	R&D subsidies positively impact private R&D intensity.
Czarnitzki and Lopes Bento (2012)	EU member states (Belgium, Germany, Luxembourg and Spain) and the Republic of South Africa	Non-subsidised companies would invest more in R&D activities if they were to receive an R&D subsidy.
Jin et al. (2018)	China	The impact of R&D subsidies on firms' R&D expenditures is stronger in privately-owned companies than in state-owned companies.
Bayona-Sáez and García-Marco (2010)	EU countries	Participants of the Eureka programme achieve better corporate performance than companies which did not participate in this programme.
Duch et al. (2007)	Spain	Companies which benefited from R&D subsidies have changed their business practices and improved their performance.
Wallsten (2000)	USA	R&D subsidies do not increase the R&D activities performed by companies.
Busom (2000)	Spain	There are some companies in Spain for which the full crowding-out effect of R&D subsidies can be confirmed.
Hud and Hussinger (2015)	Germany	There is a crowding-out effect of R&D subsidies during economic crisis.

Source: Own presentation.

1.4.3 Literature on the effect of R&D tax incentives

Empirical studies addressing the relationship between R&D tax incentives and firms' R&D expenditures are relatively scarce. This may be explained from the perspective of data limitations since the data from corporation tax forms is often subject to confidentiality. Still,

the existing empirical studies try to examine the effect of R&D tax incentives on firms' R&D spending.

Czarnitzki et al. (2011) investigate the impact of R&D tax incentives on the innovation activities of Canadian companies. They establish that R&D tax incentives have a positive impact on firms' R&D expenditures, with their results also showing that R&D tax incentives increase the recipient companies' innovation output by leading to more product innovations and higher sales of products that are novel and improved. Further, they establish that companies which benefited from R&D tax credits are more likely to introduce genuine market novelties and thus have better performance indicators.

A recent study by Chen and Gupta (2017) looked at a sample of Taiwanese companies and gives empirical evidence that R&D tax incentives stimulate firms' incremental R&D spending. They establish that an increase in the level of R&D tax incentives has a positive impact on firms' R&D expenditures in high-tech companies that have a taxable status. Yet, the results are not encouraging for non-high-tech companies. These results suggest that R&D tax incentives may be effective only when companies have sufficient profitable innovation opportunities. Still, the results indicate that introduction of a more generous R&D tax incentive scheme increases companies' motivation to invest in R&D activities. In the Taiwanese context, Yang et al. (2012) examined the impact of R&D tax incentives on R&D activity in manufacturing companies. They established that the beneficiaries of R&D tax incentives achieve on average 53.80% higher R&D expenditures than they would have without R&D tax incentive benefits, while the growth rate of R&D expenditures is not significantly higher. Further, they found that R&D tax credits have a significantly positive impact on firms' R&D expenditures and their growth, notably in electronics companies. The marginal effect of R&D tax incentives is moderate, ranging from 0.094 to 0.120. They additionally found that R&D elasticity in relation to R&D tax incentives tends to grow gradually as the R&D tax incentives move closer to expiring.

Similar results are found in an empirical study by Kobayashi (2014) which examined the impact of R&D tax incentives on SMEs in Japan. He established that the use of R&D tax incentives leads to higher R&D expenditures in SMEs. The results also suggest that the effect of R&D tax incentives on private R&D expenditures is considerably higher in SMEs which face liquidity constraints than in unconstrained SMEs. In the setting of Japanese manufacturing companies, Koga (2003) looked at the effectiveness of R&D tax incentives. The results of the empirical analysis show that R&D tax incentives are effective for increasing R&D expenditures in companies. Yet, when the sample is divided by company size, the tax price elasticity is much higher in large companies than in smaller ones, suggesting that R&D tax credits are effective for boosting R&D investment especially in large companies. A summary of the key literature on the effect of R&D tax incentives is given in Table 1.3.

Table 1.3: Summary of the key literature on the effect of R&D subsidies

Authors	Countries	Findings
Czarnitzki et al. (2011)	Canada	R&D tax incentives positively impact firms' R&D expenditures. The results also suggest that R&D tax incentives increase the innovation output of the recipient companies.
Chen and Gupta (2017)	Taiwan	The level of R&D tax incentives has a positive impact on firms' R&D expenditures in high-tech companies that have a taxable status.
Yang et al. (2012)	Taiwan	Beneficiaries of R&D tax incentives on average achieve 53.80% higher R&D expenditures than they do without R&D tax incentive benefits.
Kobayashi (2014)	Japan	The use of R&D tax incentives leads to greater R&D expenditures in SMEs. The results also suggest the effect of R&D tax incentives on private R&D expenditures is considerably higher in SMEs that face liquidity constraints than in unconstrained SMEs.
Koga (2003)	Japan	R&D tax incentives are effective for increasing R&D expenditures in companies. This especially holds for large companies.

Source: Own presentation.

1.4.4 Literature on the joint effect of R&D subsidies and R&D tax incentives

Despite the extensive economic literature that deals with only R&D subsidies or R&D tax incentives at one time, empirical studies that simultaneously consider both instruments of public support for R&D investment are scarce. Nonetheless, some studies focus on how companies use R&D subsidies and R&D tax incentives at the same time by assessing the impact on firms' R&D expenditures (Carboni, 2011), their innovative or corporate performance (Bérubé & Mohnen, 2009; Radas et al., 2015) or by examining the determinants of the choice of a certain instrument of public support (Busom et al., 2014).

The empirical results given by Carboni (2011) for Italy suggest that public support for R&D investment positively impacts companies' R&D investment, meaning that companies which use instruments of public support devote more of their own resources than in absence of public support. The results also reveal that R&D tax incentives are more effective than R&D subsidies. Finally, there is also some evidence in this study that public support has positive effects for credit financing for R&D. Further, Bérubé and Mohnen (2009) examine the effectiveness of R&D subsidies and R&D tax incentives in Canada by comparing the innovation performance of companies that benefited from R&D tax incentives only with their counterparts which benefited from both, namely R&D tax incentives and R&D subsidies. They establish that the dual use of both instruments of public support is more effective than the use of R&D tax incentives alone. One can thus say that companies which benefited from these two instruments of public support introduced more products, were responsible for more 'world-first' product innovations and enjoyed greater success in

commercialising their innovations than their rivals that benefited solely from R&D tax incentives.

Radas et al. (2015) investigate the effects of R&D subsidies and R&D tax incentives on SMEs in Croatia. They find that, either used alone or with R&D tax incentives, R&D subsidies add to the R&D orientation, innovation output and absorptive capacity of SMEs. The effects of instruments of public support become especially obvious when comparing these companies with those that did not benefit from either instrument. When comparing just the beneficiaries of R&D subsidies with the companies that used both instruments of public support (R&D subsidies and R&D tax incentives), not much difference is found. These results suggest that, when it comes to SMEs, R&D subsidies take precedence over R&D tax incentives since in this case the latter do not contribute to greater R&D spending.

In the context of Spain, Busom et al. (2014) investigate the use of R&D subsidies and R&D tax incentives in addressing financing constraints and appropriability difficulties, which represent two sources of market failure. They also examine whether the two instruments of public support for R&D investment act as substitutes. Their findings reveal that SMEs faced with financing constraints (whether internal or external) are more likely to use R&D subsidies than R&D tax incentives. In the case of SMEs, they also establish that SMEs utilising legal intellectual protection mechanisms are more likely to use R&D tax incentives even if financing constraints increase. The findings for large companies show that large companies facing external financing constraints prefer R&D subsidies over R&D tax incentives. With respect to large companies, they do not establish a relationship between the use of intellectual protection mechanisms and the use of only one instrument of public support. The authors conclude by stating a common finding pertaining to both SMEs and large companies. They claim that both prefer R&D tax incentives (either alone or combined with R&D subsidies) where they have past R&D experience. They additionally establish that young companies operating in knowledge-intensive industries prefer R&D subsidies over R&D tax incentives. The authors conclude that R&D subsidies and R&D tax incentives possess distinct abilities, especially in addressing the causes of market failures. From the policy point of view, these two instruments of public support may therefore be regarded as complementing each other. A summary of the key literature addressing the joint effect of R&D subsidies and R&D tax incentives is presented in Table 1.4.

Table 1.4: Summary of the key literature on the joint effect of R&D subsidies and R&D tax incentives

Authors	Countries	Findings
Carboni (2011)	Italy	Companies that use instruments of public support devote more of their own resources to R&D than in the absence of public support. The results also reveal that R&D tax incentives are more effective than R&D subsidies.
Bérubé and Mohnen (2009)	Canada	The evidence suggests that the dual use of both instruments of public support is more effective than the use of R&D tax incentives alone.
Radas et al. (2015)	Croatia	R&D subsidies, when used alone or with R&D tax incentives, enhance the R&D orientation, innovation output and absorptive capacity of SMEs. The evidence also shows that for SMEs R&D subsidies take precedence over R&D tax incentives.
Busom et al. (2014)	Spain	The findings reveal that SMEs faced with financing constraints (whether internal or external) are more likely to use R&D subsidies than R&D tax incentives. The findings for large companies show that large companies facing external financing constraints prefer R&D subsidies over R&D tax incentives.

Source: Own presentation.

The review of the literature on the joint effect of R&D subsidies and R&D tax incentives reveals that generally speaking to a greater or a smaller extent both instruments enhance firms' R&D expenditures, improve their innovation performance and correct market failures. Despite the beneficial effect of R&D subsidies and R&D tax incentives, the way these two instruments of public support influence companies may be different, especially due to the existence of some differential features related to the eligibility, magnitude and certainty as well as timing of public support (Busom et al., 2014).

As regards eligibility for public support, all R&D projects are qualified for R&D tax credits if they meet all of the conditions for classifying them as an R&D activity, although this does not apply to R&D subsidies where only R&D projects revealing a high level of novelty, risk or spillover capacity may qualify for a subsidy.

In terms of the magnitude of public support, R&D subsidies provide companies with greater certainty regarding the extent of R&D cost reduction. For example, beneficiaries of R&D subsidies know the exact amount of the R&D subsidies in advance before starting the R&D project, whereby the benefits of R&D tax incentives mostly depend on a company's tax position at the end of the fiscal year. Namely, the amount of tax liability at the end of the fiscal year might be smaller than the benefits of the potential R&D tax incentives. This often occurs in the case of SMEs and young companies. In this sense, in the case of companies faced with financing constraints (whether internal or external), R&D subsidies are more beneficial than R&D tax incentives since financially-constrained companies cannot generate sufficient R&D expenditures to qualify for R&D tax incentives.

With respect to the timing of public support, R&D subsidies are obtained ex ante before the R&D project starts, while R&D tax incentives are obtained ex post at the end of the fiscal year. Thus, companies can only benefit from R&D tax incentives if they have enough of their own internal or external financial resources to fund the R&D project in advance. Since SMEs and young companies often encounter financing constraints, they are less likely to benefit from R&D tax incentives. Further, R&D subsidies may also serve as an indicator of the quality of an R&D project, allowing companies to signal their success to potential investors. This means that, due to the certification effect, the receipt of R&D subsidies may lead to easier access to external finance (Meuleman & De Maeseneire, 2012; Wu, 2017). Yet this is not the case for R&D tax incentives. A summary and comparison of the characteristics of R&D subsidies and R&D tax incentives is presented in Table 1.5.

Table 1.5: Comparison of R&D subsidies and R&D tax incentives by individual characteristics

Characteristics	R&D subsidies	R&D tax incentives
Eligibility	Only R&D projects accomplishing funding agency requirements.	All R&D projects funded by companies' own internal or external finances.
Magnitude and certainty	Depends on the amount of R&D subsidies, which companies know in advance (greater certainty).	Depends on a company's tax position at the end of the fiscal year (less certainty).
Timing	Obtained *ex ante* before the R&D project starts.	Obtained *ex post* at the end of the fiscal year.

Source: Busom et al., 2014.

The extensive literature review shoes that both forms of public support for R&D investment have generally positive effects. However, the vast majority of empirical studies mostly focus on a single public policy instrument, i.e. R&D subsidies or R&D tax incentives. Moreover, many empirical studies concentrate on advanced or large economies, leaving smaller ones typically neglected and, similarly, studies often consider only larger and listed companies, thereby overlooking smaller and non-listed ones. Therefore, the Slovenian context may be seen as a great opportunity to examine the impact of different forms of public support for R&D investment on firms' R&D expenditures by considering mainly smaller and non-listed companies.

Since two different instruments of public support for R&D investment are available in Slovenia, two different research hypotheses are developed. The first one concerns R&D subsidies, which are considered as direct public support for R&D investment. It is generally expected that R&D subsidies should enhance firms' R&D expenditures. Yet, the specific nature of R&D subsidies in terms of eligibility, magnitude and certainty as well as timing may hold important implications for their effectiveness. According to the above discussion, the following research hypothesis is proposed:

- **Hypothesis 1.1:** *Direct public support for R&D investment in the form of R&D subsidies stimulates R&D expenditures, where its specific nature makes it a less effective instrument than indirect public support in the form of R&D tax incentives.*

Another important instrument of public support for R&D investment is R&D tax incentives, which are regarded as indirect support for R&D investment. Like with R&D subsidies, R&D tax incentives are often expected to bring beneficial effects for firms' R&D spending. However, given the broader or more general nature of R&D tax incentives it can also be anticipated that they are an effective instrument for a wider population of companies. Given the above discussion, the following research hypothesis is posited:

- **Hypothesis 1.2:** *Indirect public support for R&D investment in the form of R&D tax incentives stimulates R&D expenditures with its more general nature making it an effective instrument for a wider population of companies.*

1.5 Data and research methods

1.5.1 Sample selection

A comprehensive empirical analysis is performed on a unique dataset of Slovenian companies. The data come from three main different sources provided by the Statistical Office of the Republic of Slovenia (SORS). The first source is a database that contains data on the R&D activity of Slovenian companies. It covers all companies that are: 1) registered to perform R&D activity (NACE 72 classification) and have more than two employees; 2) not registered to perform R&D activity but are recipients of R&D subsidies; 3) eligible for general and regional R&D tax incentives; and 4) reporting about R&D investments in a survey on innovation activity (SORS, 2018). This database is the leading source of data, meaning that it dictates the number of companies that could be included in the empirical analysis. It provides crucial and comprehensive data on R&D activity within a certain company. The second source is data taken from corporation tax forms. It encompasses all relevant data on a company's tax status, including any reliance on R&D tax incentives. The third source provides data from companies' financial statements, including balance-sheet and income-statement data. All of the above data sources are merged to create a unique and comprehensive database of Slovenian companies.

The nature of the empirical analysis requires a period in which both instruments of public support for R&D investment were available to Slovenian companies. Moreover, the research period that is needed must encompass stable operating conditions. Ever since R&D tax incentives were introduced in Slovenia in 2005, they have been subject to considerable changes in terms of their rates. The latest major change in the R&D tax allowance rate was in 2012 when the rate rose significantly to 100%. After that, no significant changes have affected the R&D tax allowance rate in Slovenia. Nevertheless, changes like this could

produce a situation in which companies opportunistically time their patterns of R&D spending so as to obtain additional benefits from R&D tax incentives (Chen & Gupta, 2018). Therefore, the research period for the empirical analysis is restricted to the latest available data for the five-year period 2012–2016.

The final sample consists of Slovenian non-financial private companies operating in either the manufacturing (NACE 10-33) or service sectors (NACE 35-99) and taking the legal organisational form of a private or public limited company; namely, such companies are a good reflection of Slovenia's small open economy. Moreover, company-year observations with incomplete data, negative equity or less than one employee are excluded from the empirical analysis. Finally, in order to mitigate the small deflator problem, company-year observations with less than EUR 100,000 of total assets and net sales are excluded from the analysis. The final unbalanced panel dataset of Slovenian companies consists of 3,113 company-year observations. Although the overall sample of Slovenian companies included in the empirical analysis invests in R&D activity, a share of 26% of the final sample does not benefit from public support for R&D investment. The remaining 74% share can be further divided into company-year observations in which Slovenian companies receive or claim: 1) only R&D subsidies (17% of the sample); 2) only R&D tax incentives (41% of the sample); and 3) both instruments of public support for R&D investment (16% of the sample). Interestingly, 32% of the final sample does not claim any R&D tax incentives despite having a positive tax base and positive value of their R&D investment, which is financed solely by the company itself (without any R&D subsidies). The distribution of the final sample of Slovenian companies by years is shown in Table 1.6. It reveals that the company-year observations vary from a minimum of 541 in 2012 to a maximum of 675 in 2014.

Table 1.6: Sample distribution of Slovenian companies by years

Year	No.	Share (in %)
2012	541	17.38
2013	615	19.76
2014	675	21.68
2015	667	21.43
2016	615	19.76
Total	**3,113**	**100**

Source: SORS, 2018; own calculations.

1.5.2 Variables

1.5.2.1 Dependent variable

This empirical study looks specifically at the impact of different public support for R&D investment on firms' R&D expenditures. Since the principal interest of this study is R&D expenditures funded by companies themselves, the dependent variable measures firms'

R&D expenditures without R&D subsidies, data for which are provided by different Slovenian and EU institutions. Accordingly, net R&D intensity (NRDI) is defined as firms' R&D expenditures (excluding R&D subsidies) divided by total assets. This measure represents a comparable basis for companies of different sizes and is widely used in existing empirical studies (Curtis et al., 2016; Ryan Jr, 2002).

1.5.2.2 Independent variables

This empirical study is interested in two main independent variables which try to capture the scope of a certain instrument of public support for R&D investment. These are R&D subsidy intensity (SUB) and R&D tax incentive intensity (TAX). They are defined as the amount of R&D subsidies received or R&D tax incentives claimed divided by the amount of net sales. Such measures are also used in other empirical studies (Jin et al., 2018). In order to obtain additional and comprehensive insights regarding how public support for R&D investment impacts firms' R&D expenditures, the following interaction effects are considered in the analysis. The first interaction term between R&D subsidy intensity and R&D tax incentive intensity (SUBxTAX) tries to capture the simultaneous use of both public policy instruments. The second interaction term between R&D subsidy intensity and net sales growth (SUBxNSG) is considered as part of examining how R&D subsidies influence firms' R&D spending relative to company growth. Similarly, the third interaction term between R&D tax incentive intensity and net sales growth (TAXxNSG) is considered for the purposes of establishing how R&D tax incentives affect firms' R&D expenditures in relation to company growth. According to the proposed research hypotheses, it is expected that both forms of public support for R&D investment (R&D subsidies and R&D tax incentives) as well as their interaction terms positively impact firms' R&D expenditures.

1.5.2.3 Control variables

Existing empirical studies suggest several factors may impact firms' R&D expenditures. Therefore, all relevant determinants of firms' R&D expenditures (financial leverage, company net sales growth, and company size) are included and considered as control variables in the empirical analysis.

The first control variable is financial leverage (LEV), measured as total (short-term and long-term) liabilities divided by total assets. According to previous empirical studies, it is expected that financial leverage has a negative impact on firms' R&D expenditures (Min & Smyth, 2016). Namely, financial leverage may be considered a channel through which companies can obtain additional financial resources which they invest in R&D activities. When a company approaches to its debt limit, obtaining debt financing becomes increasingly difficult and may limit the company's R&D activities. Yet, some companies, especially smaller ones, may encounter difficulties accessing debt markets since R&D investment is risky and uncertain, making it difficult to use it as collateral (Vincente-Lorente, 2001;

Simarly & Li, 2000). The second control variable is company net sales growth (NSG), measured as simple 1-year growth of net sales, which is expected to positively impact firms' R&D expenditures (Coad & Rao, 2010). It is established in the literature that growing companies typically experience increasing profitability, while loss-making companies eventually exit the market (Jovanovic, 1982). Thus, growing companies, which usually also exhibit profits, can then obtain extra funding available for different investment activities like R&D activity.

The third control variable is company size (SIZE), measured as the natural logarithm of employees. Empirical studies show that large companies tend to devote greater funding to R&D investment (Meisel & Lin, 1983). Namely, larger companies often have better access to capital markets, allowing them to obtain more funds for R&D activity (Nunes et al., 2009; Titman & Wessles, 1988). Moreover, besides the size of a company, this control variable captures human capital. It is generally believed in the literature that human capital is an important determinant of R&D spending (Pingfang & Weimin, 2003). It is therefore expected that company size has a positive impact on firms' R&D spending (Jin et al., 2018). In addition, year dummy variables (YEAR) are included in the empirical analysis to control for time effects. Based on 2012, there are four dummy variables which take the value of 1 if a company-year observation is from a year studied (from 2013 to 2016), and 0 otherwise.

The empirical analysis includes the whole range of different variables that are important while comprehensively analysing the relationship between public support for R&D investment and firms' R&D expenditures. A summary of all variables employed in the empirical analysis is presented in Table 1.7.

Table 1.7: Summary of the variables used in the empirical analysis

Abbreviation	Variable	Definition	Source
Dependent variable			
NRDI	Net R&D intensity	The ratio between firms' R&D expenditures and total assets.	SORS
Independent variables			
SUB	R&D subsidy intensity	The ratio between received R&D subsidies and total assets.	SORS
TAX	R&D tax incentive intensity	The ratio between claimed R&D tax incentives and total assets.	FURS
SUBxTAX	Interaction between R&D subsidy intensity and R&D tax incentive intensity	The interaction between R&D subsidy intensity and R&D tax incentive intensity.	SORS/FURS
SUBxNSG	Interaction term between R&D subsidy intensity and net sales growth	The interaction between R&D subsidy intensity and company net sales growth.	SORS/AJPES
TAXxNSG	Interaction term between R&D tax incentive intensity and net sales growth	The interaction between R&D tax incentive intensity and company net sales growth.	FURS/AJPES
Control variables			
LEV	Financial leverage	The ratio between total liabilities and total assets.	AJPES
NSG	Net sales growth	Simple 1-year growth of net sales.	AJPES
SIZE	Company size	The natural logarithm of employees.	AJPES
YEAR	Year dummy variable	Dummy variable that takes 1 for a year studied, 0 otherwise.	AJPES

Note: SORS – Statistical Office of the Republic of Slovenia; FURS –Financial Administration of the Republic of Slovenia; AJPES – Agency of the Republic of Slovenia for Public Legal Records and Related Services.

Source: Own presentation.

1.5.3 Research methods

This empirical study involves a comprehensive empirical analysis of the impact of different forms of public support for R&D investment on firms' R&D expenditures. The empirical analysis examines the relationship between R&D subsidies and firms' R&D expenditures together with the relationship between R&D tax incentives and firms' R&D expenditures. To accomplish this systematically, several multiple regression models are estimated in two separate steps. The first one evaluates the impact of different R&D public policy instruments as well as their interaction term on firms' R&D expenditures, while the second step assesses the interaction of R&D public policy instruments with net sales growth in order to obtain further insights.

The first step entails estimating the impact of different public policy instruments, namely R&D subsidies and R&D tax incentives, as well as their interaction term on firms' R&D expenditures. Net R&D intensity (NRDI) is accordingly regressed against the main independent variables, i.e. R&D subsidy intensity (SUB), R&D tax incentive intensity (TAX), and the interaction term between R&D subsidy intensity and R&D tax incentive

intensity (SUBxTAX) as measures of public support for R&D investment (SUP). They are estimated in separate models as well as simultaneously. In addition, some control variables are further included in the multiple regression models, i.e. financial leverage (LEV), net sales growth (NSG) and company size (SIZE). In order to control for year effects, time dummy variables (YEAR) are also considered. The multiple regression model is presented in Equation (1.1) where the main independent variables of interest (SUP) are presented as a vector.

$$NRDI_{i,t} = \alpha_0 + \beta_1 SUP_{i,t} + \beta_2 LEV_{i,t} + \beta_3 NSG_{i,t} + \beta_4 SIZE_{i,t} + \sum YEAR_{i,t} + \varepsilon_{i,t} \quad (1.1)$$

where NRDI is a dependent variable measuring net R&D intensity. Furthermore, independent variables are identified as a vector of independent variables for public support for R&D investment (SUP), such as: R&D subsidy intensity (SUB), R&D tax incentive intensity (TAX), and the interaction term between R&D subsidy intensity and R&D tax incentive intensity (SUBxTAX). Some control variables are also included, which represent possible determinants of net R&D intensity like: financial leverage (LEV), net sales growth (NSG) and company size (SIZE). Finally, control variables for time effects are considered as well (YEAR).

In order to obtain further insights, the second step is concerned with the impact of different public policy instruments, namely, R&D subsidies and R&D tax incentives, by considering their interaction with net sales growth. Accordingly, net R&D intensity (NRDI) is regressed against the main independent variables, i.e. R&D subsidy intensity (SUB), R&D tax incentive intensity (TAX), as well as their interaction terms with net sales growth (SUBxNSG and TAXxNSG) denoted by (INT). They are estimated both in separate models and simultaneously. Like in the first step, financial leverage (LEV), net sales growth (NSG) and company size (SIZE) are considered as control variables. In order to control for year effects, time dummy variables (YEAR) are also taken into consideration. The multiple regression model is presented in Equation (1.2) where the main independent variables of interest (INT) are presented as a vector.

$$NRDI_{i,t} = \alpha_0 + \beta_1 SUB_{i,t} + \beta_2 TAX_{i,t} + \beta_3 INT_{i,t} + \beta_4 LEV_{i,t} + \beta_5 NSG_{i,t} + \beta_6 SIZE_{i,t} + \sum YEAR_{i,t} + \varepsilon_{i,t} \quad (1.2)$$

where NRDI is a dependent variable measuring net R&D intensity. Further, independent variables are identified as R&D subsidy intensity (SUB) and R&D tax incentive intensity (TAX). A vector of interaction variables (INT) is also considered such as the interaction term between R&D subsidy intensity and net sales growth (SUBxNSG) and the interaction term between R&D tax incentive intensity and net sales growth (TAXxNSG). In addition, some control variables representing possible determinants of net R&D intensity are included, such as: financial leverage (LEV), net sales growth (NSG) and company size (SIZE). Finally, control variables for time effects are considered as well (YEAR).

The proposed regression models can be estimated by using different econometric specifications. Generally, there are three main different alternative econometric specifications of regression models for panel data: the pooled regression model, the random effects model and the fixed effects model. In order to determine statistically which econometric specification is most suitable for the data used in the empirical analysis, a three-step procedure is followed. First, the LM test is used to decide between the random effects and pooled regression models. Second, the F test is applied to compare the pooled regression and fixed effects models. Third, the Hausman test is conducted in order to choose between the random effects and fixed effects models (Hausman, 1978).

Regression disturbances are assumed by standard panel regression models to be homoscedastic and to hold the same variance across individuals. This assumption cannot easily be made for company-level panel data since companies vary greatly in size (Lee, 2018). A serious consequence of heteroscedasticity is the bias of standard errors. Since standard errors are a central parameter for conducting significance tests, their bias therefore leads to inappropriate statistical inferences (Washington et al., 2010). In order to check the presence of heteroscedasticity, a modified Wald test for groupwise heteroscedasticity is performed (Baum, 2001). Since the results of a modified Wald test show a positive result for all multiple regression models ($P < 0.001$), the heteroscedasticity-robust (White) standard errors are employed in the multiple regression models in order to alleviate the problem of heteroscedasticity.

1.6 Empirical results

1.6.1 Descriptive statistics

Descriptive statistics of variables (except year and interaction effects) for the period 2012–2016 are presented in Table 1.8. which shows the mean and standard deviation values for variables included in the empirical analysis. Since companies represent a very heterogeneous group of units, there may be some outliers in the data. In order to eliminate the effect of possibly spurious outliers, all of the continuous variables are winsorised at the 1% and 99% levels by each year. Further, the Winsorisation procedure is often also considered as robust statistics (Reifman & Keyton, 2010).

Table 1.8: Descriptive statistics of variables

Variable	Mean	SD
NRDI	0.111	0.216
SUB	0.021	0.070
TAX	0.031	0.055
LEV	0.427	0.223
NSG	0.112	0.439
SIZE	3.624	1.605

Note: Data for Slovenian companies are strictly confidential so the minimum and maximum values for an individual variable are not shown.

Source: SORS, 2018; own calculations.

The descriptive statistics presented above reveal that Slovenian companies devote funds for R&D activity in a proportion exceeding 11% of their total assets. Moreover, the mean values of R&D subsidy intensity (SUB) and R&D tax incentive intensity (TAX) suggest the latter are more popular among Slovenian companies than R&D subsidies. The mean value of financial leverage (LEV) indicates it is at a relatively high level compared to net R&D intensity (NRDI). Finally, the descriptive statistics reveal that on average Slovenian companies grow at a rate of 11.20%.

Table 1.9 shows Pearson's correlations between variables (except year and interaction effects). The simple correlation shows a positive and significant correlation between different forms of public support for R&D investment and firms' R&D expenditures. The Pearson correlation matrix also reveals that financial leverage (LEV) and company size (SIZE) are negatively correlated with firms' R&D expenditures. Finally, the correlation between net sales growth (NSG) and firms' R&D expenditures seems to be positive. These results are largely (except for company size) in line with the expectations. Nevertheless, the simple correlation between the explanatory variables does not indicate any strong linear relationship, suggesting there is no issue of multicollinearity in the data of these Slovenian companies.

Table 1.9: Pearson correlation matrix of variables for the Slovenian companies

Variable	NRDI	SUB	TAX	LEV	NSG	SIZE
NRDI	1					
SUB	0.293***	1				
TAX	0.265***	0.088***	1			
LEV	-0.783***	0.001	-0.232***	1		
NSG	0.137***	0.152***	0.189***	0.048**	1	
SIZE	-0.316***	-0.206***	-0.277***	0.054**	-0.144***	1

*Note: Levels of significance: *p<0.05; **p<0.01; ***p<0.001.*

Source: SORS, 2018; own calculations.

1.6.2 Multiple regression analysis

This chapter looks at the impact of public support for R&D investment on firms' R&D expenditures. In order to obtain detailed insights, the empirical analysis is performed in two separate, yet interrelated steps. The first step estimates the impact of different public policy instruments on firms' R&D expenditures, while the second step further investigates their impact on firms' R&D expenditures according to company growth.

Multiple regression models may be estimated by using three main different alternative econometric specifications: the pooled regression model, the random effects model and the fixed effects model. Based on a three-step procedure of different model specification tests (LM test, F test and Hausman test), it is statistically determined that the fixed effects model is the most preferred among all of the multiple regression models.

The empirical results for the relationship between public support for R&D investment and firms' R&D expenditures are presented in Table 1.10. As regards the impact of two different forms of public support, the empirical results are as follows. The regression coefficients of R&D subsidy intensity (SUB) reveal it has a negative impact on net R&D intensity (NRDI), while the regression coefficient of R&D tax incentive intensity (TAX) shows it has a positive impact on net R&D intensity (NRDI). These results are evident in Model 1.1 (a) and Model 1.1 (b), which estimate only one individual public policy instrument, i.e. R&D subsidies or R&D tax incentives. Since these results might be biased due to the inclusion of only a single instrument of public support in the estimation, Model 1.1 (c) extends the previous models by considering the simultaneous impact of the two public policy instruments. In this case, the empirical results remain similar. The regression coefficient of R&D subsidy intensity (SUB) suggests that a 1% increase in R&D subsidy intensity (SUB) leads to a 0.347% decrease in net R&D intensity (NRDI). On the contrary, the regression coefficient of R&D tax incentive intensity (TAX) suggests that a 1% increase in R&D tax incentive intensity (TAX) leads to a 0.245% increase in net R&D intensity (NRDI). All of these regression coefficients are significant at the 0.1% level and reveal the impact on firms' R&D expenditures is negative for R&D subsidies and positive for R&D tax incentives.

Since Slovenian companies are allowed to benefit from both forms of public support for R&D investment, it is necessary to include the interaction between R&D subsidy intensity and R&D tax incentive intensity (SUBxTAX). The empirical results of Model 1.1 (d) reveal the following. The impact on net R&D intensity (NRDI) is significantly negative for R&D subsidy intensity (SUB) and non-significantly positive for R&D tax incentive intensity (TAX). However, the main interest in this multiple regression model is the interaction between R&D subsidy intensity and R&D tax incentive intensity (SUBxTAX), which is positive and highly significant. This suggests that the dual use of both R&D subsidies and R&D tax incentives stimulates firms' R&D expenditures.

Table 1.10: Multiple regression results for the relationship between public support for R&D investment and firms' R&D expenditures

Variable	Predicted Sign	Model 1.1 (a) NRDI	Model 1.1 (b) NRDI	Model 1.1 (c) NRDI	Model 1.1 (d) NRDI
SUB	+	-0.342*** (0.045)		-0.347*** (0.045)	-0.477*** (0.051)
TAX	+		0.233*** (0.064)	0.245*** (0.063)	0.091 (0.069)
SUBxTAX	+				2.174*** (0.388)
LEV	-	-0.060** (0.023)	-0.061** (0.023)	-0.050* (0.023)	-0.054* (0.023)
NSG	+	0.027*** (0.005)	0.019*** (0.005)	0.024*** (0.005)	0.025*** (0.005)
SIZE	+	0.023** (0.010)	0.015 (0.010)	0.024* (0.010)	0.025* (0.010)
Constant	?	0.081** (0.037)	0.093* (0.038)	0.066 (0.037)	0.069 (0.037)
Year	?	Yes	Yes	Yes	Yes
R^2		0.1038	0.0032	0.0716	0.0830
Observations		3,113	3,113	3,113	3,113
LM test		1,872.16***	2,223.95***	1,830.23***	1,795.46***
F test		156.00***	27.66***	168.21***	192.29***
Hausman test		168.69***	44.90***	185.98***	207.92***

*Note: 1) Levels of significance: *p<0.05; **p<0.01; ***p<0.001. 2) Heteroscedasticity-robust standard errors are in parentheses.*

Source: SORS, 2018; own calculations.

As regards the control variables, the results are as follows. First, the regression coefficient of financial leverage (LEV) is negative and significant, suggesting that companies with higher debt devote less funding to R&D activity. This is consistent with the fact that some companies encounter difficulties accessing debt markets since R&D investment is risky and uncertain, making it difficult to use as collateral (Vincente-Lorente, 2001; Simarly & Li, 2000). This is also in line with previous research (Min & Smyth, 2016). Second, the regression coefficient of net sales growth (NSG) is positive and significant, suggesting that growing companies devote more funds to R&D activity due to the rising profitability and increasing funds, which can be used to finance R&D activity (Coad & Rao, 2010; Jovanovic, 1982). Finally, the regression coefficient of company size (SIZE) is positive and significant (except for Model 1.1 (b)), indicating that larger companies have better access to capital markets, allowing them to obtain more funds for R&D activity (Nunes et al., 2009; Titman & Wessles, 1988). This also agrees with previous empirical studies (Jin et al., 2018; Pingfang & Weimin, 2003).

The empirical results for the relationship between public support for R&D investment and firms' R&D expenditures according to their growth are presented in Table 1.11. The main variables of interest in this step of the empirical analysis are the interactions between R&D subsidy intensity, R&D tax incentive intensity, and net sales growth (SUBxNSG and

TAXxNSG). These interactions are estimated separately (see Model 1.2 (a) and Model 1.2 (b)) and together (see Model 1.2 (c)). Regardless of the empirical results for other relevant variables, which remain similar to those presented in the first step of the analysis, the results for the interaction terms give the following insights. The regression coefficients of both interaction terms are positive and significant, suggesting that both forms of public support for R&D investment positively impact firms' R&D spending for growing companies. The empirical results remain similar regardless of the model estimated.

Table 1.11: Multiple regression results for the relationship between public support for R&D investment and firms' R&D expenditures according to their growth

Variable	**Predicted Sign**	**Model 1.2 (a) NRDI**	**Model 1.2 (b) NRDI**	**Model 1.2 (c) NRDI**
SUB	+	-0.395*** (0.049)	-0.339*** (0.045)	-0.393*** (0.049)
TAX	+	0.262*** (0.064)	0.126 (0.068)	0.141* (0.068)
SUBxNSG	+	0.087* (0.035)		0.097** (0.035)
TAXxNSG	+		0.273*** (0.059)	0.282*** (0.059)
LEV	-	-0.051* (0.023)	-0.049* (0.023)	-0.051* (0.023)
NSG	+	0.016** (0.006)	0.008 (0.006)	-0.001 (0.007)
SIZE	+	0.024* (0.010)	0.027** (0.010)	0.028** (0.010)
Constant	?	0.066 (0.037)	0.056 (0.037)	0.055 (0.037)
Year	?	Yes	Yes	Yes
R^2		0.0736	0.0799	0.0822
Observations		3,113	3,113	3,113
LM test		1,814.32***	1,832.77***	1,816.54***
F test		169.13***	173.48***	174.83***
Hausman test		191.03***	195.30***	288.87***

*Note: 1) Levels of significance: *p<0.05; **p<0.01; ***p<0.001. 2). Heteroscedasticity-robust standard errors are in parentheses.*

Source: SORS, 2018; own calculations.

With respect to the control variables, the empirical results are as follows. The impact on net R&D intensity (NRD) is negative for financial leverage (LEV) and positive for net sales growth (NSG) and company size (SIZE), where the regression coefficients are not necessarily always significant. Still, the results are similar to those presented in the first step of the analysis and in line with the initial expectations.

After controlling for different relevant determinants of firms' R&D expenditures, the empirical results for the relationship between public support for R&D investment and firms' R&D investment show that both forms of public policy instruments play an important role

in stimulating R&D expenditures at the firm level. This is consistent with the findings of Carboni (2011) who established that companies benefiting from government support for R&D investment devote more funds to R&D activities than in the absence of public support.

However, the results are not straightforward. As regards the impact of R&D subsidies on firms' R&D expenditures, it seems they have a negative impact on firms' R&D expenditures, which is out of step from the initial expectations and some earlier studies. Yet, there are some cases when the impact of R&D subsidies on firms' R&D expenditures becomes positive. The first situation where the positive impact occurs is when companies use R&D subsidies in combination with R&D tax incentives. This suggests that the dual use of both public policy instruments is more effective than the use of only one instrument, as established in previous research studies (Bérubé and Mohnen, 2009). The aforementioned especially holds for companies which benefit solely from R&D subsidies. The second situation where the impact of R&D subsidies on firms' R&D expenditures is positive is when companies are in a growing phase. Based on the above discussion, the first research hypothesis (Hypothesis 1.1) may be confirmed, stating that direct public support for R&D investment in the form of R&D subsidies stimulates R&D expenditures where its specific nature makes it a less effective instrument than indirect public support in the form of R&D tax incentives. That is, a positive impact can only be confirmed for those companies which use R&D subsidies combined with R&D tax incentives, and for growing companies.

As concerns the impact of R&D tax incentives on firms' R&D expenditures, the empirical analysis reveals positive effects regardless of the model estimated. This is also in line with other authors (Chen & Gupta, 2017; Czarnitzki et al., 2011; Kobayashi, 2014: Koga, 2003; Yang et al., 2012). Moreover, further examination shows the impact of R&D tax incentives on firms' R&D expenditures becomes more prominent for growing companies. This result seems reasonable given that growing companies often exhibit a positive and large tax base, which is a prerequisite for claiming R&D tax incentives in Slovenia. Therefore, the second research hypothesis (Hypothesis 1.2) is confirmed, which states that indirect public support for R&D investment in the form of R&D tax incentives stimulates R&D spending, where its general nature makes it an effective instrument for a wider population of companies.

To summarise, a comprehensive empirical analysis of a sample of Slovenian companies provides interesting findings on the impact of public support for R&D investment and firms' R&D spending. It shows that R&D subsidies are only effective when combined with R&D tax incentives and when companies that are growing receive them. On the contrary, R&D tax incentives are always effective when companies have a sufficient tax base from which R&D tax incentives are deducted. These results coincide with the finding of Deloitte (2016b), which observes that Slovenian companies are more familiar with R&D tax incentives than with R&D subsidies. Such results are consistent with the theoretical foundations which stress the role of public support for R&D investment in reducing certain market failures, which helps companies devote more funds to R&D investment. This mainly occurs through a reduction of the costs entailed in performing R&D activities.

1.7 Discussion and implications

This part of the doctoral dissertation examines the impact of public support for R&D investment on firms' R&D expenditures. Therefore, an empirical analysis was performed on a sample of 3,113 company-year observations for Slovenian companies for the period 2012–2016. The empirical analysis involved two separate, yet interrelated steps. The first step estimated the impact of different public policy instruments on firms' R&D expenditures, while the second step further investigated their impact on firms' R&D expenditures according to company growth.

The results of the empirical study explain that public support for R&D investment plays an important role in firms' R&D spending. The empirical results suggest that R&D subsidies generally displace firms' R&D expenditures in Slovenia. Yet, the results show that R&D subsidies become more effective when used in combination with R&D tax incentives and when growing companies receive them. On the contrary, the empirical results show that R&D tax incentives are always effective when companies have a sufficient tax base. This implies that Slovenian companies are not exploiting the potential of R&D subsidies. This partly relates to the fact that Slovenian companies are not so familiar with R&D subsidies. On the other hand, it seems that R&D tax incentives are a good and effective public policy instrument that is being successfully exploited by Slovenian companies.

The reasons for the different findings on the impact of public support for R&D investment on firms' R&D expenditures arise from the differences in the characteristics of R&D subsidies and R&D tax incentives. As regards eligibility for public support, only R&D projects with a high degree of novelty, risk or spillover capacity and meet funding-agency requirements are eligible for R&D subsidies. On the contrary, all R&D projects are eligible for R&D tax incentives. Further, the magnitude of R&D subsidies depends on their amount, which companies know in advance, while the magnitude of R&D tax incentives depends on a company's tax position at the end of the fiscal year. Therefore, R&D subsidies are considered as being more certain than R&D tax incentives. Finally, as concerns the timing of public support, R&D subsidies are obtained ex ante before an R&D project starts, while R&D tax incentives are obtained ex post at the end of the fiscal year. These characteristics of R&D subsidies do not stimulate companies towards their natural growth, which would ultimately lead to an increase in their R&D expenditures. This implies that the effects of R&D subsidies lie more in maintaining companies' business operations rather than in stimulating their growth and thus their funds for R&D activity. On the contrary, the presented characteristics of R&D tax incentives suggest they are more growth-oriented since they depend largely on a company's tax position at the end of the fiscal year. The overall conclusion is that R&D subsidies are used more to help companies that are growing less to maintain employment and replace older products, processes and services (unlike what is happening in companies that rely on both public policy instruments, and growing companies), while R&D tax incentives are used by companies with a sufficient tax base.

The study results provide additional empirical support for the main theoretical foundations which are often used to explain why public support for R&D investment is needed in a certain economy. The results reveal that public support for R&D investment contributes to reducing certain market failures by lowering the costs entailed in performing R&D activities, then allowing companies to invest more in R&D activities. In the case of R&D subsidies, this can be confirmed for companies that use R&D subsidies and R&D tax incentives at the same time, as well as for growing companies. On the other hand, in the case of R&D tax incentives, this can be confirmed in a general sense.

The findings of this study also hold several important practical implications. The overall findings suggest that R&D tax incentives are more effective than R&D subsidies in Slovenia for the following reasons. First, the overall system in Slovenia is relatively small, fragmented (with an abundance and variety of R&D tenders and a non-homogeneous population of companies) and two-tiered (especially since 2012 when the R&D tax allowance rate of 100% was introduced). This implies that companies with a sufficient tax base are more inclined to R&D tax incentives since all R&D projects funded by companies' own internal or external finances may be eligible for this form of public support for R&D investment. On the other hand, R&D subsidies are still attractive, especially for smaller companies without a sufficient tax base. It is hence important to consider both public policy instruments as two parallel ways of supporting firms' R&D expenditures. It is crucial that policymakers exploit the advantages and reduce the weaknesses of each instrument in order to provide public support for R&D investment in the most efficient way.

Despite the new and interesting findings, some limitations must be recognised and future avenues for research are proposed. The first limitation is the limited research period 2012–2016 due to the need for a research period encompassing stable operating conditions for companies and a period in which both instruments of public support for R&D investment were available in Slovenia. Accordingly, one direction for future research is to extend the research period. This may provide additional empirical evidence on this research topic, especially during the recent economic crisis. Second, the limited research period also makes it difficult to use sophisticated econometric approaches as they often require a longer research period to gain credible empirical results. Finally, since this study is based solely on a financial database certain important information could be overlooked. Moreover, the database used in this study lacks data on innovation outputs or related non-financial information. Given the last two limitations, it would be beneficial to conduct surveys or interviews so as to obtain non-financial information for the purposes of acquiring further insights with an emphasis on industry characteristics, something that cannot be obtained through financial data alone.

2 THE IMPACT OF PUBLIC SUPPORT FOR R&D INVESTMENT ON THE ACCOUNTING TREATMENT OF R&D EXPENDITURES

2.1 Introduction

Many world economies have in recent years faced a gradual shift towards a knowledge-based economy in which the economic importance of intangible assets as well as R&D expenditures as a significant component of them have become the primary pillar for enhancing companies' competitiveness and ensuring their long-term viability. However, the current emphasis on R&D investment also raises questions of how this investment should be treated in accounting. Today, a major concern for policymakers, accounting-standard setters, managers, investors and other company stakeholders is the appropriateness of the measurement and reporting of an R&D investment. The main reason driving this concern is the significant growth of R&D expenditures seen in recent years, especially in the private sector, coupled with the limitations associated with current information on R&D expenditures (Cañibano et al., 2000; Zambon, 2003).

The way intangible assets are treated in accounting has always been contentious (Ravšelj & Aristovnik, 2019). This especially refers to internally-generated intangible assets or related R&D expenditures incurred within the company. According to the International Financial Reporting Standards (IFRS) that provide accounting guidelines for public companies and the Slovenian Accounting Standards (SAS) that give an accounting framework for private companies, different accounting treatments of R&D expenditures is envisaged depending on the phase in which they occur. The two mentioned accounting standards allow the capitalisation of R&D expenditures on the balance sheet if certain conditions are met (Cazavan-Jeny & Jeanjean, 2006). In other words, by taking the distinction between R&D expenditures on research expenditures and development expenditures provided by the IFRS and SAS into the account, spending in the research phase should be treated as expenditures on the income statement while expenditures made in the development phase may be treated (but not necessarily) as an intangible asset on the balance sheet. The appropriate assessment of the recognition criteria for intangible assets therefore plays a very important role.

Although accounting standards give detailed guidelines on the accounting treatment of R&D expenditures, the existing accounting regulation allows management a free choice on the accounting treatment of R&D expenditures. This implies that management has the opportunity to decide whether or not certain criteria for the capitalisation of R&D expenditures (i.e. recognising R&D expenditures on the balance sheet as an intangible asset) have been fulfilled (Markarian et al., 2008). In this regard, the capitalisation of R&D expenditures is thus often considered a tool for earnings management (Anagnostopoulou & Ballas, 2014; Cazavan-Jeny & Jeanjean, 2006; Dinh et al., 2016; Markarian et al., 2008; Wang, 2016, Wang et al., 2017). Consequently, this raises several questions related to the

adequacy of such accounting regulations and to the motives underpinning companies' decision on the accounting treatment of R&D expenditures.

The vast majority of empirical studies looking at the determinants of the accounting treatment of R&D expenditures are inspired by Positive Accounting theory, which attempts to explain and predict the choices companies make of accounting methods (Watts & Zimmerman, 1986). Yet, the role of public support for R&D investment in the accounting treatment of R&D expenditures is neglected in the accounting literature, even though public policies are often perceived as one of the main drivers of companies' business decisions (National Research Council, 2005). This also refers to decisions made on companies' accounting policy since they believe the information provided in the financial statements can affect the perception and decision-making of companies' external stakeholders (Tzovas, 2006).

Nevertheless, while some empirical studies examined the role played by public policy instruments (subsidies and tax incentives) and earnings management, they bring conflicting findings. Namely, evidence from the USA shows that the beneficiaries of public support manage their earnings more aggressively than their counterparts (Pappas et al. (2017). Conversely, evidence from China reveals that public support reduces the need for earnings management (He, 2016). However, both of these empirical studies consider public support irrespective of its purpose so their findings cannot be completely transferred to the field of public support for R&D investment given the existence of certain specifics. Namely, the IFRS aligns the accounting treatment of R&D subsidies and R&D expenditures, implying that R&D subsidies are tax-neutral. Therefore, they cannot be the main driver of the R&D accounting treatment decision. There are some other empirical studies which consider the tax-related perspective and the accounting treatment of R&D expenditures (Anagnostopoulou & Ballas, 2014; Wang, 2016). A study by Wang (2016) examines the role of effective tax rate, while a study by Anagnostopoulou and Ballas (2014) investigates the role of R&D tax incentives by considering them at the country level, which is only a very rough approximation of R&D tax incentives at the company level.

A short overview of existing empirical studies indicates a paucity of studies examining the relationship between government policies for promoting R&D investment and a company's accounting R&D expenditure policy. Therefore, the core aim of this chapter is to answer the primary research question of how public support for R&D investment influences the accounting treatment of R&D expenditures. Accordingly, this chapter seeks to answer this question by shedding light on the issues related to the accounting treatment of R&D expenditures via the perspective of the conflicting goals of profit maximisation and tax minimisation. Namely, Slovenia may be seen as a natural environment for evaluating the impact of public support for R&D investment on the accounting treatment of R&D expenditures since, under the IFRS and SRS, both accounting methods (i.e. capitalisation and expensing) may be used by Slovenian companies. Further, empirical studies often focus on advanced or large economies, largely neglecting smaller ones. Similarly, many studies

only consider larger and listed companies in their empirical analysis, while smaller and non-listed ones are generally overlooked. The aforementioned is especially the case in the accounting literature.

Accordingly, this chapter makes several contributions. First, by utilising a unique and comprehensive database of Slovenian companies, it provides a significant contribution to the accounting literature by examining the relationship between public support for R&D investment and the accounting treatment of R&D expenditures. Second, it adds to understanding of the determinants driving the R&D accounting treatment decision with an emphasis on public support for R&D expenditures. Finally, it presents empirical evidence for the small open economy of Slovenia, which primarily consists of smaller and non-listed companies.

In terms of the expected results, this study expands theoretical and practical knowledge. Theoretically, this study gives further empirical support for the theoretical foundations of the Positive Accounting theory. Practically, the study results may benefit different stakeholders like policymakers, accounting-standard setters, managers, investors and others. The results may be of use not only for Slovenia but also other countries characterised by high ownership concentration, considerable dependency on bank financing, and high book-tax conformity, i.e. the characteristics of the business environment that are described can be found in many EU member states.

The chapter is structured as follows. The second section describes the accounting treatment of intangible assets as per the International Financial Reporting Standards (IFRS) and Slovenian Accounting Standards (SAS), representing an important basis for understanding the regulatory background. In the third section, the accounting treatment of public support for R&D expenditures is presented. The fourth section sets out some theoretical considerations and a literature review. The fifth section describes the data and the research methods. In the fifth section, the empirical results are presented. At the end, a discussion unfolds and the implications are summarised.

2.2 Accounting treatment of intangible assets in the EU and the Slovenian context

The fundamental accounting standard prescribing accounting guidelines for intangible assets for listed companies in the European context is International Accounting Standard 38 (IAS 38). Moreover, for Slovenian companies Slovenian Accounting Standard 2 (SAS 2) is very important in accounting for intangible assets in private companies. IAS 38 states the accounting treatment for intangible assets. It prescribes the recognition criteria for intangible assets, the measurement of their carrying amount, and disclosures about them (IAS 38). Similarly, SAS 2 defines the areas on which it focuses, namely the: a) classification of intangible assets; b) recognition of intangible assets; c) initial accounting measurement of intangible assets; c) revaluation of intangible assets; and d) disclosure of intangible assets (SAS 2).

In general, IAS 38 has a very similar scope to SAS 2. Some differences also stem from the fact that IAS 38 focuses on listed companies and thus on consolidated accounts, while SAS 2 concentrates on private ones and on individual accounts. Consequently, the substantive emphasis of individual elements in the accounting standard may vary since they actually refer to very different groups of companies with different fundamental characteristics.

2.2.1 Definition and characteristics of an intangible asset

IAS 38 defines an intangible asset as an identifiable non-monetary asset without any physical substance. In addition, IAS 38 prescribes three criteria that must be satisfied to declare an asset an intangible asset: a) identifiability; b) control over a resource; and c) the existence of future economic benefits.

The overarching criterion important for intangible assets is identifiability. The criterion of identifiability entails two conditions that must be satisfied to establish an that intangible asset is identifiable. Hence, an intangible asset is identifiable when it: a) is separable, meaning there is a possibility to separate or divide it from the company and to sell, rent, exchange, license or transfer it either alone or along with a related contract, asset or liability; or b) arises contractual or other legal rights, irrespective of whether such rights can be transferred or separated from the company or from other rights and obligations (IAS 38). Such accounting rules for the identifiability of intangible assets are prescribed in order to help distinguish between identifiable intangible assets and goodwill. IASB prefers that all identifiable assets obtained through a business acquisition be separated from goodwill since the latter is subject to limited transparency for financial-statement users (Mackenzie et al., 2014).

In order to be called an intangible asset, a company must have control over the resource. IAS 38 states the company has control over the resource when it can: a) obtain the economic benefits from the resource in the future; and b) limit others' access to such benefits. Certainly, the existence of control over a resource stems from legal rights (such as patents, copyrights etc.). Nevertheless, such legal rights and their enforceability are not a mandatory condition for control over a resource because a company might still be able to control the economic benefits coming in the future in another way (IAS 38). However, a patent provides a company with the exclusive right to use the products or processes without any interference or infringement from others.

Yet, contrary to the above, intangible assets arising from the technical knowledge of employees, customer loyalty, and long-term training benefits find it hard to satisfy the recognition criteria despite the expected future economic benefits deriving from them. It is namely impossible for a company to have full control over these resources or to restrain others from controlling them. In practice, there are also situations when companies spend large amounts of money on employee training with the expectation that the increased skills of the employees will bring future economic benefits. However, the company does not have

control over such economic benefits since it is unable to prevent trained employees changing employers (Mackenzie et al., 2014). The criterion which relates to being able to generate future economic benefits applies to both tangible and intangible asset types. For intangible assets, IAS 38 states that future economic benefits may take the form of revenues from selling products or services, savings in costs, or other benefits due to the company's use of the asset (IAS 38).

2.2.2 Recognition and measurement of intangible assets

Satisfying the definition of intangible asset is in itself insufficient for a company to simply recognise intangible assets in their financial statement. Therefore, IAS 38 states recognition criterion concerning two requirements that must be satisfied: a) the existence of the probability the expected future benefits stemming from the intangible asset will flow to the company; and b) the existence of a reliable measure of the cost of the intangible asset. Further, IAS 38 proposes accounting solutions for companies depending on how intangible assets are acquired or generated. In general, companies can acquire intangible assets in several ways, namely: through individual acquisition, as part of a mixed offer in business, via a government grant, exchanges of assets, or internally creating them (IAS 38).

IAS 38 generally states that the initial recognition of externally obtained intangible assets in the financial statement is at cost, where this cost represents the fair value of the intangible asset on the day of acquisition. Yet, some exceptions appear when intangible assets are acquired by way of a government grant. In this case, besides IAS 38, accounting standard IAS 20 regulates accounting when government grants are involved as well as when government assistance is to be disclosed. Pursuant to IAS 20, companies may choose between two accounting treatments. The first option refers to the initial recognition of both the intangible asset and the grant at their fair value. In the case of the intangible asset is not initially recognised at fair value, companies may recognise it initially at a nominal amount together with the corresponding expenditure attributable to preparing the intangible asset for its intended use (IAS 38).

The biggest challenge for companies is the accounting treatment of intangible assets they have generated internally since they are often subject to considerable uncertainty and information asymmetry (Aboody & Lev, 2000; Moehrle & Walter, 2008). This is especially so with R&D expenditures which generally represent the lion's share of internally-generated intangible assets. For intangible assets that are generated internally, IAS 38 prescribes their initial recognition at cost as well, while stating additional criteria that must be satisfied in order to recognise the intangible assets in the financial statement.

Companies often have problems assessing internally generated intangible assets in terms of identifying those intangible assets which qualify for recognition in the financial statements. This problem is due to two uncertainties: a) identification of an intangible asset expected to

generate future economic benefits; and b) determination of a reliable measurement of the cost of the intangible asset.

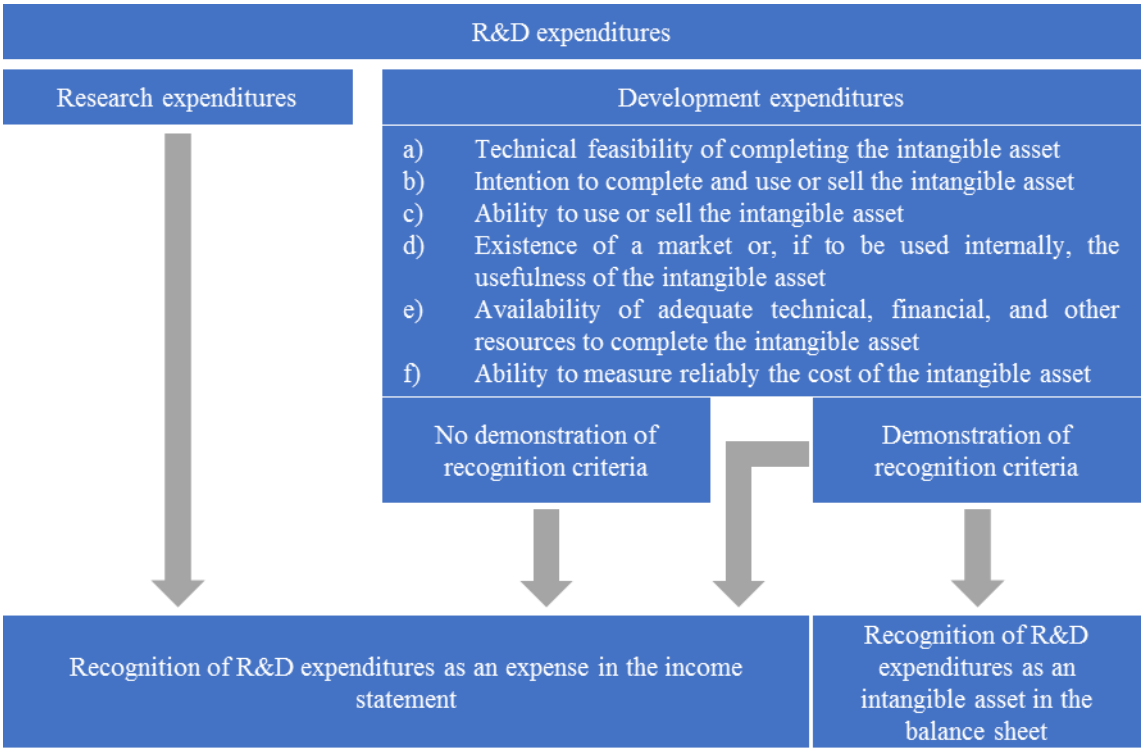
Therefore, apart from general criteria governing an intangible asset's recognition and initial measurement, IAS 38 states additional criteria that focus solely on internally-generated intangible assets and further explain their generation process. For this purpose, IAS 38 divides the intangible asset generation process into two, namely the research phase and the development phase, and gives general definitions aimed at helping to distinguish these two phases. The research phase encompasses an original and planned investigation aimed at achieving new scientific or technical knowledge and understanding. The development phase concerns applying the research findings or other knowledge to plan or design the production of novel or considerably improved devices, materials, processes, products, systems or services prior to commercial production or use starting.

Moreover, IAS 38 also prescribes different accounting treatments of R&D expenditures depending on the phase of the intangible asset generation (IAS 38). As regards spending arising from the research phase, IAS 38 states they should not be recognised as an intangible asset on the balance sheet but should instead be treated as an expense in the income statement. The reason for this accounting treatment of research expenditures is explained by stating that a company cannot demonstrate which research expenditures will generate probable economic benefits in the future. IAS 38 also states that when a company is unable to differentiate the expenditures associated with the research phase from the spending associated with the development phase, the company should consider the entire generation process as the research phase and treat those unclassified expenditures as an expense in the income statement (IAS 38).

As concerns expenditures arising in the development phase, IAS 38 states that a company can identify an intangible asset from those expenditures. Namely, it is more likely a company will expect probable economic future benefits from these expenditures because the development phase often represents a continuation of the research phase and is generally more advanced than the research phase. Further, IAS 38 specifies that expenditures arising in the development phase should be treated as an intangible asset on the balance sheet if the following conditions are met: a) completion of the intangible asset is technically feasible; b) it is intended to complete and use/sell the asset; c) it is possible to use/sell the asset; d) a market for it exists or, if for internal use, the asset is useful; e) sufficient technical, financial and other resources are available to finish the asset; and f) one can reliably measure the asset's cost. When the company proves the existence of an intangible asset, it should further identify the cost at which it should be recognised. In this context, IAS 38 states that the cost of an intangible asset generated internally includes all costs related to creating, producing and preparing the intangible asset to make it ready to operate according to management's intention (IAS 38).

Under IAS 38, R&D expenditures can be accounted for in two different ways: as either an expense in the income statement or an intangible asset on the balance sheet (Mihai et al., 2011). Yet, the second way is subject to the criteria of IAS 38, which are not so easily met. In order to help companies choose the appropriate accounting treatment of R&D expenditures, IAS 38 provides quite detailed guidelines to assist managers through the entire process of the internal generation of intangible assets. Since managers often have power to decide whether recognition criteria are met or not, they might conceal the fact these criteria have been satisfied, implying that development expenditures can then be treated as an expense in the income statement rather than an intangible asset on the balance sheet. The accounting of internally-generated intangible assets or R&D expenditures incurred within the company is summarised and graphically presented in Figure 2.1.

Figure 2.1: The accounting treatment of R&D expenditures under the IAS



Source: IAS 38; own presentation.

As soon as an intangible asset is properly recognised and initially measured, it becomes important for a company to think about its measurement over time. Two options are available for companies to measure their intangible assets in successive periods: the cost model and the revaluation model. According to the cost model, a company should recognise intangible assets at cost. In the revaluation model, which is relevant for intangible assets with an established, active market, the company should recognise such revalued assets at an amount representing their fair value on the day of revaluation without any later accumulated amortisation or later accumulated impairment losses (IAS 38). Although both models are available under IAS 38, the revaluation model is not an option according to SAS 2.

In the context of the successive measurement of intangible assets, it is important that a company determines their useful life as this then leads to different accounting treatments of intangible assets. The useful life of an intangible asset may be finite or indefinite, with an intangible asset with a finite useful life being subject to amortisation while an intangible asset with an indefinite useful life is not. The IAS 38 provides guidelines to help with the decision on whether an intangible asset has a finite or indefinite useful life. These relate to: a) the use of the intangible asset that is expected by the company; b) typical product life cycles for the intangible asset; c) obsolescence of the intangible asset; d) the stability of the industry in which the intangible asset is found; e) expected steps by competitors; f) the spending on maintenance needed to yield the anticipated economic benefits from the asset in the future; g) the period of control over the asset; and h) the reliance on the asset's useful life on the useful life of other assets (IAS 38; Mackenzie et al., 2014).

2.2.3 Disclosures of intangible assets

The accounting guidelines on the disclosures of intangible assets in the financial statements are also covered in IFRS. IAS 1, which guides the presentation of financial statements, obliges companies to disclose information on their intangible assets on a separate line on the balance sheet. Further, IAS 38 provides detailed guidelines for disclosures about intangible assets. In general, for each class of intangible assets, a company must differentiate between the intangible assets that are generated internally and other intangible assets. A company has to disclose information regarding the asset's useful life, amortisation rate and reconciliation of the carrying amount at the year's start and end. Additional requirements for disclosures are also prescribed for intangible assets that are material to the company (IAS 38). Finally, IFRS 13 prescribes disclosures on the fair value measurement of intangible assets.

IAS 38 does not require any disclosures on internally-generated intangible assets such as brands, mastheads, publishing titles, consumer lists and similar items. Although the company has control over these intangible assets, the associated expenditures are always recognised in the income statement since they do not satisfy the recognition criteria to be classified as a development expenditure and recognised on the balance sheet (IAS 38). Still, IAS 38 tries to encourage companies to also disclose information on these intangibles in the notes or in the management reports for the purposes of giving useful information to their stakeholders. Therefore, it seems that disclosures of intangible assets are based more on a discretionary basis.

2.3 Accounting treatment of public support for R&D expenditures

Many modern governments around the world provide public support in the two common forms of R&D subsidies and R&D tax incentives. In order to understand the role held by different public policy instruments, one must understand the accounting foundations for R&D subsidies provided by IAS 20 as well as the accounting for income taxes provided by

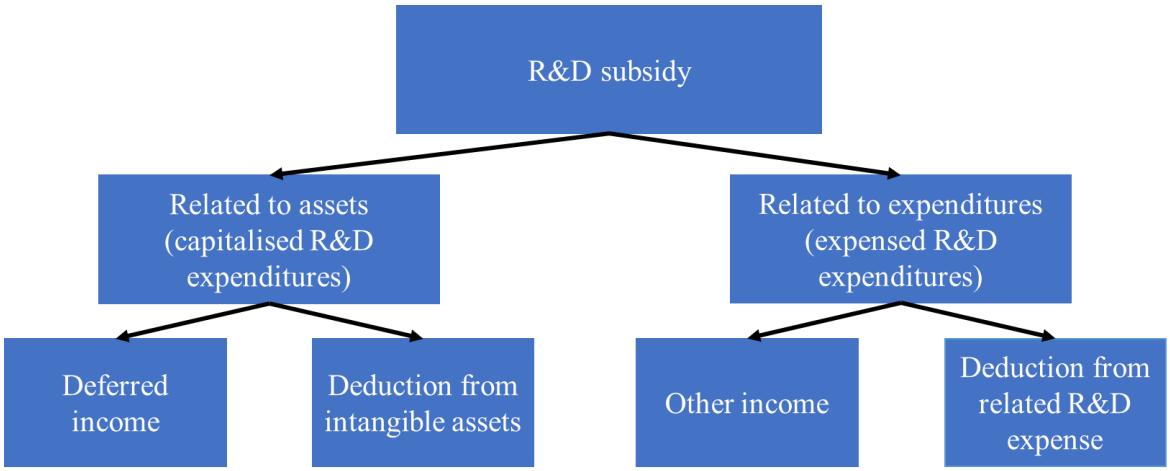
IAS 12 and a certain country's tax legislation, which usually regulates R&D tax incentives. In general, the accounting treatment for R&D subsidies is more regulated by the accounting rules in comparison with R&D tax incentives that usually concern the national taxation system in each country. Although IAS and SAS are highly aligned, some differences are recognised and emphasised.

According to IAS 20, subsidies may be classified in two groups: 1) government grants related to assets; and 2) government grants related to income. Nonetheless, two reasons make a company's receipt of a government subsidy important when preparing financial statements. The first is that where resources are transferred an appropriate accounting method for that transfer must be used. The second is that it is desirable to show the extent to which during the reporting period the company benefited from that subsidy. This permits a comparison of the company's financial statements with those from both earlier times and other companies. Government grants may be recognised if a reasonable assurance is given that: 1) the company shall adhere to the attached conditions; and 2) the subsidies will actually be received (IAS 20).

There are two broad accounting approaches to government subsidies: 1) the capital approach where a subsidy is recognised outside the income statement; and 2) the income approach in which a subsidy is recognised in the income statement over one or more periods. The IFRS prescribe the income approach, meaning a company must systematically recognise government subsidies as income for those periods in which the company recognises the related costs for which the subsidies are intended to compensate as expenses (IAS 20).

Since companies can receive a subsidy for either the acquisition of an asset or the reimbursement of costs, accounting rules apply that take account of the purpose of the subsidy received. If a company receives the subsidy to acquire an asset, there are two options for showing the subsidy in the financial statements. Option one is to label the subsidy as deferred income, that is, it is recognised as income on a rational and systematic and basis over the useful life of the asset. The second method deducts the subsidy to determine the asset's carrying amount. In this case, the subsidy is recognised as income throughout the life of a depreciable asset by using a lower depreciation charge. There are also two options for presenting a subsidy in the financial statements if a company receives the subsidy for the reimbursement of costs. The first one is to present the subsidy income as a separate item as other income, while the second refers to the deduction of the subsidy income from the related expense (IAS 20). Pursuant to the IAS, different options are available for the accounting treatment of R&D expenditures. However, despite the different options for the accounting treatment of R&D subsidies under the IAS, a deduction from intangible assets and R&D expenses is not an option in the SAS. A summary of the accounting treatment for R&D subsidies under the IAS is presented in Figure 2.2.

Figure 2.2: The accounting treatment of R&D subsidies under the IAS



Source: IAS 20; own presentation.

Although R&D subsidies may attract different accounting treatments, no method presented above affects the tax base and hence tax liability. This implies that R&D subsidies are tax-neutral since they are recognised simultaneously with R&D-related expenditures. Therefore, the IFRS prescribes that the accounting treatment of R&D expenditures is strictly aligned with the accounting treatment of R&D subsidies. Thus, management discretion regarding the accounting treatment of R&D expenditures is very difficult or almost impossible.

Under IAS 12, companies can capitalise their development expenditures and amortise them over future periods so as to establish accounting profit, but can deduct them to establish the taxable profit in the period during which they were incurred. Development expenditures of this nature therefore have a tax base of nil because they have already been taken away from taxable profit. The temporary difference is due to the variation between the development expenditures' carrying amount and their zero tax base (IAS 12). Accordingly, a deferred tax liability can arise when development expenditures are capitalised for accounting purposes and expensed for tax purposes. The deferred tax liability may be considered a tax incentive in itself because it gives the opportunity to defer the recognition of taxes to a future period, rather than having to pay in an earlier one (Anagnostopolou & Ballas, 2014).

However, this is not the case for Slovenia due to the high book-tax conformity, meaning that the income for accounting purposes is closely related to the income for tax purposes (Novak & Valentinčič, 2017). Moreover, there is also no single accounting standard in SRS that defines the accounting treatment of R&D tax incentives since they are subject to the Corporate Income Tax Act (Official Gazette of RS, Nos. 117/06, 56/08, 76/08, 5/09, 96/09, 110/09 – ZDavP-2B, 43/10, 59/11, 24/12, 30/12, 94/12, 81/13, 50/14, 23/15, 82/15, 68/16, 69/17 and 79/18) and the Rules on claiming tax relief for investments in research and development (Official Gazette of RS, No. 75/12). The currently applicable legislation in Slovenia, in force since 2012, allows companies to obtain a 100% R&D tax allowance for expenditures on internal and external R&D activities, irrespective of the accounting

treatment of R&D expenditures. Since R&D tax incentives in Slovenia can be obtained for capitalised and expensed R&D expenditures, they do not explicitly dictate the decision on the accounting treatment of R&D expenditures, which in principle applies to R&D subsidies.

2.4 Theoretical considerations and literature review

2.4.1 Theoretical foundations

The fundamental theoretical framework for the empirical analysis of management's discretionary choices regarding the accounting treatment of R&D expenditures is Positive Accounting theory, which proposes that managers hold discretionary power to choose the accounting and valuation methods. The methods can be chosen for the purposes of either pursuing their own interest or corporate performance. This theory is developed by Watts and Zimmerman (1986) and represents an early attempt to empirically explain companies' accounting practices. In this theory, the accounting methods companies adopt are systematically related to their specific characteristics. Due to the potentially opportunistic behaviour of company managers, this theory can help predict and understand which accounting method a company will adopt. There are three hypotheses in Positive Accounting theory: 1) the bonus plan hypothesis; 2) the debt covenant hypothesis; and 3) the political cost hypothesis.

The bonus plan hypothesis assumes that managers are interested in adopting accounting methods that shift operating performance from future periods to the current one to maximise managers' bonuses. The debt covenant hypothesis proposes that, in the case of indebtedness indicators, managers will choose accounting methods that increase the current operating performance and improve the financial position at the expense of future performance. According to the political cost hypothesis, the managers of larger companies, which often encounter great political costs, will choose accounting methods that reduce the current operating performance in favour of future performance. This hypothesis includes tax effects (Watts & Zimmerman, 1986).

2.4.2 The importance of R&D accounting treatment in the financial reporting context

Although public support for R&D investment (especially R&D tax incentives) can drive the decision on the R&D accounting treatment, it is necessary to understand its importance in the context of financial reporting. Namely, in the accounting literature one finds conflicting opinions on the accounting treatment of R&D expenditures. Some authors support R&D capitalisation in the belief that R&D expenditures can produce future economic benefits, representing a meaningful reason to treat them as an asset on the balance sheet (Ballester et al., 2003; Sougiannis, 1994). Accordingly, they argue that R&D capitalisation allows management to signal its private information about successful (capitalised) and unsuccessful

(expensed) R&D investments, which then helps investors discriminate between those investments (Aboody & Lev, 1998; Healy et al., 2002; Kothari et al., 2002; Callimaci & Landry, 2004; Ahmed & Falk, 2006; Cazavan-Jeny et al., 2011; Wang & Fan, 2014; Wang et al., 2017).

Yet, other authors are opposed to R&D capitalisation because they argue that future economic benefits are doubtful and management cannot assert the success of an R&D project with certainty. They therefore contend that firms' R&D expenditures should be treated as expenses in the income statement since such accounting treatment may make financial reports more objective (Cazavan-Jeny et al., 2011; Kothari et al., 2002). Namely, expensing R&D expenditures eliminates the opportunity to recognise R&D expenditures on the balance sheet of unsuccessful R&D investments that have a low probability of success (Nixon, 1997; Mande et al., 2000). In short, recognition of R&D expenditures on the balance sheet (capitalisation) highlights their relevance and usefulness, while recognition of R&D expenditures in the income statement (expensing) highlights the objectivity and reliability of the accounting measurement (Healy et al., 2002; Wang et al., 2017).

In the context of IFRS and SAS, the capitalisation of R&D expenditures is allowed for R&D expenditures incurred within the company that satisfy certain criteria for them to be classified as expenditures from the development phase. Despite the clearly defined guidelines in the accounting standards governing the accounting treatment of R&D spending, some authors claim that such accounting regulation allows management a free choice of the accounting treatment for R&D expenditures, meaning a company must decide whether the criteria for capitalisation have been fulfilled or not (Markarian et al., 2008). From the perspective of financial reporting, it is therefore very important to identify and understand the determinants and motivations of the decision on the accounting treatment of R&D expenditures. This is particularly important for the users of financial reports in order for them to be able to recognise the presence of earnings management or misleading information. Namely, financial reports, which are required and prepared according to the applicable accounting standards, are a useful tool for providing different financial information to the company's stakeholders. They are often used as a communication channel via which management provides information about past financial performance and future expectations.

The users of financial reports are a mixed group with different information requirements. From the perspective of private companies and given that the owners of private companies are directly involved in management, a high level of information asymmetry may only exist between the company and its external stakeholders. The letter refers especially to creditors and tax authorities, which are often the main stakeholders of private companies interested in the financial information provided by financial reports (Di Pietra et al., 2008). While creditors require financial reports in order to evaluate the company's financial position and to thereby assess its ability to pay its financial obligations upon maturity, tax authorities use them to determine the tax liability. Consequently, this often leads to a situation where

companies are motivated to report a better financial position by pursuing the profit-maximisation goal when it comes to the creditors, and motivated to report lower accounting income by pursuing the tax-minimisation goal with respect to the tax authorities. These goals are mutually exclusive and frequently cannot be achieved simultaneously.

Anagnostopoulou and Ballas (2014) argue that investments in R&D activities are strongly influenced by financial reporting goals in terms of boosting accounting profit or avoiding reporting losses. Relying on a sample of companies in the United Kingdom that expense all R&D expenditures as incurred, Garcia Osma and Young (2008) establish that short-term earnings pressures induce contemporaneous cuts in R&D investment. This implies that in this case companies pursue the profit-maximisation goal by reducing their investment in R&D activities. Moreover, in a situation where R&D capitalisation is allowed companies can also pursue the profit-maximisation goal by capitalising their R&D expenditures on the balance sheet. The consequences of the R&D accounting choice are reflected in the financial reports for the year in which the accounting choice is made and for future accounting periods (Wang et al., 2017). Many authors thus argue that the accounting choice on the accounting treatment of R&D expenditures can form part of earnings management by influencing the reported income and other financial performance measures (Anagnostopoulou & Ballas, 2014; Dinh et al., 2016; Markarian et al., 2008; Wang, 2016, Wang et al., 2017).

Although both methods – cuts in R&D investment and R&D capitalisation – result in higher accounting income, their use cannot achieve the reduction of the tax base from which the tax liability is determined, meaning that companies cannot pursue a tax-minimisation strategy in this way. This is a reason explaining why many choices in financial reporting include a search for a compromise between the goals of profit maximisation and tax minimisation (Shackelford et al., 2001). In line with Anagnostopoulou and Ballas (2014), further discussion is based on the assumption that companies are motivated for profit maximisation in order to exhibit a company's improved financial position for stakeholders by displaying the motivation to minimise their tax liabilities at the same time.

2.4.3 The role of public support for R&D investment on its accounting treatment

The accounting literature contains only a few empirical studies that examine the role of different public policy instruments in terms of earnings management. Pappas et al. (2017) consider the relationship between public support and income smoothing, which is measured by applying two widely used measures, i.e. the ratio of the standard deviation of earnings adjusted for abnormal accruals to the standard deviation of cash flows from operations, and the correlation between the change in total accruals and the change in pre-managed earnings. Using a sample of listed companies in the USA, they establish that public support positively impacts income-smoothing behaviour. They find that companies in receipt of public support smooth their earnings more aggressively than their counterparts which do not receive public support. This is consistent with the idea that companies which receive public support often

have higher political costs and motivation for income smoothing in order to steer away from public attention and to reduce their political exposure. Moreover, by separating public support into tax incentives and subsidies, they find that income smoothing is more pronounced when public support is granted via non-tax-related channels, which gain greater public visibility than other sources.

In another context, using data for public companies in China, He (2016) notes that companies engage in less earnings management, measured by conventional linear accrual models, when they receive greater preferential tax treatment or higher financial subsidies. This study also shows that preferential tax treatment reduces earnings management more strongly than financial subsidies. This could be due to the fact that a company regards preferential tax treatment as a more stable and long-term economic incentive to a subsidy that is different from year to year. This reduces companies' motivation to become involved in earnings management so as to adjust their performance.

The two empirical studies presented above suggest that public policies can be considered important drivers of companies' business decisions. Yet, these findings are not fully transferable to the setting of public support for R&D investment and the relationship with its accounting treatment since management discretion on the R&D accounting treatment is only possible in the case of R&D tax incentives. Still, some empirical studies address the role of public support for R&D investment (especially R&D tax incentives) and its impact on the R&D accounting choice.

Since tax is often seen as an important factor driving accounting choices, Wang (2016) provides a tax-perspective explanation for certain accounting choices regarding R&D expenditures on a sample of Chinese listed companies. In China, a distinction is made of the R&D accounting treatment that is consistent with IAS 38. A negative association is shown in the results between the capitalisation ratio of R&D spending and the effective tax rate, suggesting that companies facing a higher effective tax rate have a considerably lower capitalisation ratio of R&D expenditures than companies whose effective tax rate is lower. These results show that companies with a higher effective tax rate are more motivated to expense their R&D expenditures rather than to capitalise them due to the higher tax benefit stemming from the reduced tax liability. The negative association between the effective tax rate and capitalisation of R&D spending is shown to be more obvious for companies whose financial reporting costs are lower, are not state-owned and encounter an environment of weak tax enforcement.

Further, the empirical study by Anagnostopoulou and Ballas (2014) examines the role of R&D tax incentives in R&D accounting treatment. Relying on a cross-country sample of large listed European companies that follow IFRS, they establish that R&D tax incentives have an impact on companies' accounting R&D policy. R&D tax incentives at the country level induce companies to treat R&D expenditures as an intangible asset on the balance sheet at least to some extent, rather than treating them as an expense in the income statement. They

explain that R&D tax incentives may help to align companies' conflicting goals represented by the goals of minimising the tax burden and maximising the accounting income. R&D tax incentives offer companies an opportunity to reduce the amount of tax-related cash outflow and help accomplish the tax-burden-minimisation goal. On the other hand, capitalising R&D expenditures gives an opportunity for companies to simultaneously report higher accounting income.

Both of the empirical studies above presented address the role of tax-related issues on the accounting treatment of R&D expenditures using a sample of larger and listed companies. Therefore, the conclusions they draw cannot be generalised to smaller and non-listed companies, which are more sensitive to tax-related matters (Ravšelj & Aristovnik, 2018a; Ravšelj et al., 2019). The motivation for reducing tax is more prominent in smaller and non-listed companies than in larger and listed companies, especially due to the different levels of the principal-agent conflict. That is to say, the owners of smaller and non-listed companies are directly involved in management, suggesting the principal-agent conflict is much less present. Due to the absence or low level of information asymmetry between management and owners, the latter will benefit from tax savings in a more direct way. This consequently enhances the motivation of smaller and non-listed companies to lower their accounting profit, which is actually a basis of taxable income. A summary of the key accounting empirical literature is presented in Table 2.1.

Table 2.1: Summary of key accounting empirical literature

Authors	Countries	Findings
Pappas et al. (2017)	USA	Public support has a positive impact on income-smoothing behaviour. They find that companies receiving public support smooth their earnings more aggressively than their counterparts which do not receive public support.
He (2016)	China	Companies engage in less earnings management if they enjoy more preferential tax treatment or more financial subsidies. This study also establishes that preferential tax treatment mitigates earnings management to a greater extent than financial subsidies.
Wang (2016)	China	The results reveal a negative association between the effective tax rate and the capitalisation ratio of R&D expenditures.
Anagnostopoulou and Ballas (2014)	EU member states (UK, France, Germany, Italy, Spain, Netherlands)	R&D tax incentives impact companies' accounting R&D policy. R&D tax incentives at the country level induce companies to treat R&D expenditures as an intangible asset on the balance sheet at least to some extent, rather than treating them as an expense in the income statement.

Source: Own presentation.

In the context of the R&D accounting decision, public support for R&D investment in the form of R&D tax incentives may provide a good mechanism for striking a compromise between the profit-maximisation and tax-minimisation goals, i.e. the use of R&D tax

incentives reduces companies' tax base and hence their tax liability. This is often considered a desirable outcome for companies because this will leave them with more funds available to pursue any kind of business goals they may have (Anagnostopoulou & Ballas, 2014). Yet, the accounting rules prescribed by IAS 38 limit the capitalisation of R&D expenditures by providing certain criteria which should be followed by companies regarding the recognition of an intangible asset on the balance sheet. It may accordingly be assumed that the accounting standards restrict R&D capitalisation rather than encourage it. Nevertheless, Markarian et al. (2008) establish that management has a discretion on the decision whether the recognition criteria have been satisfied or not, allowing them to opportunistically decide on the accounting treatment of R&D expenditures.

Moreover, companies' motivation for pursuing certain goals is very important when considering whether certain criteria for R&D capitalisation have been met or not. In this context, also the level of book-tax conformity plays an important role. The Slovenian business environment is characterised by high book-tax conformity, meaning that the accounting income determined and disclosed in the income statement is closely associated with the taxable income recognised in the company tax return (Novak & Valentinčič, 2017). In the case of R&D expenditures, this implies that only those R&D expenditures expensed and recognised in the income statement will be considered in the tax return, while R&D expenditures treated as an intangible asset will not. In the absence of tax incentives, the following situations may occur. If a company chooses to capitalise its R&D expenditures this will result in higher accounting and taxable income and a higher tax liability. On the contrary, if a company chooses to expense R&D expenditures this will result in lower accounting income and taxable income as well as in a lower tax liability. In both situations, there is a conflict between profit maximisation and tax minimisation. In the first case, the company pursues the profit-maximisation goal, while in the second the tax-minimisation goal.

Taking the above into the account, R&D tax incentives may be a good mechanism for striking a balance between accounting income-maximisation and tax-minimisation goals. That is because, regardless of the accounting treatment of R&D expenditures, the use of R&D tax incentives will result in a lower tax liability. Beneficiaries of R&D tax incentives are thus motivated to capitalise R&D expenditures in order to exhibit higher accounting income, while the benefits of R&D tax incentives will reduce the tax base and tax liability. In this way, the conflict between profit maximisation and tax minimisation will be reduced. It is therefore expected that R&D tax incentives have a positive impact on R&D capitalisation.

When it comes to R&D subsidies, a second public policy instrument for enhancing R&D investment, it is important to stress that R&D subsidies do not affect accounting income, taxable income and consequently tax liability. Therefore, they cannot be seen as a mechanism for balancing out the goals of profit maximisation and tax minimisation. Namely, R&D subsidies are tax-neutral since they are recognised simultaneously with the R&D-

related expenditures. The IFRS prescribes that the accounting treatment of R&D expenditures is strictly aligned with the accounting treatment of R&D subsidies, making the decision on the accounting treatment of R&D expenditures very difficult or almost impossible.

Although both forms of public support for R&D investment are currently available to Slovenian companies, the latest trends indicate the predominance of R&D tax incentives over R&D subsidies in the Slovenian and wider contexts (Ravšelj & Aristovnik, 2017, 2018b). Therefore, in the Slovenian business environment, R&D tax incentives are expected to be the primary instrument of public support affecting the accounting treatment of R&D expenditures. Based on the extensive literature review, it is therefore expected that the beneficiaries of R&D tax incentives as well as the extent of R&D tax incentives will be important factors in the accounting treatment of R&D expenditures. Namely, companies which do not claim R&D tax incentives have a higher effective tax rate than their counterparts in receipt of R&D tax incentives, implying they are more motivated to expense their R&D expenditures than to capitalise them due to a greater benefit arising from the reduced tax liability. On the contrary, companies which claim R&D tax incentives have a lower effective tax rate and are therefore more motivated to capitalise their R&D expenditures because they are able to find a compromise between the profit-maximisation and tax-minimisation goals.

Therefore, two different research hypotheses are developed. The first research hypothesis refers solely to examining whether companies that benefit from indirect public support for R&D investment in the form of R&D tax incentives are more inclined to capitalise their R&D expenditures. Since companies that claim R&D tax incentives generally have a lower effective tax rate, it is expected they are more inclined to treating R&D expenditures as intangible assets on the balance sheet. Accordingly, the following research hypothesis is proposed:

- **Hypothesis 2.1:** *The beneficiaries of indirect public support for R&D investment in the form of R&D tax incentives are more likely to treat R&D expenditures as intangible assets on the balance sheet.*

In addition to the use of R&D tax incentives, their extent may hold important implications for the accounting treatment of R&D expenditures. That is to say, companies that benefit from higher R&D tax incentives have a much lower effective tax rate than their counterparts. It is therefore expected that the extent of R&D tax incentives may have important implications for companies' decision on the accounting treatment of R&D expenditures. The following research hypothesis is thus proposed:

- **Hypothesis 2.2:** *The extent of indirect public support for R&D investment in the form of R&D tax incentives positively impacts companies' decision to treat R&D expenditures as intangible assets on the balance sheet.*

2.5 Data and research methods

2.5.1 Sample selection

The empirical analysis is performed on a comprehensive sample of Slovenian companies. The dataset is obtained from three main sources provided by the Statistical Office of the Republic of Slovenia (SORS). The first one is the database including details of the R&D activity of Slovenian companies. It covers all companies that are: 1) registered to perform R&D activity (NACE 72 classification) and have more than two employees; 2) not registered to perform R&D activity but are the recipients of R&D subsidies; 3) eligible for general and regional R&D tax incentives; and 4) reporting about their R&D investments in a survey on innovation activity (SORS, 2018). This database is the leading source of data, meaning that it then dictates the number of companies that could be included in the empirical analysis. It provides crucial and comprehensive data on R&D activity in a certain company. The second source provides data taken from corporation tax forms. It includes all relevant information on a company's tax status, including its use of R&D tax incentives. Finally, the third source gives data from the financial statements of companies, including information from the balance sheet and income statement. All three data sources are merged to create a unique and comprehensive dataset of Slovenian companies.

The nature of the empirical analysis requires a research period that encompasses stable operating conditions for companies. Accordingly, the research period for the sample of Slovenian companies is restricted to the latest available data for the five-year period 2012–2016. Ever since R&D tax incentives were introduced in Slovenia in 2005, they have been subject to significant changes in terms of their rates. The latest big change in the R&D tax allowance rate was in 2012 when the rate was significantly increased to 100%. After that, no significant changes have occurred in terms of changing the R&D tax allowance rate in Slovenia. Nevertheless, these changes may produce a situation in which companies opportunistically time their patterns of R&D spending in order to "game" additional benefits from R&D tax incentives (Chen & Gupta, 2018). Therefore, the research period in this empirical analysis is restricted to the latest available data for the five-year period 2012–2016.

The final sample consists of Slovenian non-financial private companies operating in either the manufacturing (NACE 10-33) or service sectors (NACE 35-99) and taking the legal organisational form of a private or public limited company. Namely, such companies are a good reflection of Slovenia's small open economy. Moreover, company-year observations with incomplete data, negative equity and which have a non-positive value of net sales are excluded from the empirical analysis. The final unbalanced panel dataset of Slovenian companies consists of 3,417 company-year observations. Although the overall sample of Slovenian companies included in the empirical analysis invests in R&D activity, a share of 27% of the final sample does not benefit from public support for R&D investment. The remaining 73% of the final sample can be further divided into company-year observations

in which Slovenian companies receive or claim: 1) only R&D subsidies (19% of the sample); 2) only R&D tax incentives (39% of the sample); or 3) both instruments of public support for R&D investment (15% of the sample). Interestingly, 33% of the final sample does not claim R&D tax incentives despite having a positive tax base and a positive value of R&D investment financed by the company itself alone (without R&D subsidies). The distribution of the final sample of Slovenian companies by years is shown in Table 2.2. It reveals that the company-year observations vary from a minimum of 586 in 2012 to a maximum of 748 in 2015.

Table 2.2: Sample distribution of Slovenian companies, by years

Year	No.	Share (in %)
2012	586	17.15
2013	672	19.67
2014	725	21.22
2015	748	21.89
2016	686	20.08
Total	**3,417**	**100**

Source: SORS, 2018; own calculations.

2.5.2 Variables

2.5.2.1 Dependent variable

The dependent variable employed in this study is the capitalisation of R&D expenditures (CAP). It measures the accounting treatment of R&D expenditures. Due to the lack of information on the amortisation of capitalised R&D expenditures, it is defined as a binary variable. It actually divides companies into two groups: 1) companies that recognise R&D as an intangible asset on the balance sheet to a partial or full extent (capitalisers); and 2) companies that recognise R&D expenditures as an expense in the income statement (expensers). An intangible assets balance sheet item comprises several subitems such as long-term property rights, goodwill, long-term deferred R&D costs and other intangible assets. For the purposes of the categorisation, the following approach is applied. Namely, if a company reports a non-zero value for long-term deferred R&D costs on its balance sheet representing an intangible asset stemming from R&D investment, the company-year observation is considered as a capitaliser; otherwise, it is considered as an expenser. Accordingly, the dependent variable takes the value of 1 if a company-year observation is classified as a capitaliser, and 0 otherwise. A similar categorisation approach was also taken in previous accounting empirical studies (O'Connel et al., 2017; Oswald & Zarowin, 2007; Oswald, 2008).

2.5.2.2 Independent variables

Two main independent variables are employed in these empirical studies, where both capture matters related to R&D tax incentives (TAX). The first independent variable indicates beneficiaries of R&D tax incentives (TAXD). It is defined as a dummy variable which takes the value of 1 if a company has claimed an R&D tax incentive, and 0 otherwise. The second independent variable tries to measure the extent of R&D tax incentives (TAXR). It is defined as the amount of claimed R&D tax incentives divided by the amount of the tax base and actually represents the tax-base reduction due to the R&D tax incentives. According to the proposed research hypotheses, it is expected that both R&D tax-incentive-related variables positively impact the capitalisation of R&D expenditures, where these variables are considered separately in the empirical analysis.

2.5.2.3 Control variables

Several empirical studies investigate the determinants of the accounting treatment of R&D expenditures, with most typically concentrating on fundamental factors. Accordingly, prior empirical studies suggest the choice of capitalising R&D expenditures on the balance sheet as an intangible asset is driven by various factors such as financial leverage (LEV), profitability in terms of return on assets (ROA), company size (SIZE) and legal form (FORM). Therefore, all of these fundamental factors are considered as control variables in the empirical model given that they may be important drivers of the R&D accounting treatment decision.

Financial leverage (LEV) is a crucial factor behind the decision on the accounting treatment of R&D spending. It is measured as total (short-term and long-term) liabilities divided by total assets (Anagnostopoulou & Ballas, 2014; Markarian et al., 2008: He, 2016; Wang, 2016). The empirical literature establishes that companies are often inclined to engage in earnings management in order to improve their financial reports and to thus avoid violating debt covenants (Burgstahler et al., 2006; Givoly et al., 2010). Since R&D accounting treatment is often considered to form part of earnings management by influencing the profitability indicators, it is expected that companies with greater financial leverage are more likely to capitalise their R&D expenditures so as to improve their financial position and avoid breaching debt covenants.

Return on assets (ROA) is another important determinant of the R&D accounting treatment decision. It is defined as earnings before taxes divided by total assets. Given that the accounting treatment of R&D expenditures affects the accounting income, taxable income and thus tax liability, profitability may play an important role in the R&D accounting treatment decision. The motivation for expensing R&D expenditures rather than capitalising them exists so long as the profits remain positive since expensing R&D expenditures implies lower profitability indicators and hence a lower tax liability. On the contrary, in the case of negative profitability, companies may not be motivated to expense their R&D expenditures

because negative profitability does not impose a tax liability on companies regardless of the R&D accounting treatment. In other words, expensing R&D expenditures may be more attractive for profit-making companies since they can lower their tax liability, while capitalising R&D expenditures may be more attractive for loss-making companies as they can improve their position on the balance sheet. Therefore, it is expected that companies with lower profitability are more likely to capitalise their R&D expenditures (Oswald, 2008).

Company size (SIZE) is often considered a fundamental determinant of the R&D accounting treatment decision and is measured by the widely used proxy of the natural logarithm of total assets (Cazavan-Jeny & Jeanjean, 2006; Cazavan-Jeny et al., 2011; Eierle & Wencki, 2016; Markarian et al., 2008). In general, larger companies have established internal management accounting systems that help them manage their R&D activities more efficiently (Dinh et al., 2016). Hence, larger companies may have an advantage over smaller companies in dividing the R&D expenditures incurred between the research and development phases. Moreover, larger companies enjoy economies of scale, meaning that the efficiency of R&D investment may be higher (Wang, 2016). This means that larger companies can easily justify whether the criteria for R&D capitalisation are satisfied or not. Accordingly, it is expected that company size has a positive impact on the capitalisation of R&D expenditures.

Legal form (FORM) as an approximation for the information asymmetries between shareholders and management can also be very important in terms of the R&D accounting treatment decision. It is defined as a dummy variable, which takes the value of 1 if a company has the legal organisational form of a public limited company, and 0 if a company has the legal organisational form of a private limited company. The literature shows the information asymmetries between shareholders and management depend on the legal form a company takes due to the varying information rights held by the owners. For instance, shareholders of private limited companies hold more comprehensive information rights than shareholders of public limited companies. One anticipates information asymmetries to thus be more common in public limited companies than in private limited ones (Eierle & Wencki, 2016). Thus, it is expected that companies operating in the legal form of a public limited company are more likely to capitalise their R&D expenditures.

In addition, year dummy variables (YEAR) are included in the empirical analysis for the purposes of controlling for time effects. Based on 2012, there are four dummy variables which take the value of 1 if a company-year observation is from a year studied (from 2013 to 2016), and 0 otherwise.

This empirical study includes the entire range of different variables which are important for the empirical analysis of the relationship between public support for R&D investment and the accounting treatment of R&D expenditures. A summary of all variables used in the empirical analysis is presented in Table 2.3.

Table 2.3: Summary of variables used in the empirical analysis

Abbreviation	Variable	Definition	Source
Dependent variable			
CAP	Capitalisation of R&D expenditures	Dummy variable that takes 1 if a company-year defined as a capitaliser, 0 otherwise.	SORS
Independent variables			
TAXD	Beneficiary of R&D tax incentives	Dummy variable that takes 1 if a company claims R&D tax incentives, 0 otherwise.	FURS
TAXR	The extent of R&D tax incentives	The ratio between R&D tax incentives and the tax base.	FURS
Control variables			
LEV	Financial leverage	The ratio between total liabilities and total assets.	AJPES
ROA	Return on assets	The ratio between earnings before taxes and total assets.	AJPES
SIZE	Company size	The natural logarithm of total assets.	AJPES
FORM	Legal form	Dummy variable that takes 1 if a company is a public limited company, 0 otherwise.	AJPES
YEAR	Year dummy variable	Dummy variable that takes 1 for a year studied, 0 otherwise.	AJPES

Note: SORS – Statistical Office of the Republic of Slovenia; FURS – Financial Administration of the Republic of Slovenia; AJPES – Agency of the Republic of Slovenia for Public Legal Records and Related Services.

Source: Own presentation.

2.5.3 Research methods

This empirical study conducts a comprehensive empirical analysis of the impact of public support for R&D investment on the accounting treatment of R&D expenditures. Accordingly, the dependent variable – the capitalisation of R&D expenditures (CAP) – is binary and distinguishes capitalisers and expensers. Where the outcome variable is discrete, binary choice models such as logistic regression models are frequently used statistical techniques (Hosmer et al., 2013). In this empirical study, a pooled binary logistic regression analysis is estimated. A similar approach was taken in other studies since it is assumed that a panel-level variance component does not significantly impact the estimation and therefore panel-based estimators have no advantages over pooled estimators (Eierle & Wencki, 2016; O'Connel et al., 2017).

For the purposes of evaluating the probability of companies' membership of a certain group, the binary logistic regression analysis uses the maximum likelihood estimation. In addition, a binary logistic regression analysis does not assume normality, linearity or homoscedasticity, making this research method more attractive (Starkweather & Moske, 2011). The reasons for using a logistic regression model in the empirical analysis are thus the following: 1) it allows easier interpretation of the empirical results; 2) it allows characteristics of two groups of companies to be compared; and 3) it removes deficiencies in dealing with outliers (Lee, 2019).

Since the accounting treatment of R&D subsidies is strictly aligned with the accounting treatment of R&D expenditures, which renders the decision on the accounting treatment of R&D expenditures very difficult or almost impossible, the empirical analysis focuses on public support for R&D investment in the form of R&D tax incentives. To examine the impact of R&D tax incentives on the accounting treatment of R&D expenditures, two different R&D tax-incentive-related variables (TAX) are regressed against the main variable of interest: the capitalisation of R&D expenditures (CAP). In addition, control variables are further included in the logistic regression models, namely financial leverage (LEV), profitability measured as return on assets (ROA), company size (SIZE) and legal form (FORM). In order to control for year effect, time dummy variables (YEAR) are taken into consideration as well. The presented binary regression model is estimated using logistic estimation. Robust logistic regression models are estimated to control for heteroscedasticity. The logistic regression model is presented in Equation (2.1) where the main independent variables of interest (TAX) are presented as a vector.

$$Logit\ CAP_i = \alpha_0 + \beta_1 TAX_i + \beta_2 LEV + \beta_3 ROA_i + \beta_4 SIZE_i + \beta_5 FORM_i + \sum YEAR_i + \varepsilon_i \qquad (2.1)$$

where CAP is a dependent variable measuring the accounting treatment of R&D expenditures and takes the value of 1 if the company-year observation is defined as a capitaliser, and 0 if the company-year observation is defined as an expenser. Further, independent variables are identified as a vector of independent variables (TAX), such as: beneficiary of R&D tax incentives (TAXD) and the extent of R&D tax incentives (TAXR). In addition, some control variables are included that are possible determinants of the R&D accounting treatment decision, such as: financial leverage (LEV), return on assets (ROA), company size (SIZE) and legal form (FORM). Finally, control variables for time effects are also considered (YEAR).

2.6 Empirical results

2.6.1 Descriptive statistics

Descriptive statistics of the variables (except year effects) for the period 2012–2016 are presented in Table 2.4, which shows the mean and standard deviation values for the variables included in the empirical analysis. Since companies represent a very heterogeneous group of units, there may be some outliers in the data. In order to eliminate the effect of possibly spurious outliers, all of the continuous variables are winsorised at the 0.5% and 99.5% levels by each year. Moreover, the Winsorisation procedure is also often considered as robust statistics (Reifman & Keyton, 2010). The descriptive statistics is presented for the total sample as well as for the capitalisers and expensers separately. In the last column, mean differences in the determinants of R&D capitalisation between the capitalisers and expensers are shown. Accordingly, a t-test is performed so as to test whether the differences between

the capitalisers and the expensers in certain determinants of R&D capitalisation are significant.

The descriptive statistics presented reveal that, of the total of 3,417 company-year observations, 695 company-year observations (20% of the sample) are classified as capitalisers and 2,722 company-year observations (80% of the sample) are classified as expensers. They also show that 54% of the sample of Slovenian companies claim R&D tax incentives. Furthermore, the mean value of the extent of R&D tax incentives (TAXR) reveals that on average Slovenian companies reduce their tax base for 26% due to the R&D tax incentives. The mean value of financial leverage (LEV) indicates it is at a relatively high level compared to the profitability (ROA), which reveals that on average Slovenian companies are effectively using their assets to generate profits. Finally, the descriptive statistics shows that 12% of the sample takes the legal organisational form of a public limited company.

Table 2.4: Descriptive statistics of the variables

Variable	Total sample (n = 3,417)		Capitalisers (n = 695)		Expensers (n = 2,722)		Mean difference
	Mean	SD	Mean	SD	Mean	SD	
CAP	0.203	0.403	1.000	0.000	0.000	0.000	-
TAXD	0.541	0.498	0.580	0.494	0.531	0.499	0.049*
TAXR	0.258	0.337	0.290	0.351	0.250	0.332	0.040**
LEV	0.426	0.228	0.498	0.215	0.407	0.227	0.091***
ROA	0.080	0.132	0.055	0.121	0.086	0.134	-0.031***
SIZE	14.915	2.079	15.402	2.108	14.791	2.054	0.611***
FORM	0.129	0.335	0.183	0.387	0.115	0.319	0.068***

*Note: 1) Data for Slovenian companies are strictly confidential so the minimum and maximum values for an individual variable are not presented. 2) Levels of significance: *p<0.05; **p<0.01; ***p<0.001.*

Source: SORS, 2018; own calculations.

As suggested by the t-test results, a comparison of the capitalisers and expensers shows these two groups are significantly different in all determinants that drive the decision on the accounting treatment of R&D expenditures. This comparison makes it evident that R&D tax incentives are more widely used by capitalisers. Further, it is clear that capitalisers engage in a greater level of the extent of R&D tax incentives (TAXR), financial leverage (LEV) and lower profitability (ROA). Finally, it also shows that capitalisers are larger companies, as further supported by the share of companies that take the legal form of a public limited company since those companies are typically larger than companies that have adopted the legal form of a private limited company.

Table 2.5 presents the Pearson correlation between variables (except year effects). The simple correlation shows a strong, positive and significant correlation between the R&D tax-incentive-related variables (TAXD and TAXR). Yet, these variables are estimated in

different logistic regression models. Moreover, Pearson's correlation matrix reveals these variables are positively correlated with the capitalisation of R&D expenditures (CAP).

Table 2.5: Pearson correlation matrix of the variables for the Slovenian companies

Variable	CAP	TAXD	TAXR	LEV	ROA	SIZE	FORM
CAP	1						
TAXD	0.039*	1					
TAXR	0.048**	0.706***	1				
LEV	0.161***	-0.164***	-0.085***	1			
ROA	-0.096***	0.349***	0.204***	-0.342***	1		
SIZE	0.118***	0.068***	-0.167***	0.065***	-.0.115***	1	
FORM	0.081***	-0.074***	-0.129***	-0.044*	-0.108***	0.418***	1

*Note: Levels of significance: *p<0.05; **p<0.01; ***p<0.001.*

Source: SORS 2018; own calculations.

As concerns other (control) variables, the Pearson correlation matrix shows the following: financial leverage (LEV), company size (SIZE) and legal form (FORM) are positively correlated, while profitability (ROA) is negatively correlated with the capitalisation of R&D expenditures. All of the results presented above are in line with the initial expectations. Nevertheless, the simple correlation between the explanatory variables does not indicate any strong relationship, suggesting there is no issue of multicollinearity in the data of these Slovenian companies.

2.6.2 Logistic regression analysis

This chapter considers the impact of public support for R&D investment on the accounting treatment of R&D expenditures. However, since the accounting treatment of R&D subsidies is strictly aligned with the accounting treatment of R&D expenditures, in turn making the decision on the accounting treatment of R&D expenditures very difficult or almost impossible, there is no sense in including R&D subsidies in the empirical analysis. The analysis therefore concentrates on R&D tax incentives.

The results of the empirical analysis are presented in Table 2.6, where two different logistic regression models are estimated. The first model (Model 2.1 (a)) is estimated in order to determine whether the beneficiaries of R&D tax incentives are more likely to capitalise their R&D expenditures, while the second model (Model 2.1 (b) is considered in order to establish whether the extent of R&D tax incentives has a positive impact on R&D capitalisation.

The empirical results of the first logistic regression model (Model 2.1 (a)) show the regression coefficient of beneficiaries of R&D tax incentives (TAXD) is positive and significant. This confirms the first research hypothesis (Hypothesis 2.1) which states that the beneficiaries of indirect public support for R&D investment in the form of R&D tax

incentives are more likely to treat R&D expenditures as intangible assets on the balance sheet. Moreover, the empirical results for the second logistic model (Model 2.1 (b)) reveal that the extent of R&D tax incentives (TAX) positively influences the capitalisation of R&D expenditures. This confirms the second research hypothesis (Hypothesis 2.2) which states that the extent of indirect public support for R&D investment in the form of R&D tax incentives positively impacts companies' decision to treat R&D expenditures as intangible assets on the balance sheet.

Table 2.6: Results of logistic regression models for the relationship between public support for R&D investment and R&D capitalisation

Variable	**Predicted Sign**	**Model 2.1 (a) CAP**	**Model 2.1 (b) CAP**
TAXD	+	0.470*** (0.098)	
TAXR	+		0.747*** (0.133)
LEV	+	1.778*** (0.215)	1.744*** (0.216)
ROA	-	-1.498** (0.495)	-1.226* (0.487)
SIZE	+	0.098*** (0.023)	0.130*** (0.024)
FORM	+	0.393** (0.131)	0.369** (0.131)
Constant	?	-3.975*** (0.383)	-4.420*** (0.402)
Year	?	Yes	Yes
Pseudo R^2		0.0498	0.0519
Chi-Square		148.73***	148.44***
Observations		3,417	3,417

*Note: 1) Levels of significance: *p<0.05; **p<0.01; ***p<0.001. 2) Heteroscedasticity-robust standard errors are in parentheses*

Source: SORS, 2018; own calculations.

The presented empirical results are consistent with Wang (2016), suggesting there is a negative correlation between the effective tax rate and the capitalisation of R&D expenditures in China. This means that companies with a lower effective tax rate have less motivation to capitalise their R&D expenditures, and vice versa. Since R&D tax incentives result in a lower effective tax rate for companies, this implies they are more motivated to capitalise their R&D expenditures rather than expensing them. The findings are also consistent with Anagnostopoulou and Ballas (2014) who argue that R&D tax incentives at the country level encourage the capitalisation of R&D capitalisation in the EU context. Overall, this finding can be explained via the perspective of striking a balance between two conflicting goals, an exercise companies generally engage in. These are the profit-maximisation goal according to which companies try to exhibit their improved financial

position to their stakeholders and the tax-minimisation goal, which relates to the motivation to minimise the overall tax liability (Anagnostopoulou & Ballas, 2014).

The empirical analysis reveals the following with respect to the control variables. Financial leverage (LEV) plays an important role in the decision to capitalise R&D expenditures because the results show that companies with greater financial leverage are more likely to capitalise their R&D expenditures, meaning that the capitalisation of R&D expenditures may be used to improve the financial reports for debt holders (Burgstahler et al., 2006; Givoly et al., 2010). The regression coefficient of profitability (ROA) is negative and significant, suggesting that it is another important determinant of R&D capitalisation. This result indicates that the motivation to expense R&D expenditures rather than capitalising them exists so long as profits remain positive since expensing R&D expenditures implies lower profitability indicators and thus lower tax liability. This implies that expensing R&D expenditures may be more attractive for profit-making companies as they can thereby lower their tax liability, while capitalising R&D expenditures may be more attractive for loss-making companies since they can improve their position on the balance sheet (Oswald, 2008).

Company size is also important in the decision to capitalise R&D expenditures given that the results reveal that larger companies are more likely to capitalise their R&D expenditures. This may imply that larger companies manage their R&D more efficiently in the sense they can easily distinguish between the R&D expenditures incurred in the research and development phases, and justify whether the criteria for R&D capitalisation are satisfied or not (Dinh et al., 2016; Wang, 2016). Finally, the regression coefficient of legal form (FORM) is positive and significant, which implies that companies taking the legal form of a public limited company are more likely to capitalise their R&D expenditures than companies that have adopted the legal form of a private limited company. This result suggests that information asymmetries are another important factor to consider while examining the determinants of R&D capitalisation since they depend on the company's legal form due to differences in owners' information rights (Eierle & Wencki, 2016).

To summarise, after controlling for other different fundamental determinants of R&D capitalisation, the empirical results show that R&D tax incentives have a crucial role in the management decision to capitalise R&D expenditures. Indirect public support in the form of R&D tax incentives may therefore provide a good mechanism for striking a compromise between the profit-maximisation and tax-minimisation goals. The results to somewhat consistent with the Positive Accounting theory, which states that managers hold discretionary power to choose the accounting and valuation methods (Watts & Zimmerman, 1986).

2.7 Discussion and implications

This part of the doctoral dissertation examines the impact of public support for R&D investment on the accounting treatment of R&D expenditures in Slovenia, which is characterised by high ownership concentration, considerable dependency on bank financing, and high book-tax conformity. The empirical analysis considered a sample of 3,417 company-year observations for Slovenian companies for the period 2012–2016.

Overall, the empirical results reveal the presence of earnings management after receiving public support in the form of R&D tax incentives. Given that R&D tax incentives relieve companies' tax burden, they aim to maximise the accounting profit by R&D capitalisation. This is also confirmed by the significant and positive effects of financial leverage and profitability. Moreover, the empirical results suggest that larger companies and companies adopting the legal form of a public limited company are more likely to capitalise their R&D expenditures. As regards R&D subsidies, the IFRS aligns their accounting treatment with the accounting treatment of R&D expenditures, which implies that R&D subsidies are tax-neutral. Therefore, they cannot be the main driver of the R&D accounting treatment decision.

The empirical results suggest that public support for R&D investment (especially R&D tax incentives) may impact the company's accounting policy decision on the accounting treatment of R&D expenditures. This finding is robust to alternative logistic regression models as well as to controlling for other possible determinants behind the decision on the accounting treatment of R&D expenditures identified by previous research. The results suggest that R&D tax incentives have an impact on the R&D accounting choice, which implies they help companies in finding a balance between the profit-maximisation and tax-minimisation goals. The aforementioned suggests the presence of earnings management when companies benefit from R&D tax incentives and when accounting regulation permits the capitalisation of R&D expenditures. In other words, by using R&D tax incentives companies can balance out the profit-maximisation and tax-minimisation goals because R&D capitalisation allows them to exhibit a higher accounting income and simultaneously have a lower tax liability due to the R&D tax incentives that are received.

The findings of the empirical analysis illuminate the role of public support for R&D investment in the accounting treatment of R&D expenditures, an aspect largely neglected in the existing literature, especially due to the difficulties of obtaining the relevant data. Further, previous empirical research also focused only on larger world economies and included larger and listed companies, whereby smaller ones such as the Slovenian economy, have been widely neglected. This implies that such findings cannot be fully transferred to the context of small open economies to cover smaller and non-listed companies as the motivation for earnings management in non-listed companies may not be the same as in listed companies. Accordingly, the study results provide further empirical support for the theoretical foundations of the Positive Accounting theory, which states that managers hold discretionary power to choose the accounting and valuation methods.

The findings of this study also hold several important practical implications. First, the findings may be of benefit while developing the discussion among accounting-standard setters on the accounting treatment of intangible assets, especially those related to R&D activity. In addition, the results may be interesting to policymakers by helping them to deepen their understanding of how public policy can affect companies' accounting policy.

This chapter provides some new and interesting insights. However, some limitations must be recognised which, in turn, point to some directions for future research. The first limit is the restriction of the research period to the period 2012-2016. The prime reason for this was the need to identify a research period with stable operating conditions for companies. Consequently, one possible direction for future research lies in extending the research period. This might provide additional empirical evidence on the impact of public support for R&D investment on the accounting treatment of R&D expenditures during the recent economic crisis. Second, the limited research period also makes the use of sophisticated econometric approaches difficult because they often require a longer research period in order to acquire credible empirical results. Finally, since this study is based exclusively on a database which, besides some basic company characteristics, only includes financial items of individual companies, certain important information or determinants of the capitalisation of R&D expenditures might have been overlooked. According to the last two limitations, it would be beneficial to apply sophisticated econometric approaches and to conduct surveys or interviews for the purposes of obtaining further non-financial insights with an emphasis on industry characteristics, something that cannot be accomplished with financial data alone.

3 THE IMPACT OF R&D EXPENDITURES ON CORPORATE PERFORMANCE

3.1 Introduction

Nowadays, R&D investment is becoming a critical element of generating the competitive advantage of companies, causing them to invest persistently in R&D activities (Chang et al., 2017; Ravšelj & Aristovnik, 2017, 2018b). This stems from the global economy shifting from an economy based on industry to one based on knowledge, which has drastically altered both the business environment and how different stakeholders function. This is seen in the global competition becoming ever tougher which is forcing companies to provide value-added products, processes and services. This is why R&D investment is indispensable in modern business operations because it helps companies retain their market position in terms of competitiveness. According to the current rising position of R&D investment, it is no surprise that R&D expenditures play a vital role in the business sector's overall investment activity.

The motivation for R&D investment is due to the potential benefits of such investment. Namely, companies firmly believe that the end result of R&D investment is seen in enhanced core competencies and the commercialisation of innovation outcomes such as new products, processes and services, allowing them to achieve greater market competitiveness. This should then be ultimately reflected in better corporate performance (Kim et al., 2014). In other words, the vast majority of companies is interested in R&D investment provided such investment brings the promise of benefits. To understand the role of R&D investment in the business sector, it is therefore necessary to consider what motivates companies to improve their core competencies as well as their tendency to generate innovation outcomes as a prerequisite for generating companies' competitive market advantage and their organic growth.

According to the Resource-based theory, companies possess strategic resources that give them an exceptional opportunity to develop competitive advantages over their competitors (Barney, 1991; Penrose, 1959). This implies that investment activity should be seen as one of the most important activities because it is central to all companies' functioning. In this context, due to the intangible nature of R&D expenditures, they may be considered an important part of companies' resources since they are unique and are thus able to generate a sustainable competitive advantage leading to a better overall corporate performance. The role of intangible assets is even more strongly emphasised in the Knowledge-based theory which addresses complex issues regarding intangible capital (Grant, 1996). Finally, assuming perfect information in the market, the Efficient Market theory provides a reasonable explanation of the relationship between R&D expenditures and market performance. Namely, under the assumption of market efficiency, any kind of investment

activity, including R&D expenditures, should be immediately recognised by the market and reflected in the better market performance of the company.

The practical and theoretical aspects stress the importance of R&D investment in the business sector, which triggers a series of debates on the impact of R&D expenditures on corporate performance. Therefore, comprehensive empirical studies in economics, accounting and finance aim to facilitate understanding of how R&D investment affects corporate performance given that it differs considerably from other investment types due to the high uncertainty and information asymmetry (Aboody & Lev, 2000; Moehrle & Walter, 2008).

The vast majority of empirical studies establish that R&D spending is an important factor driving corporate performance. Yet, previous studies provide mixed, even conflicting results concerning the impact of R&D expenditures on corporate performance. On one hand, some studies find an immediate positive impact of R&D expenditures on operating performance (Apergis & Sorros, 2014; Eberhart et al., 2004; Shin et al., 2009). In contrast, other studies show the negative impact of R&D expenditures on operating performance and suggest there is a lag effect between R&D expenditures and operating performance (Ayaydin & Karaaslan, 2014; Busru & Shanmugasundaram, 2017; Hsu et al., 2013; Kiraci et al., 2016; Rao et al., 2013). Further, while Cazavan-Jeny & Jeanjean (2006) establish a negative impact of R&D expenditures on market performance, most studies suggest there is a positive relationship between R&D and market performance (Bae & Noh, 2001; Chan et al., 2015; Ehie & Olibe, 2010; Ho et al., 2005).

The main aim of this chapter is to answer the main research question of how R&D expenditures influence operating and market corporate performance. In this context, the study seeks to empirically verify whether the conflicting results observed in the literature arise from the fact that the impact of R&D expenditures depends on: 1) different measurements of corporate performance; 2) different characteristics of companies; and 3) a different economy-specific legal framework and financial environment. For these purposes, empirical analysis is performed on a sample of Slovenian companies by utilising different indicators for operating performance. An additional empirical analysis is performed on a sample of world R&D companies, i.e. companies that heavily invest in R&D and operate in the EU, the USA, China and Japan in order to further confirm the results and obtain extra insights into market performance. Moreover, the utilisation of two different datasets allows the factors associated with different characteristics of companies and economies to be isolated, which may bring important implications for corporate performance. Finally, the use of both databases gives a unique opportunity to obtain comprehensive and interesting findings.

Accordingly, this chapter provides several contributions. First, it investigates the impact of overall R&D expenditures on operating performance in Slovenia, which is characterised by mainly small and non-listed companies, low profit margins and low value added. Second, it

offers additional empirical insights concerning a sample of world R&D companies with respect to the relationship between R&D expenditures and operating performance, in turn allowing an investigation of whether Slovenian companies differ from world R&D companies in the impact of R&D expenditures on their operating performance. Finally, it examines the impact of overall R&D expenditures on market performance for a sample of world R&D companies. The mentioned contributions, based on use of both a comprehensive dataset of Slovenian companies and two different datasets for Slovenian and world R&D companies, make this study unique in the literature. To sum up, this study involves a comprehensive empirical analysis of the impact of R&D expenditures on operating and market performance for Slovenia and beyond. In terms of the expected results, the study adds to theoretical and practical knowledge. Theoretically, the study provides further empirical support for the theoretical foundations of the Resource-based theory, Knowledge-based theory and Efficient market theory. Practically, the study results may be of particular benefit to managers who are often inclined to pursue short-term goals and short-term performance.

This chapter is structured as follows. The second section presents the literature review and theoretical considerations. The third section describes the data and the research methods. In the section four, the empirical results are presented while, at the end, a discussion is provided and the implications are summarised.

3.2 Theoretical considerations and literature review

3.2.1 Theoretical foundations

The global economy currently faces new challenges associated with globalisation and the emergence of new technologies reflected in ever-changing, highly competitive and fast-growing markets, which have dramatically altered companies' investment structure and the importance held by certain types of investment. (Ahuja, 2011). This is then forcing companies to develop new strategic responses in order to overcome contemporary challenges, confront their competition and retain their market position. It is a generally well-established fact that investment is one of the most important activities since it is central to the functioning of any company.

The process of exploiting different resources with a view to producing or improving products, processes and services in the future is, from an economic point of view, a defining part of what companies do. Traditionally, investment in physical assets was an important component of companies' investment structure. During the period of industrialisation, tangible assets were the main source of value creation. However, in the last few decades the nature and patterns of investment have seen gradual but significant changes. In the knowledge-based economy, the type of investment that has risen inexorably is investment in intangible assets, which covers investment in knowledge, ideas, brands etc., that has become

crucial and holds greater potential for value creation than tangible assets (Haskel & Westlake, 2018; Sullivan & Sullivan, 2000). The above-mentioned especially refers to R&D expenditures, which are in fact the main driver of the creation of intangible assets in any modern company.

The theoretical framework guiding this study consists of combining several relevant theories. In order to ensure a broader perspective on the issues relating to R&D expenditures and their impact on corporate performance, a single theory is incapable of resolving certain essential problems. Therefore, the primary theories guiding this study are the Resource-based theory, Knowledge-based theory and Efficient Market theory. Their combination or interlacing gives a key theoretical foundation for understanding the relationship between R&D expenditures and corporate performance from the perspective of both operating and market performance.

The Resource-based theory provides a strong perspective highlighting that all business processes and decisions happening within the company are critical to its future development. It emphasises that companies' competitive advantages stem from their unique resources and specific capabilities, based on which companies can expect a better corporate performance (Barney, 1991; Penrose, 1959). Hence, in a complex business environment faced with contemporary challenges it is crucial that companies have the appropriate resources and capabilities that lead to competitive advantages (Kaleka, 2002). The Resource-based theory also includes the notion that not all resources are equally able to generate competitive advantages (Fortune & Shelton, 2012). A critical fundamental assumption made in the Resource-based theory is the heterogeneity of resources across companies (Barney, 1991; Hoopes et al., 2003; Peteraf, 1993). Resources can be classified in three categories: personnel-based, tangible and intangible (Grant, 1991). Yet since resources have different characteristics, they are not equally able to provide sustained competitive advantages (Barney, 1991). Transferred to the context of R&D spending, they are an important component of companies' resources since they are intangible in nature and may therefore be seen as a unique resource. In order to be competitive, companies must also devote their funds to R&D activity because an effective investment in this activity and its proper management can benefit overall corporate performance.

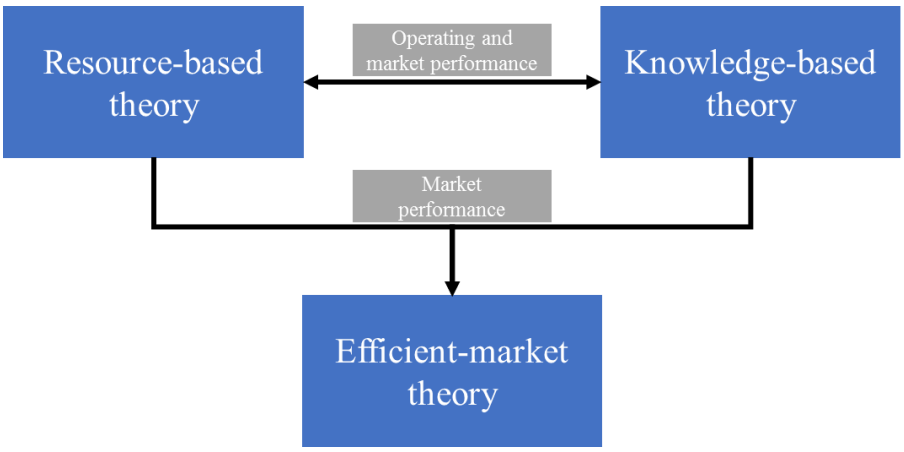
The increasing role of intangible assets, which make up an important element of companies' resources in modern economies, has contributed to the development and emergence of new theories. This clearly includes the Knowledge-based theory which builds upon and extends the Resource-based theory by emphasising intangible assets in first place. It stresses the role of intangible resources and considers them the most crucial and unique resource of the company since they more frequently bring together the requirements needed to generate a sustainable competitive advantage. This implies that intangible assets are regarded as valuable and highly heterogeneous between companies, making them rare and difficult for other companies to replicate (Grant, 1996; Kostopoulos, 2004). Therefore, the Knowledge-

based theory is recognised as adequate for explaining the relationship between R&D expenditures and overall corporate performance.

Further, the Efficient market theory tries to explain fluctuations in market performance. The chief assumption made in this theory is that there is perfect information in the market. This implies that a market is able to absorb the entirety of companies' relevant intrinsic information as soon as it becomes available. In other words, if the financial markets are efficient, all information regarding business operations should be instantly reflected in market performance (Malkiel & Fama, 1970). This also applies to companies' tangible and intangible investment activity. The Efficient market theory assumption of market efficiency makes it very useful for explaining the relationship between R&D expenditures and market performance, and thus provides several important implications of this relationship. Namely, the assumption of perfect market information allows the following considerations. The initial one is that a company's market capitalisation can be seen as a reasonable approximation of its underlying value, with it only being subject to change should the market acquire new general or company-specific information that influences investors' expectations concerning the company's cash flows (Grandi et al., 2009; Pakes, 1985; Woolridge & Snow, 1990). Consequently, if R&D expenditures contribute to an increase in intangible assets, which are often considered able to generate future cash flows, they will affect the market value (Grandi et al., 2009; Griliches, 1981). Second, companies' shareholders agree that all decisions, including investment decisions with payoffs in the long term, should be considered while evaluating their contribution to the market value (Fama & Jensen, 1985; Grandi et al., 2009). It may thus be assumed that managers act in the interests of shareholders from the perspective of making those investment choices that maximise the market value. In these circumstances, one can explain that R&D expenditures also aim at maximising the market value (Grandi et al., 2009; Hall, 1993; Pakes, 1985).

The combination of the theoretical foundations of the Resource-based theory, Knowledge-based theory and Efficient market theory are crucial for explaining the impact of R&D expenditures on corporate performance in terms of operating performance and market performance. They provide a general answer to various questions on the role of R&D expenditures in the business operations of contemporary companies faced with the consequences of globalisation and emergence of new technologies in the sense of an unpredictable market. All relevant theories which explain the implications of R&D expenditures for corporate performance are presented in Figure 3.1.

Figure 3.1: Relevant theories explaining the implications of R&D expenditures for corporate performance



Source: Own presentation.

Figure 3.1 shows that the Resource-based and Knowledge-based theories are closely related. Namely, the rising importance of intangible capital on the global level has led to the need to develop new theories able to explain the complex issues surrounding its role in modern economies. Consequently, the Knowledge-based theory developed from the Resource-based theory with the aim of emphasising intangible assets in first place. However, both theories can explain the relationship between R&D expenditures and corporate performance since they both consider R&D expenditures as a unique resource of a company able to generate sustainable competitive advantage and thus a better overall corporate performance. Further, the combination of the Resource-based and Knowledge-based theories with Efficient Market theory gives the theoretical foundation for explaining the relationship between R&D expenditures and market performance. Namely, on the assumption of market efficiency, the investment activity should be immediately recognised by the market, which then leads to an increase in the company's market performance. As the Resource-based and Knowledge-based theories highlight the importance of companies' unique resources, it is reasonable to expect that R&D expenditures will lead to a better market performance.

Apart from the presented theoretical foundations, which broadly acknowledge the important role of R&D expenditures for enhancing corporate performance, many empirical studies in the literature point to the role of R&D expenditures as an important part of companies' overall spending. However, the results of these empirical studies often differ, presumably due to the: 1) different measurements of corporate performance; 2) different characteristics of companies; and 3) a different economy-specific legal framework and financial environment.

3.2.2 Literature on R&D expenditures and operating performance

The impact of R&D expenditures on operating performance is widely studied. Some empirical studies establish that R&D expenditures have an immediate beneficial impact on current operating performance. An empirical study by Eberhart et al. (2004) indicates the positive impact of R&D expenditures on operating performance for companies operating in the USA. Similarly, Apergis and Sorros (2014) find a positive and significant relationship between R&D investment and profitability measured as return on assets (ROA) and return on equity (ROE) for companies operating in the energy sector in the USA. A study by Shin et al. (2009) provides similar evidence for companies operating in the global electronics industry. The study reveals a positive relationship between R&D expenditures and gross profit, although it shows that R&D expenditures do not enhance ROE and ROA. This may be explained by noting that the performance of R&D activities allows companies to charge a premium, which then leads to higher gross profits. Yet, these higher profit margins are outweighed by the costs of performing R&D activities, meaning the impact of R&D expenditures on returns to investors is not significant in the current period.

This helps explain why many authors argue that R&D expenditures concern long-term rather than short-term operating performance as they establish in their studies a non-significant or even negative impact of R&D spending on short-term operating performance. Accordingly, many empirical studies determine a significant and positive impact of R&D expenditures only for future operating performance. Empirical analysis performed on a sample of listed manufacturing companies in Turkey shows that R&D expenditures do not have a statistically significant impact on short-term operating performance within a period of up to 1 year. However, when considering long-term operating performance for periods longer than 1 year, the impact of R&D expenditures on operating performance becomes significantly positive and strong (Kiraci et al., 2016). Another study from Turkey that looked at a sample of manufacturing companies for the period 2008–2013 shows that R&D expenditures have a positive impact on future corporate performance measured as ROA in the subsequent year (Ayaydin & Karaaslan, 2014).

Similarly, for a sample of Indian listed companies it is established that R&D expenditures negatively impact operating performance in the current year, with the impact becoming positive when considering the operating performance in subsequent years. The results remain the same regardless of different profitability measures such as net profit, ROA and ROE (Busru & Shanmugasundaram, 2017). Further, a study comparing China and Japan reveals the lag between R&D expenditures and profitability measured as ROE is about 1 year in Japan and 2 years in China (Rao et al., 2013). The 2-year lag between R&D investment and financial returns is also confirmed for a sample of Taiwanese high-tech companies (Hsu et al., 2013). A summary of the key empirical literature addressing R&D expenditures and operating performance is given in Table 3.1.

Table 3.1: Summary of key empirical literature on R&D expenditures and operating performance

Authors	Countries	Findings
Eberhart et al. (2004); Apergis and Sorros (2014)	USA	The empirical evidence reveals a positive impact of R&D expenditures on operating performance measured as ROA and ROE.
Shin et al. (2009)	Global electronics industry	The empirical results suggest a positive relationship between R&D expenditures and gross profit, although it shows that R&D expenditures do not enhance ROE and ROA.
Kiraci et al. (2016); Ayaydin and Karaaslan (2014)	Turkey	R&D expenditures do not have a significant impact on short-term performance but have a positive and significant impact on long-term performance.
Busru and Shanmugasundaram (2017)	India	R&D expenditures have a negative impact on operating performance in the current year, with the impact becoming positive when considering operating performance in subsequent years.
Rao et al. (2013)	China and Japan	There is a lag between R&D expenditures and profitability measured as ROE. The lag for Japan is about 1 year and 2 years for China.
Hsu et al. (2013)	Taiwan	There is a 2-year lag between R&D investment and financial returns.

Source: Own presentation.

The literature review suggests that R&D expenditures are important for enhancing operating performance. However, the findings of different empirical studies are inconclusive. Some studies suggest there is an immediate positive impact of R&D expenditures on operating performance, while others suggest there is instead a lag effect between R&D expenditures and operating performance. Nevertheless, the dominant belief is that there should be irrespective of a significant or negative impact of R&D expenditures on current operating performance, while the impact becomes positive for the operating performance in future periods. This implies that R&D spending in the current period is effective in the long term more than in the short term (Asthana & Zhang, 2006). Given the above discussion, the following research hypothesis is proposed:

- **Hypothesis 3.1:** *R&D expenditures deteriorate current operating performance and improve future operating performance.*

3.2.3 Literature on R&D expenditures and market performance

The literature also contains some empirical studies examining the impact of R&D expenditures on market performance. An empirical study by Ehie and Olibe (2010) investigates the association between R&D expenditures and market performance for a large sample of companies operating in the USA for the period 1990–2007. They establish that R&D expenditures positively impact market performance for both manufacturing and service firms. For the same period 1990–2007, Chan et al. (2015) investigate whether companies with greater R&D spending enjoy a better market performance when they have a

good corporate performance. The results for a comprehensive dataset of listed companies operating in the USA for the period 1990–2007 show a positive impact of R&D expenditures on market performance, where the impact is more prominent for companies with good corporate governance. Similarly, using a sample of companies from the USA for the period 1991–1995 Bae and Noh (2001) establish that R&D expenditures bring benefits for the market performance of domestic and multinational corporations. Another study from the USA gives similar results for the period 1962–2001 for manufacturing and non-manufacturing companies (Ho et al., 2005).

One can also find empirical studies that extend the investigation to other countries. Bae and Kim (2003) considered the impact of R&D expenditures on the market value of companies in the USA, Germany and Japan. They establish a significant and positive impact of R&D investment on market value and stock return volatility in all three economies. For a sample of Taiwan companies operating in high-tech industries for the period 2001–2008, Wang (2011) concludes that both the optimum and minimum level of R&D expenditures have a positive impact on market value. An extensive empirical study performed on a sample of listed companies operating in 13 selected EU member states for the period 1999–2010 shows R&D expenditures positively impact market performance. This study also suggests that financial markets attribute a higher value to R&D investment in investor-friendly settings and in environments ensuring a high level of legal protection (Duqi et al., 2011). A study by Başgoze and Sayin (2013) examines the relationship between R&D expenditures and market performance for a sample of listed companies in Turkey for the period 2006–2010. Their empirical results reveal that investment in R&D activities generates value for companies due to their competitive advantages for the companies, which benefits market performance.

Unlike previous empirical studies, Cazavan-Jeny and Jeanjean (2006) establish that R&D expenditures have a negative impact on market performance for a sample of French companies for the period 1993–2002. As a reason for such unexpected results, they argue that legal enforcement may play a role in the relationship between R&D expenditures and market performance. A summary of the key empirical literature addressing R&D expenditures and operating performance is found in Table 3.2.

Table 3.2: Summary of key empirical literature on R&D expenditures and market performance

Authors	Countries	Findings
Ehie and Olibe (2010)	USA	R&D expenditures have a positive impact on market performance for both manufacturing and service firms.
Chan et al. (2015)	USA	The results show R&D expenditures have a positive impact on market performance, where the impact is more prominent for companies with good corporate governance.
Bae and Noh (2001); Ho et al., 2005	USA	R&D expenditures have beneficial effects for the market performance of domestic and multinational corporations.
Bae and Kim (2003)	USA, Germany, Japan	The results suggest a significant and positive impact of R&D investment on market value and stock return volatility in all three economies.
Wang (2011)	Taiwan	The study suggests that both the optimum and minimum level of R&D expenditures have a positive impact on market value.
Duqi et al. (2011)	Selected 13 EU member states	The study suggests that financial markets value R&D investment more highly in investor-friendly environments and those with a high level of legal protection.
Başgoze and Sayin (2013)	Turkey	Investment in R&D activities generates value for companies due to their competitive advantages for the companies, which benefits market performance
Cazavan-Jeny and Jeanjean (2006)	France	R&D expenditures have a negative impact on market performance.

Source: Own presentation.

Nevertheless, Vithessonthi and Racela (2016) explain why the impact of R&D expenditures on corporate performance is negative in the short run and positive in the long run through the application of net present value. Namely, R&D investment is often considered as a long-term investment in different R&D projects that are usually estimated to have a positive net present value. In the short term, the cash flows associated with R&D projects are negative and consequently harm corporate performance in profitability terms. Yet, in the long run, assuming that an R&D project's expected net present values are positive, an R&D investment should increase the company's market value. Competitive companies with innovative products, processes and services can also attract the attention of investors and see them increase their market share (Usman et al., 2017). According to the above discussion, the following research hypothesis is proposed:

- **Hypothesis 3.2:** *R&D expenditures improve current and future market performance.*

3.3 Data and research methods

3.3.1 Sample selection

A comprehensive empirical analysis is performed on a sample of Slovenian companies. The dataset is obtained from two main sources provided by the Statistical Office of the Republic of Slovenia (SORS). The first one is a database which contains information on the R&D activity of Slovenian companies. It covers all companies that are: 1) registered to perform R&D activity (NACE 72 classification) and have more than two employees; 2) not registered to perform R&D activity but are recipients of R&D subsidies; 3) eligible for general and regional R&D tax incentives; and 4) reporting about R&D investments in a survey on innovation activity (SORS, 2018). The mentioned database is the leading source of data, meaning that it then dictates the number of companies that could be included in the empirical analysis. It provides crucial and comprehensive data on R&D activity within a certain company. The second source provides data taken from the financial statements of companies, including balance-sheet and income-statement data. These two data sources are merged to create a unique and comprehensive dataset of Slovenian companies.

The nature of the empirical analysis requires a research period which encompasses stable operating conditions for companies. The research period for the sample of Slovenian companies is accordingly restricted to the latest available data for the five-year period 2012–2016. Further, the sample only covers non-financial private companies operating in either the manufacturing (NACE 10-33) or service (NACE 35-99) sectors and taking the legal organisational form of a private or public limited company. Namely, such companies are a good reflection of Slovenia's small open economy. In addition, company-year observations with incomplete data or negative equity are excluded from the empirical analysis. Finally, in order to mitigate the small deflator problem, company-year observations with less than EUR 10,000 in net sales are excluded from the analysis. The final unbalanced panel dataset of Slovenian companies consists of 3,399 company-year observations. The distribution of the final sample of Slovenian companies by years is shown in Table 3.3, which reveals that the company-year observations vary from a minimum of 585 in 2012 to a maximum of 743 in 2015.

Table 3.3: Sample distribution of Slovenian companies by years

Year	No.	Share (in %)
2012	585	17.21
2013	669	19.68
2014	721	21.21
2015	743	21.86
2016	681	20.04
Total	**3,399**	**100**

Source: SORS, 2018; own calculations.

An additional empirical analysis is performed on a sample of world R&D companies in order to further confirm the results and obtain additional insights into market performance. The world R&D companies are companies operating in major world economies, that is, the EU, the USA, China and Japan and are considered as companies which invest heavily in R&D on the world level. This additional empirical evidence for the sample of world R&D companies is needed to compare the implications of R&D expenditures for operating performance between Slovenian and world R&D companies and to provide additional insights into market performance. The dataset for world R&D companies is obtained from the EU Industrial R&D Investment Scoreboard 2017 and 2018 provided by the European Commission that covers economic and financial information on the top R&D corporate investors extracted directly from companies' annual reports for the three-year period 2015–2017 (European Commission 2017, 2018). The empirical study is limited to this three-year period due to the availability of information regarding companies' market value.

Two datasets are available for the period 2015–2017, with the first including 2,500 companies at the world level and the second covering 1,000 companies at the EU level. Since these two data sources overlap somewhat, they are both combined to form a single dataset by eliminating repeated companies. In order to obtain a representative sample of world R&D companies for the empirical analysis, meaning that they are continuously engaged in R&D investment, a balanced panel dataset of companies having more than EUR 1 million in net sales for the entire period 2015–2017 is created. The final sample consists of 1,700 companies for the three-year period, resulting in 5,100 company-year observations. Table 3.4 presents the distribution of the companies by major world economies.

Table 3.4: Sample distribution of world R&D companies by major world economies

Economy	No.	Share (in %)
European Union	1,611	31.59
USA	1,728	33.88
China	840	16.47
Japan	921	18.06
Total	**5,100**	**100**

Source: European Commission, 2017, 2018; own calculations.

It is evident from Table 3.4 that the share of world R&D companies included in the research sample varies between the world's biggest economies. The largest shares of world R&D companies are found in the USA and the EU, while the smallest shares are in China and Japan. However, the distribution of companies included in the research sample coincides with the overall structure of companies covered by the EU Industrial R&D Investment Scoreboard. It can therefore be assumed that the research sample used for the empirical analysis is meaningful in terms of evaluating the impact of R&D expenditures on corporate performance for world R&D companies.

3.3.2 Variables

3.3.2.1 Dependent variables

Several dependent variables that try to capture corporate performance are employed in this empirical study. Corporate performance refers to operating performance in terms of profitability indicators and market performance in terms of market value indicators. Namely, the use of two different datasets allows accounting-based and market-based performance indicators to be considered for measuring corporate performance. However, profitability indicators can be applied to both Slovenian companies and world R&D companies, while market value indicators can solely be applied to world R&D companies as they are listed on the stock exchange.

The first dependent variable is operating performance, which can be measured by different accounting-based performance indicators. In the empirical literature, the most common ratios for measuring operating performance are return on assets (ROA) (Hitt et al., 1997), return on equity (ROE) (Grant, 1987) and return on sales (ROS) (Geringer et al., 2000). Yet, some authors criticise the accounting-based indicators for measuring corporate performance (Jacobson & Aaker, 1987), especially ROA and ROE since they are very sensitive to different asset and equity valuations. This is why some authors emphasise return on sales (ROS) as an important indicator for measuring operating performance (Geringer et al., 1989). Nevertheless, the vast majority of authors argue that these accounting-based indicators are acceptable for measuring operating performance because they have been broadly used in previous empirical studies addressing the determinants of corporate performance (Bharadwaj, 2000; Geringer et al., 2000; Huang & Liu, 2005; Kim et al, 2014; Kim & Ha, 2013; Lee, 2018; Mahmood & Mann, 1993; Santhanam & Hartono, 2003; Shen et al., 2017; Tallman & Li, 1996; Tam, 1998; Tanriverdi, 2006).

In this empirical study, all three accounting-based performance indicators are employed for a sample of Slovenian companies, while only ROS is used for the sample of world R&D companies due to data limitations. Indicators for measuring operating performance are defined as follows: 1) return on assets (ROA) is defined as the ratio between net profit and total assets; 2) return on equity (ROE) is defined as the ratio between net profit and equity; and 3) return on sales (ROS) is defined as the ratio between net profit and net sales for Slovenian companies and as the ratio between operating profit and net sales for world R&D companies. These measures for operating performance in fact indicate whether companies are effectively using their assets, equity and sales to generate profits (Robins & Wiersema, 1995; Al-Matari, 2014).

The second dependent variable is market performance, which can also be measured by different market-based performance indicators. These indicators are typically used to evaluate the economic status of companies listed on the market and are important for assessing the current price of companies' shares. Accordingly, market value indicators can

give management information about investors' perceptions regarding the company's future prospects. There is a wide variety of market value indicators, with the most common being earnings per share (EPS), book value per share (BVPS), price-to-earnings ratio, and price-to-sales ratio (PSR) (Leibowitz, 2002; Vruwink et al., 2007).

In this empirical study, the price-to-sales ratio (PSR) is used as a measure of market performance for the sample of world R&D companies. It is defined as the ratio between market capitalisation and annual net sales. The price-to-sales ratio (PSR) actually measures how much investors are willing to pay for each monetary unit of sales, which means it is a very good indicator of a stock's popularity among investors (Fisher, 1984).

3.3.2.2 Independent variable

The main independent variable is R&D intensity (RDI), defined as the ratio between the amount of R&D expenditures and the amount of net sales during a 1-year period. This measure is also widely used in empirical studies (Czarnitzki & Delanote, 2015; González et al., 2005). The ratio of R&D expenditures to net sales also represents a comparable basis for companies of different sizes. R&D intensity (RDI) is identically defined for the sample of Slovenian companies as for the sample of world R&D companies. For the purposes of the investigating the current and lagged impacts of R&D expenditures on operating and market performance, a current (RDI_t) and lagged (RDI_{t-1}) variable for R&D intensity is considered in the empirical analysis. A 1-year lag is used since R&D expenditures are often considered to be a driver of future corporate performance. Although the effects of R&D expenditures may be reflected over a longer lag period, a 1-year lag can be assumed for companies which are engaged in R&D activity in any way. These are companies which perform R&D activity as their core business, benefit from public support for R&D investment, or persistently invest in R&D activity. The consideration of a 1-year lag can also be justified by the short-term nature of much commercial R&D, which is often the domain of the business sector (Klette & Møen, 1998). According to the proposed research hypotheses, it expected that R&D intensity (RDI_t) has a negative impact on current operating performance and a positive impact on future operating performance. On the other hand, it is expected that R&D intensity (RDI_{t-1}) positively impacts current and future market performance.

3.3.2.3 Control variables

Empirical studies suggest other factors can also exert an impact on corporate performance in terms of operational and market performance. Due to the availability of different financial information for the sample of Slovenian companies and world R&D companies, various control variables are considered for each sample. In both cases, it is ensured that the control variables represent other relevant and key determinants which may affect corporate performance.

For the sample of Slovenian companies, the following control variables are considered in the empirical analysis. The first one refers to financial leverage (LEV) measured as total (short-term and long-term) liabilities divided by total assets. In earlier empirical studies, it is expected that financial leverage negatively impacts operating performance since higher debt requires more company resources in order to repay the debt, which then reduces the funds available for any investments (Asimakopoulos et al., 2009; Nunes et al., 2009). The second control variable is liquidity (LIQ), measured as the total amount of short-term assets divided by total assets. According to existing research, high liquidity reduces exposure to the risk of being unable to meet financial commitments in the short term (Goddard et al., 2005). It is therefore expected that liquidity has a positive impact on operating performance.

The next control variable is company net sales growth (NSG) measured as simple 1-year growth in net sales. In previous empirical studies, company growth was usually seen as the driving force of corporate performance, mainly due to the extra income generated (Asimakopoulos et al., 2009; Lee, 2009; Nunes et al; 2009; Yazdanfar, 2013). Moreover, the literature also establishes that growing companies typically experience increasing profitability, while loss-making companies eventually exit the market (Jovanovic, 1982). It is hence expected that company net sales growth positively impacts operating performance. Finally, company size (SIZE) is measured as the natural logarithm of total assets. In empirical research, company size (SIZE) is usually considered to have a positive impact on operating performance. Namely, larger companies are able to use economies of scale, have facilitated or better access to capital markets and can create barriers to newly emerging companies (Nunes et al., 2009; Titman & Wessles, 1988).

For the sample of world R&D companies, two control variables are considered in the empirical analysis. The first control variable is capital expenditure intensity (CEI), which is defined as the amount of capital expenditure divided by net sales. This control variable is expected to have a negative impact on operating performance. Empirical studies show that to invest in physical assets such as equipment, property and industrial buildings companies usually require large amounts of funding. This may then lead to a lower operating performance (King & Lenox, 2002; Manrique & Martí-Ballester, 2017; Russo & Fouts, 1997). On the contrary, according to Chung (1998) capital expenditure intensity (CEI) is expected to positively impact market performance since the market positively values new capital expenditures. The second control variable is company size (SIZE), defined as the natural logarithm of net sales. Company size (SIZE) is expected to have a positive impact on operating performance due to the reasons stated above concerning economies of scale, access to capital markets and barriers to newly emerging companies. Yet, company size (SIZE) is expected to have a negative impact on market performance (Kim et al., 2018).

In addition, year dummy variables (YEAR) are included in the empirical analysis for the purposes of controlling for time effects. Based on 2012, there are four dummy variables which take the value of 1 if a company-year observation is from a year studied (from 2013 to 2016), and 0 otherwise.

This empirical study includes the entire range of different variables from the two different samples of Slovenian and world R&D companies. The use of individual variables for a given sample of companies depends on data availability. Nevertheless, all variables are suitable for the empirical analysis in order to investigate the impact of R&D investment on corporate performance. A summary of all variables employed in the empirical analysis is systematically presented in Table 3.5.

Table 3.5: Summary of variables used in the empirical analysis

Abbreviation	Variable	Definition	Slovenian companies (source)	World R&D companies
Dependent variable				
ROA	Return on assets	The ratio between net profit and total assets.	X (AJPES)	
ROE	Return on equity	The ratio between net profit and total equity.	X (AJPES)	
ROS	Return on sales	The ratio between net (operating) profit and net sales.	X (AJPES)	(X) (EC)
PSR	Price-to-sales ratio	The ratio between market capitalisation and net sales.		X (EC)
Independent variables				
RDI	R&D intensity	The ratio between R&D expenditures and net sales.	X (SORS)	X (EC)
Control variables				
LEV	Financial leverage	The ratio between total liabilities and total assets.	X (AJPES)	
LIQ	Liquidity	The ratio between short-term assets and total assets.	X (AJPES)	
NSG	Net sales growth	Simple 1-year growth of net sales.	X (AJPES)	
CEI	Capital expenditure intensity	The ratio between capital expenditure and net sales.		X (EC)
SIZE	Company size	The natural logarithm of total assets (net sales).	X (AJPES)	(X) (EC)
YEAR	Year dummy variable	Dummy variable that takes 1 for a year studied, 0 otherwise.	X (AJPES)	X (EC)

Note: 1) SORS – Statistical Office of the Republic of Slovenia; FURS – Financial Administration of the Republic of Slovenia; AJPES – Agency of the Republic of Slovenia for Public Legal Records and Related Services; EC – European Commission. 2) The use of the variable in each sample is indicated by X.

Source: Own presentation.

3.3.3 Research methods

This empirical study involves a comprehensive empirical analysis of the impact of R&D expenditures on corporate performance for Slovenia and beyond. Since the sample of Slovenian companies consists solely of companies not listed on the stock exchange, an additional dataset of world R&D companies is utilised in order to obtain additional insights. To examine the impact of R&D expenditures on operating performance, profitability

indicators (PRO) are regressed against the main independent variables of interest. For the sample of Slovenian companies, the dependent variables (ROA, ROE and ROS are regressed against the R&D intensity (RDI_t) and lagged R&D intensity (RDI_{t-1}), which are estimated in separate models. In addition, some control variables are included in the multiple regression models, namely financial leverage (LEV), liquidity (LIQ), net sales growth (NSG) and company size (SIZE). In order to control for year effects, time dummy variables (YEAR) are also taken into consideration. The multiple regression model is presented in Equation (3.1) where the effects of current and lagged R&D intensity (RDI) are considered in separate models.

$$PRO_{i,t} = \alpha_0 + \beta_1 RDI_{i,t\,(t-1)} + \beta_2 LEV_{i,t} + \beta_3 LIQ_{i,t} + \beta_4 NSG_{i,t} + \beta_5 SIZE_{i,t} + \sum YEAR_{i,t} + \varepsilon_{i,t} \qquad (3.1)$$

where PRO represents a vector of dependent variables such as: ROA, ROE and ROS. Moreover, R&D intensity (RDI_t) and lagged R&D intensity (RDI_{t-1}) are considered to be the main independent variables of interest. Further, some control variables are included that represent possible determinants of operating performance, such as: financial leverage (LEV), liquidity (LIQ), net sales growth (NSG) and company size (SIZE). Finally, control variables for time effects are also considered (YEAR).

Similarly, in order to obtain additional empirical verification, for the sample of world R&D companies the dependent variable return on sales (ROS) is regressed against R&D intensity (RDI_t) and lagged R&D intensity (RDI_{t-1}), which are estimated in separate models. Due to data limitations, fewer control variables are included in the multiple regression models: capital expenditures intensity (CEI) and company size (SIZE). In order to control for year effects, time dummy variables (YEAR) are also taken into consideration. The regression model is presented in Equation (3.2) where the effects of current and lagged R&D intensity (RDI) are considered in separate models.

$$ROS_{i,t} = \alpha_0 + \beta_1 RDI_{i,t\,(t-1)} + \beta_2 CEI_{i,t} + \beta_3 SIZE_{i,t} + \sum YEAR_{i,t} + \varepsilon_{i,t} \qquad (3.2)$$

where ROS is the dependent variable measuring operating performance. Moreover, R&D intensity (RDI_t) and lagged R&D intensity (RDI_{t-1}) are considered as the main independent variables of interest. Further, some control variables representing possible determinants of operating performance are included, such as: capital expenditure intensity (CEI) and company size (SIZE). Finally, the control variables for time effects are also considered (YEAR).

The sample of world R&D companies also allows an examination of the impact of R&D spending on market performance. For this purpose, the dependent variable price-to-sales ratio (PSR) is regressed against the main independent variables of interest, R&D intensity (RDIt) and lagged R&D intensity (RDI_{t-1}), which are estimated in separate models. In addition, some control variables are further included in the multiple regression models, namely capital expenditure intensity (CEI) and company size (SIZE). In order to control for

year effects, time dummy variables are also included. The regression model is presented in Equation (3.3).

$$PSR_{i,t} = \alpha_0 + \beta_1 RDI_{i,t\,(t-1)} + \beta_2 CEI_{i,t} + \beta_3 SIZE_{i,t} + \sum YEAR_{i,t} + \varepsilon_{i,t} \quad (3.3)$$

where PSR is the dependent variable measuring market performance. Moreover, R&D intensity (RDI_t) and lagged R&D intensity (RDI_{t-1}) are considered as the main independent variables of interest. Some control variables representing possible determinants of operating performance are also included, such as: capital expenditure intensity (CEI) and company size (SIZE). Finally, control variables for time effects are also considered (YEAR).

All of the proposed regression models can be estimated using different econometric specifications. Generally, three main different alternative econometric specifications of regression models exist for panel data: the pooled regression model, random effects model and fixed effects model. In order to statistically determine which econometric specification is most suitable for the data used in the empirical analysis, a three-step procedure is applied. First, the LM test is used in order to decide between the random effects and pooled regression models. Second, the F test is applied to compare between the pooled regression and fixed effects models. Third, the Hausman test is conducted to choose between the random effects and fixed effects models (Hausman, 1978).

Regression disturbances are assumed in standard panel regression models to be homoscedastic and to entail the same variance across individuals. This assumption does not fully apply to company-level panel data since companies vary greatly in size (Lee, 2018). A serious consequence of heteroscedasticity is the bias of standard errors. Since standard errors are a central parameter for conducting significance tests, their bias therefore leads to inappropriate statistical inferences (Washington et al., 2010). In order to check for the presence of heteroscedasticity, a modified Wald test for groupwise heteroscedasticity is performed (Baum, 2001). Since the results of a modified Wald test show a positive result for all multiple regression models ($P < 0.001$), the heteroscedasticity-robust (White) standard errors are employed in the multiple regression models in order to alleviate the problem of heteroscedasticity.

3.4 Empirical results

3.4.1 Descriptive statistics

Descriptive statistics of variables (except year effects) are presented for the sample of Slovenian companies and world R&D companies separately. Since the companies are a very heterogeneous group of units, there may be some outliers in the data. In order to eliminate the effect of possibly spurious outliers, all of the continuous variables are winsorised at the 2.5% and 97.5% levels by each year for the sample of Slovenian companies and at the 5%

and 95% levels by each year for the sample of world R&D companies. Further, the Winsorisation procedure is often also considered as robust statistics (Reifman & Keyton, 2010).

Table 3.6 presents descriptive statistics for Slovenian companies for the period 2012–2016. It shows the mean and standard deviation values for the variables included in the empirical analysis. The mean values of return on assets (ROA), return on equity (ROE) and return on sales (ROS) indicate that on average Slovenian companies are effectively using their assets, equity and sales to generate profits. Moreover, the mean values of R&D intensity (RDI), financial leverage (LEV) and liquidity (LIQ) show they are at a relatively high level compared to the current operating performance in terms of company profitability. Finally, the descriptive statistics reveal that Slovenian companies on average grow at a rate of 10.50%.

Table 3.6: Descriptive statistics of the variables for the Slovenian companies

Variable	Mean	SD
ROA	0.073	0.101
ROE	0.132	0.208
ROS	0.063	0.104
RDI	0.186	0.341
LEV	0.426	0.224
LIQ	0.562	0.232
NSG	0.105	0.381
SIZE	14.928	2.007

Note: Data for Slovenian companies are strictly confidential so the minimum and maximum values for an individual variable are not presented.

Source: SORS, 2018; own calculations.

Similarly, Table 3.7 shows descriptive statistics for world R&D companies for the period 2015–2017. It presents the mean, standard deviation, minimum and maximum values for the variables included in the empirical analysis. The mean value of ROS indicates that, on average, world R&D companies are effectively using their sales to generate profits. Further, the mean value of the price-to-sales ratio (PSR) shows it is at a relatively high level compared to the current company profitability. The mean values for R&D intensity (RDI) and capital expenditures intensity (CEI) suggest world R&D companies devote more funds to R&D investment rather than to acquiring or upgrading their physical assets such as equipment, property and industrial buildings.

Table 3.7: Descriptive statistics of the variables for the world R&D companies

Variable	Mean	SD	Min	Max
ROS	0.058	0.168	-0.545	0.293
PSR	2.474	2.597	0.224	11.692
RDI	0.096	0.119	0.005	0.489
CEI	0.057	0.049	0.009	0.218
SIZE	21.271	1.639	17.847	24.230

Source: European Commission, 2017, 2018; own calculations.

Table 3.8 shows Pearson's correlation between variables (except year effects) for the sample of Slovenian companies. The simple correlation shows a strong, positive and significant correlation between the operating performance indicators (ROA, ROE and ROS), which are used as dependent variables in separate multiple regression models. The Pearson correlation matrix also reveals that R&D intensity (RDI) and financial leverage (LEV) are negatively correlated with operating performance. Liquidity (LIQ) and net sales growth (NSG) seem positively correlated with operating performance. This is in line with expectations. However, company size (SIZE) seems to be negatively correlated with operating performance, which is contrary to expectations. Nevertheless, the simple correlation between the explanatory variables does not indicate any strong linear relationship, suggesting there is no issue of multicollinearity in the data for the Slovenian companies.

Table 3.8: Pearson's correlation matrix of the variables for the Slovenian companies

Variable	ROA	ROE	ROS	RDI	LEV	LIQ	NSG	SIZE
ROA	1							
ROE	0.860^{***}	1						
ROS	0.830^{***}	0.751^{***}	1					
RDI	-0.089^{***}	-0.091^{***}	-0.026^{**}	1				
LEV	-0.365^{***}	-0.137^{***}	-0.372^{***}	-0.026	1			
LIQ	0.308^{***}	0.261^{***}	0.182^{***}	-0.021	-0.196^{***}	1		
NSG	0.258^{***}	0.289^{***}	0.191^{***}	0.113^{***}	0.067^{***}	0.090^{***}	1	
SIZE	-0.146^{***}	-0.119^{***}	-0.062^{***}	-0.394^{***}	0.061^{***}	-0.305^{***}	-0.136^{***}	1

*Note: Levels of significance: *p<0.05; **p<0.01; ***p<0.001*

Source: SORS, 2018; own calculations.

Similarly, Table 3.9 shows Pearson's correlation between variables (except year effects) for the sample of world R&D companies. The Pearson correlation matrix reveals that R&D intensity (RDI) is negatively correlated with return on sales (ROS) and positively correlated with price to sales ratio (PSR). Capital expenditure intensity (CEI) is negatively correlated with return on sales (ROS) and positively correlated with price-to-sales ratio (PSR), while the correlation between company size (SIZE) and corporate performance indicators is invertible. This is in line with expectations. Still, the simple correlation between the explanatory variables does not indicate any strong linear relationship, suggesting there is no issue of multicollinearity in the data for the world R&D companies.

Table 3.9: Pearson's correlation matrix of the variables for the world R&D companies

Variable	ROS	PSR	RDI	CEI	SIZE
ROS	1				
PSR	-0.321***	1			
RDI	-0.637***	0.715***	1		
CEI	-0.169***	0.244***	0.190***	1	
SIZE	0.423***	-0.472***	-0.621***	-0.087***	1

*Note: Levels of significance: *p<0.05; **p<0.01; ***p<0.001*

Source: European Commission, 2017, 2018; own calculations.

3.4.2 Multiple regression analysis

This chapter investigates the impact of R&D expenditures on corporate performance for Slovenia and beyond. The latter refers to operating performance in terms of profitability indicators and market performance in terms of market value indicators. To this end, a comprehensive empirical analysis on two different datasets is performed separately. First, multiple regression models are estimated for the sample of Slovenian companies. Second, additional multiple regression models are assessed for the sample of world R&D companies in order to gain additional insights into the role of R&D expenditures in terms of enhancing operating performance. Further, since world R&D companies are listed on the stock exchange, the relationship between R&D expenditures and market performance can be further examined.

Multiple regression models may be estimated using three main different alternative econometric specifications: the pooled regression model, random effects model and fixed effects model. Based on a three-step procedure of different model specification tests (LM test, F test and Hausman test), it is statistically determined that the fixed effects model is the most preferred model for all of the multiple regression models.

The empirical results for Slovenian companies are presented in Table 3.10. With respect to the leading interest of the empirical study, i.e. the relationship between R&D expenditures and operating performance for Slovenian companies, the empirical results show the following. According to Model 3.1 (a, c and e), the regression coefficient of R&D intensity (RDI_t) for operating performance indicators suggests that a 1% increase in R&D intensity (RDI_t) leads to a 0.029% decrease in return on assets (ROA), a 0.056% decrease in return on equity (ROE) and a 0.030% decrease in return on sales (ROS). All of these regression coefficients are significant at the 1% level and suggest that R&D intensity (RDI_t) negatively impacts current operating performance regardless of different measurements of operating performance.

Since R&D expenditures often concern long-term performance, their impact on future operating performance is further examined in additional multiple regression models with a 1-year lagged R&D intensity (RDI_{t-1}). According to Model 3.1 (b, d and f), the regression

coefficient of lagged R&D intensity (RDI_{t-1}) for the operating performance indicators suggests that a 1% increase in lagged R&D intensity (RDI_{t-1}) leads to a 0.034% increase in return on assets (ROA), a 0.047% increase in return on equity (ROE) and a 0.033% increase in return on sales (ROS). The regression coefficients for return on assets (ROA) and return on sales (ROS) are significant at the 0.01 level, while the regression coefficient for return on equity is significant at the 0.05 level and suggests that lagged R&D intensity (RDI_{t-1}) positively impacts current operating performance regardless of different measurements of operating performance.

Further, the results for the control variables are as follows. First, the regression coefficient of financial leverage (LEV) is negative and significant, suggesting that companies with higher debt have a lower operating performance. This agrees with the fact that higher debt requires more company resources in order to repay the debt, which then reduces the funds available for potential investments, as suggested by previous empirical studies (Asimakopoulos et al., 2009; Nunes et al., 2009). Second, the regression coefficient of liquidity (LIQ) is positive and significant, indicating that companies with higher liquidity have higher profitability. Namely, high liquidity reduces exposure to the risk of being unable to meet financial commitments in the short term and this explains why higher liquidity is positively related to operating performance, which is in line with Goddard et al. (2005). Third, the regression coefficient of net sales growth (NSG) is positive and significant, suggesting that growing companies achieve higher profitability ratios due to the additionally generated income, which is consistent with earlier research (Asimakopoulos et al., 2009; Lee, 2009; Nunes et al., 2009; Yazdanfar, 2013). Finally, the regression coefficient of company size (SIZE) is positive and significant, indicating that the ability to use economies of scale, better access to the capital market and the ability to create barriers to newly emerging companies mean that larger companies achieve greater operating performance (Nunes et al., 2009; Titman & Wessles, 1988).

Table 3.10: Multiple regression results for the relationship between R&D expenditure and operating performance for the Slovenian companies

Variable	Predicted Sign	Model 3.1 (a) ROA	Model 3.1 (b) ROA	Model 3.1 (c) ROE	Model 3.1 (d) ROE	Model 3.1 (e) ROS	Model 3.1 (f) ROS
RDI_t	-	-0.029** (0.009)		-0.056** (0.020)		-0.030** (0.009)	
RDI_{t-1}	+		0.034** (0.011)		0.047* (0.024)		0.033** (0.012)
LEV	-	-0.194*** (0.014)	-0.169*** (0.019)	-0.251*** (0.033)	-0.235*** (0.042)	-0.156*** (0.015)	-0.115*** (0.021)
LIQ	+	0.041** (0.014)	0.079*** (0.019)	0.115** (0.033)	0.141** (0.043)	0.041** (0.016)	0.061** (0.022)
NSG	+	0.056*** (0.004)	0.058*** (0.005)	0.130*** (0.009)	0.128*** (0.012)	0.043*** (0.004)	0.036*** (0.006)
SIZE	+	0.018*** (0.005)	0.027*** (0.008)	0.042*** (0.012)	0.045** (0.016)	0.052*** (0.006)	0.055*** (0.008)
Constant	?	-0.138 (0.078)	-0.170 (0.107)	-0.452* (0.182)	-0.562* (0.248)	-0.664*** (0.085)	-0.779*** (0.120)
Year	?	Yes	Yes	Yes	Yes	Yes	Yes
R^2		0.1106	0.1574	0.0334	0.0479	0.0115	0.0116
Observations		3,399	2,116	3,399	2,116	3,399	2,116
LM test		1,009.64***	572.09***	641.48***	435.42***	943.72***	551.17***
F test		49.09***	47.31***	52.17***	41.06***	56.58***	62.48***
Hausman test		49.68***	41.79***	51.36***	36.84***	91.04***	48.36***

*Note: 1) Levels of significance: *p<0.05; **p<0.01; ***p<0.001. 2) Heteroscedasticity-robust standard errors are in parentheses.*

Source: SORS, 2018; own calculations.

Table 3.11 presents the empirical results for the world R&D companies. When investigating the relationship between R&D expenditures and operating performance for the world R&D companies, the empirical results show the following. According to Model 3.2 (a and b), the regression coefficient of R&D intensity (RDI_t) is negative and significant, suggesting that a 1% increase in R&D intensity (RDI_t) leads to a 1.162% decrease in return on sales (ROS). Further, when examining the impact of R&D expenditures on future operating performance, the regression coefficient of 1-year lagged R&D intensity (RDI_{t-1}) is positive and significant, indicating that a 1% increase in lagged R&D intensity (RDI_{t-1}) leads to a 0.275% increase in return on sales (ROS). These results reveal that higher R&D intensity leads to a lower current operating performance and to a higher future operating performance.

Moreover, the results for the control variables are as follows. First, the regression coefficient of capital expenditure intensity (CEI) is negative and significant, suggesting that companies which intensively invest in tangible assets exhibit a lower operating performance. Namely, investment in tangible assets such as equipment, property and industrial buildings typically requires large amounts of funds, which can consequently harm operating performance. This is in line with existing empirical studies (King & Lenox, 2002; Manrique & Martí-Ballester, 2017; Russo & Fouts, 1997). Further, the regression coefficient of company size is positive and significant, indicating that larger companies enjoy a better operating performance than

smaller ones, which is consistent with previous studies (Nunes et al., 2009; Titman & Wessles, 1988).

Table 3.11: Regression results for the relationship between R&D expenditures and operating performance for the world R&D companies

Variable	Predicted Sign	Model 3.2 (a) ROS	Model 3.2 (b) ROS
RDI_t	-	-1.162*** (0.177)	
RDI_{t-1}	+		0.275* (0.133)
CEI	-	-0.211** (0.076)	-0.335** (0.124)
SIZE	+	0.050*** (0.015)	0.133*** (0.022)
Constant	?	-0.887** (0.327)	-2.781*** (0.466)
Year	?	Yes	Yes
R^2		0.3812	0.1372
Observations		5,100	3,400
LM test		2,987.47***	943.35***
F test		25.78***	62.91***
Hausman test		97.04***	229.96***

*Note: 1) Levels of significance: *p<0.05; **p<0.01; ***p<0.001. 2) Heteroscedasticity-robust standard errors are in parentheses.*

Source: European Commission, 2017, 2018; own calculations.

After controlling for different relevant drivers of operating performance, the empirical results for the relationship between R&D expenditures and operating performance suggest they exert a negative impact on current operating performance and a positive impact on future operating performance. The results for the sample of Slovenian companies and the sample of world R&D companies are similar. Although the results for the Slovenian and world R&D companies are not completely comparable due to the different empirical models estimated, they do reveal some interesting insights.

The results show that R&D expenditures have a similar role in Slovenian and world R&D companies from the operating performance perspective. Therefore, the following findings emerge. First, the impact of R&D expenditures seems to be negative for operating performance in the same year for both samples of companies. This implies that companies, regardless of their level of R&D engagement, are unable to generate sufficient profits, i.e. profits exceeding the expenditures incurred when performing R&D activities (Shin et al., 2009). This consequently holds negative implications for current operating performance. Second, the impact of R&D expenditures on operating performance becomes positive when subsequent operating performance is concerned. A reasonable explanation for this is that no innovation outcomes such as new or developed products, processes and services can be expected to be present in the same year of R&D activity being performed. According to

Brown and Svenson (1988), R&D activity is defined as a processing system that entails the path from R&D expenditures to the economic effect and includes several phases: input, processing system, output, receiving system and outcome. Among these, the first three phases (input, processing system and output) represent the real R&D process when R&D expenditures are made, different R&D activities are performed and innovation outputs are generated. Yet, the true benefits for companies in terms of better operating performance emerge after the R&D output is made, i.e. in the phases of receiving system and outcome, when companies benefit from scale production and the marketing of their R&D outputs (Rao & Cao, 2013). It is therefore hard to dispute that there is no lag period between R&D expenditures and operating performance. Finally, another finding of note is that Slovenian companies do not differ much or lag behind the world R&D companies with respect to the relationship between R&D expenditures and operating performance.

Based on the above discussion, the first research hypothesis (Hypothesis 3.1) stating that R&D expenditures deteriorate current operating performance and improve future operating performance is confirmed. These results are also in line with previous empirical studies (Ayaydin & Karaaslan, 2014; Busru & Shanmugasundaram, 2017; Hsu et al., 2013; Kiraci et al., 2016; Rao et al., 2013).

Since this study also considers world companies, which are listed on the stock exchange, additional empirical analysis can be performed in the search for additional insights into the impact of R&D expenditures on corporate performance. In this case, the relationship between R&D expenditures and market performance is investigated. Namely, market performance is often used to approximate for long-term corporate performance as it reflects investors' expectations of companies' future earnings (Vithessonthi & Racela, 2016). Accordingly, two multiple regression models are estimated, where the first considers the current R&D intensity (RDI_t) and the second the lagged R&D intensity (RDI_{t-1}).

The empirical results presented in Table 3.12 show the following. According to Model 3.3 (a and b), the regression coefficient for R&D intensity (RDI_t) is positive and significant, thereby suggesting that a 1% increase in R&D intensity (RDI_t) leads to a 3.155% increase in the price-to-sales ratio (PSR). Further, when examining the impact of R&D expenditures on market performance in the subsequent year, the regression coefficient of 1-year lagged R&D intensity (RDI_{t-1}) suggests that a 1% increase in lagged R&D intensity (RDI_{t-1}) leads to a 1.051% increase in the price-to-sales ratio (PSR), although the regression coefficient is not significant. The results suggest that while accounting profitability follows only 1 year after RDI, market returns are immediate and fade away after a year.

The results concerning the control variables are as follows. First, the regression coefficient of capital expenditure intensity (CEI) is positive and significant, suggesting that not only R&D investment but also investment in equipment, property and industrial buildings is recognised by investors as a positive signal, which is reflected in higher market value indicators, which is consistent with Chung (1998). Second, company size (SIZE) has a

negative impact on market performance, once again consistent with previous research (Kim et al., 2018).

Table 3.12: Regression results for the relationship between R&D expenditures and market performance for the world R&D companies

Variable	Predicted Sign	Model 3.5 (a) PSR	Model 3.6 (b) PSR
RDI_t	+	3.155* (1.568)	
RDI_{t-1}	+		1.051 (2.146)
CEI	+	3.310** (1.047)	2.689 (1.501)
SIZE	-	-1.199*** (0.128)	-0.589** (0.193)
Constant	?	27.490*** (2.747)	14.806*** (4.171)
Year	?	Yes	Yes
R^2		0.3045	0.2698
Observations		5,100	3,400
LM test		3333.41***	1268.46***
F test		69.58***	35.81***
Hausman test		296.07***	217.54***

*Note: 1) Levels of significance: *p<0.05; **p<0.01; ***p<0.001. 2) Heteroscedasticity-robust standard errors are in parentheses.*

Source: European Commission, 2017, 2018; own calculations.

After controlling for capital expenditure intensity (CEI) and company size (SIZE), the empirical results for the relationship between R&D expenditures and market performance suggest that R&D expenditures have an immediate positive impact on current and future market performance. Yet, the positive impact for future market performance is not significant, indicating that after 1 year R&D investment becomes mature and does not have an impact on market performance. Therefore, the second research hypothesis (Hypothesis 3.2) stating that R&D expenditures improve current and future market performance can be confirmed with certainty only for the relationship between R&D expenditures and current market performance, which is actually an approximation for long-term corporate performance. The results are also in line with empirical studies (Bae & Kim, 2003; Bae & Noh, 2001; Başgoze & Sayin, 2013; Chan et al., 2015; Duqi et al., 2011; Ehie & Olibe, 2010; Ho et al., 2005; Usman et al., 2017; Vithessonthi & Racela, 2016; Wang, 2011).

To summarise, the comprehensive empirical analysis of the samples of Slovenian and world R&D companies provides interesting findings. The results suggest that R&D expenditures have a negative impact on short-term corporate performance in terms of operating performance and a positive impact on long-term corporate performance with respect to future operating performance and market performance. Two main factors explain why R&D expenditures negatively impact short-term corporate performance. The first one relates to

the accounting perspective. Namely, companies are often unable to generate sufficient profits, that is, ones that exceed the expenditure incurred while performing R&D activities. Second, since the process of R&D activity requires some time to develop innovation outputs, it is therefore unrealistic to expect an immediate beneficial effect for companies. Accordingly, it may be argued that R&D expenditures are effective in the long term rather than the short term (Asthana & Zhang, 2006).

These results are in accordance with the theoretical foundations of the Resource-based theory and Knowledge-based theory, which stress the role of R&D expenditures in generating competitive advantages over competitors and thus in improving operating performance. Moreover, the empirical results also support the Efficient market theory, which states that the market should correctly value different types of investment and these valuations should then be reflected in the market performance. Accordingly, it is confirmed that not only investment in tangible assets but also investment in intangible assets hold considerable implications for market performance.

3.5 Discussion and implications

This part of the doctoral dissertation examines the impact of R&D expenditures on corporate performance. Therefore, an empirical analysis was performed on a sample of 3,999 company-year observations for Slovenian companies for the period 2012–2016. An empirical analysis was also performed of a sample of 5,100 company-year observations for world R&D companies, i.e. companies investing heavily in R&D for the period 2015–2017 for the purposes of further confirming the empirical results and obtaining additional insights into market performance as these companies are listed on the stock exchange. Accordingly, a comprehensive empirical analysis using panel data estimation techniques on two different datasets was performed.

The results of the empirical study explain that R&D expenditures are an important determinant of operating and market performance. As regards operating performance, R&D expenditures have an adverse impact on current operating performance and a positive impact on future operating performance. The results are the same for the samples of Slovenian companies and world R&D companies operating in major world economies. This means that R&D expenditures hold similar implications for operating performance in those companies. Initially, the impact of R&D expenditures on operating performance is negative due to the insufficient profits that are generated, which are not high enough to exceed the R&D expenditure, and companies' inability to provide innovation outcomes in the same year as R&D activity is performed. Later on, the impact of R&D expenditures on operating performance becomes positive, suggesting that after 1 year of R&D expenditures being made, companies may benefit from the scale production and marketing of their R&D outputs. Nevertheless, the comparison of the Slovenian and world R&D companies reveals that Slovenian companies have good potential to exploit R&D expenditures in terms of

improving their future operating performance since they do not differ much or lag behind the world R&D companies with respect to the relationship between R&D expenditure and operating performance.

The utilisation of the dataset of world R&D companies listed on the stock exchange, allows for additional further insights into the relationship between R&D expenditures and market performance. The results show that R&D expenditures improve market performance, albeit this effect becomes non-significant for market performance in the subsequent year. This suggests that after 1 year, R&D expenditures become mature and do not impact market performance. Still, the results also support the idea that R&D expenditures are ineffective in the short run and bring certain benefits to companies in the long run, as suggested by market performance, which captures investors' expectations of companies' future earnings.

The study results lend further empirical support to the main theoretical foundations commonly used to explain the impact of R&D expenditures on corporate performance. According to the Resource-based theory, companies possess different unique resources which can improve their corporate performance. Further, the Knowledge-based theory highlights that especially R&D expenditures can be seen as a main driver of the generation of competitive advantage over competitors. The results suggest that higher levels of R&D intensity lead to lower levels of operating performance in the same year due to high uncertainty and risk. On the other hand, higher levels of R&D intensity lead to higher levels of operating performance in the future, which supports these two theories. This result is further supported by the positive impact of R&D expenditures on market performance as a measure of long-term corporate performance and supports the Efficient Market theory which states that all kinds of investment should be immediately reflected in market performance. This implies that some time is needed to acquire the benefits of innovation outputs, indicating that R&D expenditures bring negative returns in the short term and positive returns in future periods. Thus, these findings provide new insights into the complex relationship between R&D expenditures and corporate performance and may be seen as a meaningful complement to existing empirical studies in this research area.

The findings of this study also hold several important practical implications. The overall findings suggest that a company should wait at least 1 year to obtain beneficial effects from an R&D investment in operating performance terms. On the other hand, market performance is enhanced in the year the R&D investment is made. These findings may be especially of use to managers, who are often inclined to pursue short-term goals and short-term corporate performance, which are not necessarily aimed at generating corporate performance in a future period. Namely, it is important that managers be aware that R&D investment does not bring an immediate positive effect on operating performance. The benefits of R&D investment on operating performance should become more evident in a future period. Therefore, focusing on short-term corporate performance should be used to justify managers not investing in R&D activities. Managers are recommended to exercise patience when investing in R&D activities since such investment is not instantly reflected in a better

operating performance. At the same time, managers should be aware that R&D investment is positively valued by the market and immediately enhances market performance, which is often used to proxy for corporate performance in the long term. Briefly, in this case, managers are actually exposed to a trade-off between short- and long-term performance. This is why it is important that managers have a comprehensive picture of the effects of R&D investment on corporate performance because they can then take appropriate investment decisions on this basis. The results may also be beneficial for policymakers in order to stimulate R&D investment on the company level and to reduce the risk of such investment failing. This includes promoting R&D investment with appropriate public support mechanisms as well as establishing a stable and predictable business environment without unnecessary administrative barriers. This is crucial because R&D expenditures are expected to be a key determinant of the corporate performance of modern companies.

This chapter offers new and interesting insights regarding the relationship between R&D spending and corporate performance. Yet, the chapter also has some limitations that, while not diminishing its significance, should be seen as providing directions for future research. The first limitation is the limited research period. The research period for the sample of Slovenian companies is restricted to the period 2012–2016 and for the sample of world R&D companies to 2015–2017. However, this was due to certain reasons. The sample of Slovenian companies was limited by the need to provide a research period that included stable operating conditions for companies, while the sample of world R&D companies was limited the lack of market performance data in the EU Industrial R&D Investment Scoreboard. As a result, one direction for future research would be to extend the research period. This might provide additional empirical evidence on the impact of R&D expenditure on corporate performance, especially during the recent economic crisis.

The second limitation, somewhat touching on the limited research period, refers to the research methods adopted. Namely, the limited research period for Slovenian and world R&D companies meant that only a 1-year lag between R&D expenditures and corporate performance was considered. An extension of the research period would thus allow a longer lag period between R&D expenditures and corporate performance to be considered in the empirical analysis, in turn yielding further long-term insights. The limited research period also makes it difficult to use sophisticated econometric approaches as they often require a longer research period if credible empirical results are to be reached. Moreover, the use of sophisticated econometric approaches would allow the issue of endogeneity to be controlled, a possible concern while investigating the R&D spending/corporate performance relationship. Further, investigating the impact of R&D expenditures on corporate performance may engage the issue of reverse causality. This issue is partially controlled by lagging a suspected endogenous variable. Accordingly, a suggestion for further research is to use more sophisticated econometric approaches and techniques so as to reduce the bias of the empirical results.

The third limitation concerns the datasets. The data lack information on innovation outputs, implying that the non-financial aspect of R&D expenditures is neglected in this study. It would therefore be beneficial to obtain additional data on patents and trademarks to complement the existing database and allow possibly produce more interesting insights. Moreover, since this study is based solely on databases which, besides basic company characteristics only include financial items of individual companies, some important information might be overlooked. It would be therefore be useful to conduct surveys or interviews in order to obtain further insights beyond those obtainable only through financial data.

Finally, this study does not account for the characteristics of the industry in which companies operate, which may hold important implications for the relationship between R&D expenditures and corporate performance. Moreover, part of the empirical analysis covered a sample of world R&D companies encompassing companies that invest heavily in R&D and operate in major economies, namely, the EU, the USA, China and Japan, which may be assumed to represent a good benchmark for Slovenian companies. Yet, the major economies have different economic systems with dissimilar institutional frameworks, which may affect the involvement of government in the areas of R&D and corporate performance. This aspect is not considered in the empirical analysis given that the main interest is to compare Slovenian and world R&D companies. Nevertheless, the consideration of industry and economy characteristics is an interesting area for future research.

CONCLUSION

Main findings

Nowadays, the global economy and hence companies are faced with fresh challenges associated with globalisation, the emergence of new technologies and the transition to a knowledge-based economy. This has created challenging business conditions seen in a fast-growing and ever-changing market with increasingly fierce competition, which is forcing companies to adjust their business and investment strategies so as to provide value-added products, processes and services and retain their competitive market position. One of the possible solutions for addressing these contemporary economic challenges and ensuring companies' long-term viability entails R&D investment.

Accordingly, the primary aim of the doctoral dissertation was to examine the role of public support for R&D investment and its comprehensive effects on companies, including the implications for their performance. Therefore, the dissertation assesses: 1) the impact of public support for R&D investment on firms' R&D expenditures; 2) the impact of public support for R&D investment on the accounting treatment of R&D expenditures, and 3) the impact of R&D expenditures on corporate performance.

The first chapter investigates the impact of public support for R&D investment on firms' R&D spending. The empirical results show that public support for R&D investment is important in terms of firms' R&D expenditures. The empirical results suggest that R&D subsidies generally displace firms' R&D expenditures in Slovenia. However, the results show that R&D subsidies only become effective when used in combination with R&D tax incentives and when received by companies that are growing. On the contrary, the empirical results show that R&D tax incentives are always effective when companies have a sufficient tax base. This implies that Slovenian companies are not exploiting the potential held by R&D subsidies. This partly relates to the fact that Slovenian companies are not so familiar with R&D subsidies. Still, it seems that R&D tax incentives are a good and effective public policy instrument that is being successfully exploited by Slovenian companies.

The reasons for the different findings concerning the impact of public support for R&D investment on firms' R&D expenditures stem from differences in the characteristics of R&D subsidies and R&D tax incentives. As regards eligibility for public support, only R&D projects with a high degree of novelty, risk or spillover capacity and meet funding agency requirements are eligible for R&D subsidies. On the contrary, all R&D projects are eligible for R&D tax incentives. Further, the magnitude of R&D subsidies depends on their amount, a detail that companies know in advance, while the magnitude of R&D tax incentives depends on companies' tax position at the end of the fiscal year. R&D subsidies are therefore seen as more certain than R&D tax incentives. Finally, as regards the timing of public support, R&D subsidies are obtained ex ante before the R&D project starts, while R&D tax

incentives are obtained ex post at the end of the fiscal year. These characteristics of R&D subsidies mean they do not stimulate companies towards their natural growth, which would ultimately lead to increased R&D spending. This implies that the effects of R&D subsidies exist more in maintaining companies' business operations than in stimulating their growth and funding for R&D activity. Yet, the presented characteristics of R&D tax incentives suggest they are more growth-oriented since they depend largely on their tax position at the end of the fiscal year. The overall conclusion is that R&D subsidies are used more to help companies that experience less growth to maintain employment and replace older products, processes and services (this is not the case with companies that rely on both public policy instruments and with growing companies), while R&D tax incentives are used in companies with a sufficient tax base.

The second chapter examines how public support for R&D investment impacts the accounting treatment of R&D expenditures. The empirical results reveal that earnings management is present after public support is received in the form of R&D tax incentives. Given that R&D tax incentives relieve companies' tax burden, they aim to maximise the accounting profit by R&D capitalisation. This is further confirmed by the significant and positive effects of financial leverage and profitability. Moreover, the empirical results suggest that larger companies and companies that take the legal form of a public limited company are more likely to capitalise their R&D expenditures. As regards R&D subsidies, the IFRS aligns their accounting treatment with the accounting treatment of R&D expenditures, implying that R&D subsidies are tax-neutral. This means they cannot be the main driver of the R&D accounting treatment decision.

The empirical results suggest that public support for R&D investment (especially R&D tax incentives) may impact a company's accounting policy decision on the accounting treatment of R&D expenditures. This finding is robust to alternative logistic regression models as well as to controlling for other possible determinants of the decision on the accounting treatment of R&D expenditures identified by previous research. The results suggest that R&D tax incentives have an impact on the R&D accounting choice, which implies they help companies in balancing their profit-maximisation and tax-minimisation goals. The aforementioned suggests the presence of earnings management when companies benefit from R&D tax incentives and when accounting regulation permits the capitalisation of R&D expenditures. In other words, by using R&D tax incentives companies are able to balance their goals of profit maximisation and tax minimisation since R&D capitalisation allows them to exhibit higher accounting income.

The third chapter looks at the impact of R&D spending on corporate performance. The empirical results explain that R&D expenditures represent an important determinant of operating and market performance. As concerns operating performance, R&D expenditures have an adverse impact on current operating performance and a positive impact on future operating performance. The results are the same for the samples of Slovenian companies and world R&D companies operating in major world economies. This means that R&D

expenditures bring similar implications for operating performance in those companies. Initially, the impact of R&D expenditures on operating performance is negative due to the insufficient profits generated, which are not high enough to outweigh the R&D spending, and companies' inability to provide innovation outcomes in the same year as when R&D activity is performed. Later on, the impact of R&D expenditures on operating performance becomes positive, suggesting that after 1 year of making R&D expenditures companies can benefit from the scale production and marketing of their R&D outputs. Still, the comparison of Slovenian and world R&D companies shows that Slovenian companies hold good potential to exploit R&D expenditures in terms of improving their future operating performance since they do not differ much or lag behind the world R&D companies with respect to the R&D spending-operating performance relationship.

The utilisation of the dataset of world R&D companies listed on the stock exchange allows further insights to be obtained concerning the relationship between R&D expenditures and market performance. The results reveal that R&D expenditures improve market performance, although this effect becomes non-significant for market performance in the subsequent year. This suggests that after 1 year R&D expenditures become mature and do not have an impact on market performance. Nevertheless, the results further support the idea that R&D expenditures are not effective in the short run and bring certain benefits to companies in the long run, as suggested by market performance that captures investors' expectations about companies' future earnings.

Empirical contributions to the theory

The doctoral dissertation makes several empirical contributions to the theory by combining two contemporaneous R&D policy instruments, incorporating both the economic and accounting perspectives and considering the implications of R&D spending on different perspectives of current and future corporate performance. This is supplemented by concentrating on specific characteristics of the Slovenian business environment and utilising a unique and comprehensive database for Slovenian and world R&D companies. The aforementioned features of the dissertation make it unique with respect to the existing economic and accounting literature. The new, innovative and interdisciplinary approach taken enables it to provide a broader view into the area of R&D, in turn representing the overall value added of the doctoral dissertation.

The findings of the first chapter lend further empirical support for the main theoretical foundations commonly used to explain why public support for R&D investment is needed in a certain economy. The results reveal that public support for R&D investment helps reduce certain market failures by lowering the costs needed to perform R&D activities, which allows companies to invest more in R&D activities.

Moreover, the findings of the second and third chapters provide additional empirical support to the theoretical foundation of the Positive Accounting theory, which states that managers hold discretionary power to choose accounting and valuation methods.

Finally, the third chapter lends further empirical support for the main theoretical foundations typically referred to while explaining how R&D expenditures impact corporate performance. According to the Resource-based theory, companies possess different unique resources which are able to improve corporate performance. Further, the Knowledge-based theory emphasises that especially R&D expenditures can be seen as a main driver of the generation of competitive advantage over competitors. The results suggest that higher levels of R&D intensity lead to a lower operating performance in the same year and, as a result, to high uncertainty and risk. On the other hand, increased levels of R&D intensity lead to a higher operating performance in the future period, which supports these two theories. This result is further supported by the positive impact of R&D expenditures on market performance as a measure of long-term corporate performance and supports the Efficient Market theory, which states that all kinds of investment should be immediately reflected in market performance. Therefore, some time is needed to acquire the benefits of innovation outputs, indicating that R&D expenditures bring negative returns in the short term and positive returns in future periods. Thus, the presented findings provide fresh insights into the complex relationship between R&D spending and corporate performance and may be regarded as meaningfully complementing existing studies in this research area.

Policy recommendations and practical implications

The doctoral dissertation utilises a new, innovative and interdisciplinary approach and is therefore able to provide a broader view of the area of R&D. Accordingly, policy recommendations and practical implications are not only limited to Slovenia, but may also be useful for other economies beyond Slovenia.

The new and attractive findings may be of benefit to different stakeholders. The overall findings of chapter one suggest that R&D tax incentives are more effective than R&D subsidies in Slovenia for the following reasons. First, the overall system in Slovenia is relatively small, fragmented (with an abundance and variety of R&D tenders and a non-homogeneous population of companies) and two-tiered (especially since 2012 when an R&D tax allowance rate of 100% was introduced). This implies that companies with a sufficient tax base are more inclined to R&D tax incentives because all R&D projects funded by companies' own internal or external finances are eligible for this form of public support for R&D investment. In contrast, R&D subsidies remain attractive, especially for smaller companies without a sufficient tax base. It is thus important to consider both public policy instruments as two parallel ways of supporting firms' R&D expenditures. It is crucial that policymakers exploit the advantages and reduce the weaknesses of each instrument in order to provide public support for R&D investment in the most efficient way.

Moreover, the findings of the second chapter suggest that public support for R&D investment (especially R&D tax incentives) may impact the company's accounting policy decision on the accounting treatment of R&D expenditures. These findings may therefore be beneficial in developing further discussion among accounting-standard setters on the accounting treatment of intangible assets, especially those related to R&D activity. The results are also interesting to policymakers since they help them deepen their understanding of how public policy can affect companies' accounting policy.

Finally, the findings of chapter three suggest that a company should wait at least 1 year to obtain the benefits of an R&D investment in terms of its operating performance. On the other hand, market performance is enhanced in the year the R&D investment is made. These findings are especially beneficial for managers, who are often inclined to pursue short-term goals and short-term corporate performance, which is not necessarily undertaken to generate corporate performance in a future period. It is namely important that managers are aware that R&D investment does not bring an immediate positive effect on operating performance. The benefits of R&D investment on operating performance should become more evident in a future period. Focusing on short-term corporate performance therefore should not become a justification for managers not investing in R&D activities. Managers are recommended to be patient when investing in R&D activities since such investment is not immediately reflected in a better operating performance. At the same time, managers should be aware that R&D investment is positively valued by the market and immediately enhances market performance, which is an approximation for corporate performance in the long term. Briefly, in this case, managers encounter a trade-off between short- and long-term performance. This is why it is important that managers have a comprehensive picture of the effects of R&D investment on corporate performance as they can then take appropriate investment decisions. The results may also be of benefit to policymakers in order to stimulate R&D investment on the company level and to reduce the risk of such investment failing. This includes promoting R&D investment with suitable public support mechanisms as well as establishing a stable and predictable business environment without unnecessary administrative barriers. This is crucial because R&D expenditures are expected to be a key determinant of the corporate performance of modern companies.

Limitations and further research

Although the doctoral dissertation presents some new and interesting findings through an extensive examination of the role of public support for R&D investment and its comprehensive effects on companies and the implications for their performance, below some limitations are recognised and future research avenues are outlined.

First, the research period for Slovenian companies is limited to the five-year period 2012–2016, especially due to the need to ensure a research period containing stable operating conditions for companies. Moreover, due to specific aspects of each chapter covered in the

doctoral dissertation the research period is restricted for the following reasons. As regards Chapter 1, the additional requirement is to assure a research period in which both instruments of public support for R&D investment were available for Slovenian companies. In terms of Chapters 1 and 2, the extra requirement involves R&D tax incentives. Namely, ever since R&D tax incentives were introduced in Slovenia in 2005, they have been subject to significant changes in terms of their rates, with the latest major change to the R&D tax allowance coming in 2012 when the rate rose considerably to 100%. Therefore, before 2012 Slovenian companies were able to opportunistically treat their R&D expenditures to obtain additional benefits from R&D tax incentives. All of the above-mentioned reasons or conditions needed to ensure reliable empirical results meant the research period had to be limited to 2012–2016. Moreover, the third chapter of the dissertation extends the empirical analysis to economies beyond Slovenia, that is, to world R&D companies. However, the research period for this sample is restricted to the three-year period 2015–2017. The reason for this limitation is the lack of market performance data, which constitutes one of the main measures of corporate performance.

Accordingly, the following directions for future research are recognised. The first is to extend the research period. This might provide additional empirical evidence on the impact of public support for R&D investment on corporate performance, especially during the recent economic crisis. The limited research period also makes it difficult to apply sophisticated econometric approaches since they typically require a longer research period in order to obtain credible empirical results. It would therefore be beneficial to apply alternative econometric approaches in order to confirm the empirical results. Finally, the empirical analysis covered in the doctoral dissertation is based exclusively on databases which, besides some basic company characteristics, only include financial items for individual companies, thereby possibly overlooking some important information. It would be beneficial to conduct surveys or interviews so as to obtain further empirical insights, with an emphasis on industry characteristics, which cannot be obtained just through financial data. Moreover, the datasets used in the empirical analysis lack data about innovation outputs and thus it would be useful to obtain additional data on patents and trademarks to complement the existing databases and allow other interesting non-financial insights.

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APPENDIX

Appendix 1: Summary in Slovenian language / Daljši povzetek disertacije v slovenskem jeziku

DRŽAVNE SPODBUDE ZA VLAGANJA V RAZISKAVE IN RAZVOJ TER VPLIV NA USPEŠNOST PODJETIJ

UVOD

Doktorska disertacija proučuje vlogo državne spodbude za vlaganja v raziskave in razvoj (RR) ter njene celovite učinke na podjetja z implikacijami na njihovo uspešnost. Svetovno gospodarstvo se namreč trenutno sooča z novimi izzivi, ki so povezani z globalizacijo, pojavom novih tehnologij in prehodom k na znanju temelječem gospodarstvu. To je privedlo do zahtevnih pogojev poslovanja, ki se odražajo v hitro rastočem in vedno spreminjajočem se trgu z vse ostrejšo konkurenco, ki podjetja sili, da prilagodijo svoje poslovne in naložbene strategije na način, da zagotavljajo izdelke, postopke in storitve z dodano vrednostjo in ohranjajo konkurenčni položaj na trgu. Eno od možnih rešitev za reševanje teh sodobnih gospodarskih izzivov in za zagotavljanje dolgoročne sposobnosti preživetja podjetij je mogoče prepoznati v vlaganju v RR.

Vendar so privatna vlaganja v RR v poslovnem sektorju pogosto predmet tržnih nepopolnosti (pozitivne eksternalije, informacijske asimetrije, negotovost in tveganje), zaradi česar je njihova raven nižja od ravni, ki je družbeno zaželena. To prestavlja glavni razlog za državno spodbujanje privatnih vlaganj v RR. Številne sodobne države po svetu ponujajo različne instrumente javne politike za spodbujanje privatnih vlaganj v RR v poslovnem sektorju. Najpogostejši instrumenti državne podpore za vlaganje v RR so subvencije za RR kot način neposrednega financiranja in davčne olajšave za RR kot način posrednega financiranja. Ker obstajajo med subvencijami in davčnimi olajšavami za RR različne značilnosti, njihov vpliv na vlaganja podjetij v RR ni dobro ugotovljen. Poleg tega vedno večji pomen vlaganj v RR v sodobnih gospodarstvih zadeva tudi njihovo računovodsko obravnavo. To velja zlasti za gospodarstva z računovodskimi standardi, ki omogočajo diskrecijsko izbiro pri računovodstvu za RR. Ker se javne politike pogosto obravnavajo kot eden glavnih dejavnikov poslovnih odločitev podjetij, je pomembno razumeti razmerje med javnimi politikami za RR in računovodsko politiko podjetij. Ne nazadnje obstoj tržnih nepopolnosti (pozitivne eksternalije, informacijske asimetrije, negotovost in tveganje), postavlja pod vprašaj vpliv vlaganj v RR na uspešnost podjetij. Za razumevanje omenjenih kompleksnih vprašanj je potreben sistematičen, poglobljen in celovit vpogled v to tematiko.

Splošen cilj doktorske disertacije je raziskati vlogo državne spodbude za vlaganja v RR v smislu njenih celovitih ekonomskih in računovodskih implikacij, ki vplivajo na uspešnost podjetij. Glavno raziskovalno vprašanje se torej nanaša na vpliv državne podpore za vlaganja v RR na uspešnost podjetij. Ker državna podpora za vlaganja v RR posredno vpliva na poslovanje podjetij preko različnih kanalov, je zato pomembno opredeliti in razumeti te

kanale, skozi katere podjetja povečujejo svojo uspešnost. Skladno z omenjenim, lahko izdatki podjetij za RR in njihova računovodska obravnava, ki so lahko pod vplivom različnih instrumentov javne politike, predstavljajo kanale, skozi katere se občuti vpliv na uspešnost podjetij. Izdatke podjetij za RR ter njihovo računovodsko obravnavo je zato mogoče obravnavati kot vmesni fazi na celotni poti od državne podpore za vlaganja v RR do uspešnosti podjetij.

Z namenom doseganja lažjega razumevanja zgoraj obravnavanih kompleksnih vprašanj je potreben sistematičen, poglobljen in celovit vpogled v to tematiko. Zato doktorska disertacija prvotno vključuje naslednje elemente, ki obravnavajo: 1) kompleksna vprašanja v zvezi z javno politiko RR ter privatnimi vlaganji v RR; 2) računovodsko perspektivo v zvezi z razmerjem med javnimi politikami RR in RR računovodsko politiko podjetij; in 3) dvoumnosti glede razmerja med izdatki za RR ter uspešnostjo podjetja. Integracija različnih, vendar komplementarnih elementov, poudarja raziskavo znotraj doktorske disertacije kot edinstveno v primerjavi z obstoječo ekonomsko in računovodsko literaturo. Študija je zato zajeta oziroma strukturirana v obliki treh med seboj povezanih glavnih poglavij, obdanih z uvodom in zaključkom.

1 VPLIV DRŽAVNE SPODBUDE ZA VLAGANJA V RR NA IZDATKE PODJETIJ ZA RR

Prvo poglavje proučuje vpliv državne spodbude za vlaganja v RR na izdatke podjetij za RR. Temelji na sledeči glavni teoretični utemeljitvi državnega spodbujanja privatnih vlaganj v RR. V tem primeru gre za obstoj tržnih nepopolnosti (pozitivne eksternalije, asimetrije informacij, negotovost in tveganje), ki povzročajo, da je raven privatnih naložb v RR nižja od družbeno zaželene ravni. Navedeno predstavlja glavni razlog, zakaj bi morale države spodbujati izdatke podjetij za RR. To je mogoče doseči z implementacijo ustreznih instrumentov javne politike, ki lahko prispevajo k zmanjšanju stroškov bolj tveganih, vendar družbeno koristnih vlaganj v RR. Skladno s tem, številne sodobne države zagotavljajo različne instrumente javne politike za spodbujanje privatnih izdatkov za RR v poslovnem sektorju, pri čemer za glavne javne politike RR štejejo subvencije za RR ter davčne olajšave za RR. Vendar pa so javno finančni pritiski, ki so posledica kombinacije visokega dolga in nizke rasti gospodarstva v nedavni finančni in gospodarski krizi, poudarili razpravo o učinkovitosti različnih oblik državne spodbude za vlaganja v RR.

Glavni cilj prvega poglavja je tako odgovoriti na glavno raziskovalno vprašanje, ali različni instrumenti javne politike za vlaganja v RR spodbujajo izdatke podjetij za RR. Slovenija namreč predstavlja naravno okolje za vrednotenje vpliva različnih oblik državne spodbude za vlaganja v RR na izdatke podjetij za RR, saj sta oba instrumenta javne politike trenutno na voljo slovenskim podjetjem. Na ta način to poglavje dopolnjuje obstoječe empirične študije, saj velika večina obravnava zgolj posamezen instrument javne politike, tj. subvencije za RR ali davčne olajšave za RR. Ker vlade v številnih sodobnih gospodarstvih zagotavljajo tako neposredne kot posredne mehanizme državnih spodbud za vlaganja v RR, so ocene, ki

ne upoštevajo učinkov obeh instrumentov javne politike, lahko pristranske. Poleg tega so številne empirične študije osredotočene zgolj na napredna ali velika gospodarstva, medtem ko so manjša pretežno zanemarjena. Obstoječe študije podobno upoštevajo le večja podjetja ter tista, ki kotirajo na trgu, medtem ko so manjša podjetja in tista, ki ne kotirajo na trgu, spregledana.

Ker sta v Sloveniji na voljo dva različna instrumenta državne spodbude za vlaganja v RR, sta razviti dve različni raziskovalni hipotezi. Prva raziskovala hipoteza zajema subvencije za RR, ki se štejejo za neposredno državno spodbudo za vlaganja v RR. Na splošno se pričakuje, da bodo subvencije za RR povečale izdatke podjetij za RR. Vendar pa lahko njihova posebna narava v smislu upravičenosti, velikosti in gotovosti ter časovnega okvira, pomembno vpliva na njihovo učinkovitost. V skladu s to razpravo je predlagana sledeča raziskovalna hipoteza:

- **Hipoteza 1.1:** Neposredna državna spodbuda za vlaganja v RR v obliki subvencij za RR spodbuja izdatke za RR, pri čemer je zaradi svoje posebne narave manj učinkovit instrument kot pa posredna državna podpora v obliki davčnih olajšav za RR.

Drug pomemben instrument državne spodbude za vlaganja v RR predstavljajo davčne olajšave za RR, ki se obravnavajo kot posredna državna spodbuda za vlaganja v RR. Podobno kot za primer subvencij za RR se velikokrat pričakuje, da bodo davčne olajšave za RR ugodno vplivale na izdatke podjetij za RR. Vendar pa se lahko tudi pričakuje, da bodo zaradi njihove širše ali splošne narave predstavljale učinkovit instrument za širšo populacijo podjetij. V skladu s to razpravo je predlagana sledeča raziskovalna hipoteza:

- **Hipoteza 1.2:** Posredna državna spodbuda za vlaganja v RR v obliki davčnih olajšav za RR spodbuja izdatke za RR, pri čemer je zaradi svoje splošne narave učinkovit instrument za širšo populacijo podjetij.

Rezultati multiple regresijske analize na vzorcu slovenskih podjetij za obdobje 2012–2015 pojasnjujejo, da ima državna spodbuda za vlaganja v RR pomembno vlogo pri izdatkih podjetij za RR. Iz empiričnih rezultatov je mogoče sklepati, da subvencije za RR na splošno izpodrivajo izdatke podjetij za RR. Vendar pa rezultati nadalje kažejo, da subvencije za RR postanejo učinkovite, ko se uporabljajo v kombinaciji z davčnimi olajšavami za RR oziroma ko le-te prejmejo rastoča podjetja. Nasprotno pa empirični rezultati kažejo, da so davčne olajšave za raziskave in razvoj učinkovite v vsakem primeru, ko imajo podjetja zadostno davčno osnovo. To pomeni, da slovenska podjetja ne izkoriščajo potenciala subvencij za RR. To je deloma povezano z dejstvom, da slovenska podjetja niso dovolj seznanjena s subvencijami za RR. Po drugi strani pa se zdi, da davčne olajšave za RR predstavljajo dober in učinkovit instrument javne politike, ki ga slovenska podjetja uspešno izkoriščajo.

2 VPLIV DRŽAVNE SPODBUDE ZA VLAGANJA V RR NA RAČUNOVODSKO OBRAVNAVO IZDATKOV ZA RR

Drugo poglavje obravnava vpliv državne spodbude za vlaganja v RR na računovodsko obravnavo izdatkov za RR. Temelji na Pozitivni računovodski teoriji, ki navaja, da imajo managerji diskrecijsko moč, da izberejo računovodske metode in metode vrednotenja. Metode se lahko izberejo za namene zasledovanja njihovega lastnega interesa ali zasledovanje uspešnosti podjetij. To teorijo sta razvila Watts in Zimmerman (1986) in predstavlja enega izmed prvih poskusov, ki empirično razlagajo računovodske prakse podjetij. Skladno s to teorijo so računovodske metode, ki so jih sprejela podjetja, sistematično povezane z njihovimi značilnostmi. Zaradi potencialno oportunističnega obnašanja managerjev v podjetjih lahko ta teorija pomaga napovedati in razumeti, katero računovodsko metodo bo podjetje sprejelo. Skladno s tem to poglavje obravnava državno spodbudo za vlaganja v RR kot enega izmed možnih dejavnikov, ki vplivajo na računovodsko obravnavo RR, saj se javne politike pogosto dojemajo kot eden glavnih dejavnikov poslovnih odločitev podjetij (National Research Council, 2005). To se nanaša tudi na odločitve v zvezi z računovodsko politiko podjetij, saj menijo, da lahko informacije v računovodskih izkazih vplivajo na zaznavanje in odločanje zunanjih deležnikov podjetij (Tzovas, 2006).

Glavni cilj drugega poglavja je torej odgovoriti na glavno raziskovalno vprašanje, kako državna spodbuda za vlaganja v RR vpliva na računovodsko obravnavo izdatkov za RR. V skladu s tem je namen tega poglavja odgovoriti na to vprašanje z razsvetlitvijo določenih vprašanj, povezanih z računovodsko obravnavo izdatkov za RR z vidika nasprotujočih si ciljev maksimiranja dobička in zmanjševanja davkov. Slovenija namreč predstavlja naravno okolje za ocenjevanja vpliva državne spodbude za vlaganje v RR na računovodsko obravnavo izdatkov za RR, saj sta po MSRP in SRS obe računovodski metodi (tj. kapitalizacija in odpisovanje) dovoljeni za slovenska podjetja. Poleg tega so številne empirične študije osredotočene na napredna ali velika gospodarstva, medtem ko so manjša pretežno zanemarjena. Obstoječe študije podobno upoštevajo le večja podjetja ter tista, ki kotirajo na trgu, medtem ko so manjša podjetja in tista, ki ne kotirajo na trgu, spregledana. Obstoječi računovodski standardi usklajujejo računovodsko obravnavo subvencij za RR in izdatkov za RR, kar pomeni, da so subvencije za RR davčno nevtralne. Zato ne morejo predstavljati glavnega gonila odločitve glede računovodske obravnave za RR. Posledično se to poglavje v empiričnem delu osredotoča zgolj na davčne olajšave za RR.

Razviti sta dve različni raziskovalni hipotezi. Prva raziskovalna hipoteza se nanaša le na preučitev, ali so podjetja, ki imajo korist od posredne državne spodbude za RR v obliki davčnih olajšav za RR, bolj naklonjena kapitalizaciji izdatkov za RR. Ker imajo tista podjetja, ki uveljavljajo davčne olajšave za RR, v splošnem nižjo efektivno davčno stopnjo, se pričakuje, da so bolj naklonjena k obravnavi izdatkov za raziskave in razvoj kot neopredmetena sredstva v bilanci stanja. Zato je predlagana sledeča raziskovalna hipoteza:

- **Hipoteza 2.1:** *Upravičenci posredne državne spodbude za vlaganja v RR v obliki davčnih olajšav za RR bolj verjetno obravnavajo izdatke za RR kot neopredmetena sredstva v bilanci stanja.*

Poleg uporabe davčnih olajšav za RR lahko tudi njihov obseg pomembno vpliva na računovodsko obravnavo izdatkov za RR. Namreč podjetja, ki koristijo višje davčne olajšave za RR, imajo veliko nižjo efektivno davčno stopnjo kot pa podjetja, ki koristijo nižje davčne olajšave. Zato se pričakuje, da ima lahko obseg davčnih olajšav za RR pomembne posledice za odločitev podjetij glede računovodskega obravnavanja izdatkov za RR. Zato je predlagana sledeča raziskovalna hipoteza:

- **Hipoteza 2.2:** *Obseg posredne državne spodbude za vlaganja v RR v obliki davčnih olajšav za RR pozitivno vpliva na odločitev podjetij, da izdatke za RR obravnavajo kot neopredmetena sredstva v bilanci stanja.*

Rezultati logistične regresije razkrivajo, da je prisotno uravnavanje dobičkov po prejemu državne spodbude v obliki davčnih olajšav za RR. Glede na to, da davčne olajšave za RR razbremenjujejo davčno breme podjetij, si le-ta prizadevajo maksimirati računovodski dobiček s kapitalizacijo RR izdatkov. To potrjujejo tudi signifikantni in pozitivni učinki finančnega vzvoda in dobičkonosnosti. Empirični rezultati poleg tega kažejo, da bodo večja podjetja, in podjetja s pravno organizacijsko obliko delniške družbe, bolj verjetno kapitalizirala izdatke za RR. Kar zadeva subvencije za RR, pa MSRP usklajuje njihovo računovodsko obravnavo z računovodsko obravnavo izdatkov za RR, kar pomeni, da so subvencije za RR davčno nevtralne. Zato ne morejo predstavljati glavnega gonila odločitve računovodske obravnave izdatkov za RR.

3 VPLIV IZDATKOV ZA RR NA USPEŠNOST PODJETIJ

Tretje poglavje proučuje vpliv izdatkov za RR na uspešnost podjetij. Temelji na sledečih teoretičnih osnovah. Glede na Teorijo na temelju virov podjetja posedujejo strateške vire, ki jim ponujajo izjemno priložnost za razvoj konkurenčnih prednosti pred svojimi konkurenti (Barney, 1991; Penrose, 1959). To pomeni, da mora investicijska dejavnost predstavljati eno najpomembnejših dejavnosti, saj je ključnega pomena za delovanje vsakega podjetja. V tem kontekstu Teorija o znanju navaja, da so vlaganja v RR najpomembnejši in edinstveni vir podjetja (Grant, 1996). To poudarja vlogo vlaganj v RR pri ustvarjanju konkurenčne prednosti in izboljšanju poslovanja podjetij. Ne nazadnje Teorija učinkovitega trga, ki predpostavlja popolne informacije na trgu, predstavlja teoretično osnovo za razlaganje razmerja med investicijsko dejavnostjo podjetij in njihovo tržno uspešnostjo (Malkiel & Fama, 1970).

Glavni cilj tretjega poglavja je torej odgovoriti na raziskovalno vprašanje, kako izdatki za RR vplivajo na uspešnost podjetij. V tem kontekstu poskuša empirično preveriti, ali so nasprotujoči rezultati obstoječe literature posledica dejstva, da je vpliv izdatkov za RR

odvisen od: 1) različnega merjenja uspešnosti podjetij; 2) značilnosti različnih podjetij; in 3) različnih pravnih okvirov in finančnega okolja, ki je specifično za posamezno gospodarstvo. S tem namenom je na vzorcu slovenskih podjetij izvedena empirična analiza z uporabo različnih kazalnikov uspešnosti poslovanja. Nadalje je izvedena dodatna empirična analiza na vzorcu svetovnih podjetij za RR, tj. podjetij, ki močno vlagajo v RR ter delujejo v EU, ZDA, na Kitajskem in na Japonskem z namenom potrditve obstoječih rezultatov in pridobitve dodatnih vpogledov v smislu tržne uspešnosti podjetij. Poleg tega uporaba dveh različnih podatkovnih baz omogoča, da se izolirajo dejavniki, povezani z značilnostmi različnih podjetij in gospodarstev, ki lahko pomembno vplivajo na uspešnost podjetij. Ne nazadnje uporaba obeh podatkovnih baz ponuja edinstveno priložnost za pridobitev izčrpnih in zanimivih ugotovitev kot tudi zanimivih implikacij izdatkov za RR za uspešnost podjetij z vidika poslovne in tržne uspešnosti podjetij.
Zato sta v okviru tretjega poglavja razviti dve različni raziskovalni hipotezi. Glede razmerja med izdatki za RR in uspešnostjo poslovanja podjetij je načeloma ugotovljeno, da obstaja zamik med izdatki za RR in poslovno uspešnostjo. To pomeni, da so izdatki za RR učinkoviti bolj na dolgi rok kot pa na kratki rok (Asthana & Zhang, 2006). V skladu s to razpravo je predlagana sledeča raziskovalna hipoteza:

- **Hipoteza 3.1:** *Izdatki za RR poslabšujejo tekoče poslovanje in izboljšujejo prihodnje poslovanje podjetij.*

Poleg tega druga raziskovalna hipoteza zajema implikacije izdatkov za RR na tržno uspešnost podjetij. Na splošno je ugotovljeno, da je vpliv izdatkov za RR na uspešnost podjetij kratkoročno negativen (poslovna uspešnost podjetij) in dolgoročno pozitiven (tržna uspešnost podjetij) (Vithnessonthi & Racela, 2016). Vlaganja v RR se namreč pogosto obravnavajo kot dolgoročne naložbe v različne RR projekte, za katere se ocenjuje, da imajo pozitivno neto sedanjo vrednost. Na kratek rok so denarni tokovi, povezani z RR projekti, negativni, kar posledično ogroža poslovno uspešnost podjetij v smislu dobičkonosnosti. Vendar pa dolgoročno ob predpostavki, da so pričakovane neto sedanje vrednosti projektov raziskav in razvoja pozitivne, morajo vlaganja v RR povečati tržno vrednost podjetij. Poleg tega lahko konkurenčna podjetja z inovativnimi izdelki, postopki in storitvami pritegnejo pozornost vlagateljev, kot tudi povečajo svoj tržni delež (Usman et al., 2017). V skladu s to razpravo je predlagana sledeča raziskovalna hipoteza:

- **Hipoteza 3.2:** *Izdatki za raziskave in razvoj izboljšujejo sedanjo in prihodnjo tržno uspešnost podjetij.*

Rezultati empirične študije pojasnjujejo, da so izdatki za RR pomemben dejavnik uspešnosti poslovanja podjetij in njihove tržne uspešnosti. Na področju uspešnosti poslovanja podjetij imajo izdatki za RR negativen vpliv na tekoče poslovanje in pozitiven vpliv na prihodnje poslovanje. Rezultati so enaki za vzorec slovenskih podjetij kot tudi za vzorec svetovnih podjetij na področju RR, ki delujejo v večjih svetovnih gospodarstvih. To pomeni, da imajo izdatki za RR podobne posledice na uspešnost v teh podjetjih. Na začetku je učinek izdatkov

za RR na uspešnost poslovanja podjetij negativen zaradi nezadostnega ustvarjenega dobička, ki ni dovolj visok, da bi presegel izdatke za RR ter zaradi nezmožnosti podjetij, da bi v istem letu ponudili inovacijske rezultate. Kasneje je vpliv izdatkov za RR na uspešnost poslovanja podjetij pozitiven, kar kaže, da lahko podjetja po enem letu, ko je podjetje ustvarilo izdatke za RR, izkoristijo obseg proizvodnje in trženje svojih rezultatov raziskav in razvoja. Kljub temu pa primerjava med slovenskimi in svetovnimi podjetji za RR kaže, da imajo slovenska podjetja dober potencial za izkoriščanje izdatkov za RR v smislu izboljšanja uspešnosti poslovanja v prihodnosti.

Uporaba podatkovne baze za svetova podjetja za RR, ki kotirajo na borzi, omogoča pridobitev dodatnih spoznanj v zvezi z razmerjem med izdatki za RR in tržno uspešnostjo podjetij. Rezultati kažejo, da so izdatki za RR s strani trga ocenjeni pozitivno in posledično izboljšujejo tržno uspešnost podjetij, pri čemer pa ta učinek za tržno uspešnost v naslednjem letu ni signifikanten. To pomeni, da po enem letu izdatki za RR postanejo zreli in ne vplivajo na tržno uspešnost. Kljub temu rezultati še dodatno podpirajo zamisel, da izdatki za RR v kratkoročnem obdobju niso učinkoviti in da podjetjem v dolgoročnem obdobju prinašajo določene koristi, na kar kaže tržna uspešnost, ki zajema pričakovanja vlagateljev o zaslužkih podjetij v prihodnosti.

ZAKLJUČEK

Danes se globalno gospodarstvo in posledično podjetja soočajo z novimi izzivi, ki so povezani z globalizacijo, pojavom novih tehnologij in prehodom na gospodarstvo, ki temelji na znanju. To je privedlo do zahtevnih pogojev poslovanja, ki se odražajo v hitro rastočem in vedno spreminjajočem se trgu z vse ostrejšo konkurenco, ki podjetja sili, da prilagodijo njihove poslovne in naložbene strategije na način, da zagotavljajo izdelke, postopke in storitve z dodano vrednostjo in ohranjajo konkurenčni položaj na trgu. Eno od možnih rešitev za reševanje teh sodobnih gospodarskih izzivov in za zagotavljanje dolgoročne sposobnosti preživetja podjetij je mogoče prepoznati v vlaganju v RR. Zato je ključnega pomena poznati vlogo državne spodbude za vlaganja v RR ter njene celovite učnike na podjetja z implikacijami na njihovo uspešnost.

Na splošno rezultati empirične analize kažejo sledeče. Prvič, državna podpora za vlaganja v RR igra pomembno vlogo v smislu izdatkov podjetij za RR. Za subvencije za RR empirični rezultati kažejo, da na splošno niso učinkovite, saj izpodrivajo izdatke podjetij za RR. Vendar pa le-te postanejo učinkovite, ko se uporabljajo v kombinaciji z davčnimi olajšavami za RR in ko jih prejmejo rastoča podjetja. Nasprotno pa empirični rezultati kažejo, da davčne olajšave za RR so učinkovite v vsakem primeru, ko imajo podjetja zadostno davčno osnovo. Drugič, državna podpora za vlaganja v RR je pomembna tudi z vidika računovodske obravnave izdatkov za RR. Empirični rezultati kažejo na prisotnost uravnavanja dobička po prejemu državne spodbude v obliki davčnih olajšav za RR. Glede na to, da davčne olajšave za RR razbremenjujejo davčno breme podjetij, si le-ta prizadevajo maksimirati računovodski dobiček s kapitalizacijo izdatkov za RR. Kar zadeva subvencije za RR, računovodska pravila

usklajujejo njihovo računovodsko obravnavo z računovodsko obravnavo izdatkov za RR, kar pomeni, da so subvencije za RR davčno nevtralne. Zato ne morejo predstavljati glavnega gonila odločitve glede računovodske obravnave RR. Ne nazadnje empirični rezultati opozarjajo na pomembno vlogo RR izdatkov v smislu uspešnosti podjetij. Empirični rezultati za Slovenijo in svetovna podjetja na področju RR kažejo, da izdatki za RR negativno vplivajo na tekočo poslovno uspešnost in pozitivno vplivajo na prihodnjo poslovno uspešnost. Poleg tega empirični rezultati svetovnih podjetij na področju RR kažejo, da izdatki za RR izboljšujejo tržno uspešnost podjetij, pri čemer pa je ta učinek neznačilen za tržno uspešnost podjetij v naslednjem letu.

Doktorska disertacija zagotavlja več empiričnih teoretičnih prispevkov, saj združuje dva sočasna instrumenta RR politike, vključuje ekonomsko in računovodsko perspektivo ter upošteva implikacije izdatkov za RR na različne perspektive sedanje in prihodnje uspešnosti podjetij. Prispevek je dodatno dopolnjen s poudarkom na specifičnih značilnostih slovenskega poslovnega okolja ter z uporabo edinstvene in celovite baze podatkov za slovenska in svetovna RR podjetja. Omenjene značilnosti doktorske disertacije so edinstvene v primerjavi z obstoječo ekonomsko in računovodsko literaturo. Zaradi novega, inovativnega in interdisciplinarnega pristopa je doktorska disertacija sposobna zagotoviti širši vpogled na področje RR, kar predstavlja skupno dodano vrednost doktorske disertacije.

Celovita in sistematična raziskava, zajeta v doktorski disertaciji, poskuša prispevati k splošni ekonomski in računovodski literaturi z zagotavljanjem nekaterih novih in atraktivnih empiričnih dokazov za Slovenijo in širše. Prispeva k akademskemu in praktičnemu znanju in je koristna za različne interesne skupine, kot so: oblikovalci politik, poslovodstvo, investitorji in oblikovalci računovodskih standardov. Pridobljeni empirični dokazi lahko pomagajo osvetliti nekatere dvoumnosti, povezane z državno spodbudo za vlaganja v RR, samimi vlaganji v RR, njihovo računovodsko obravnavo in implikacijami za uspešnost podjetij, saj se pričakuje, da bodo vlaganja v RR predstavljala eno izmed ključnih vlaganj v prihodnosti.