

An evaluation of the Knowledge Development Box in the promotion and growth of research and development to aid in the sustainment of an innovation led ecosystem

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By

James E. Kennedy

N.Cert (Eng), N.Dip (Eng), B.Eng, C.Eng, PG.Dip, MBA, Ph.D, FIEI

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Executive Summary

Introduction

The Organisation for Economic Co-operation and Development (OECD) recognises the fundamental importance of research and development (R&D) and the scale of opportunity that investment in innovation can bring. With this in mind, the Irish Government has identified R&D and innovation as one of the key pillars of growth within the economy. To achieve this growth, research and development tax incentives which are adopted in advanced economies are set into policy to encourage firms to innovation as they are widely used to promote innovation; thus, making companies more competitive and productive.

However, evidence on the effectiveness of R&D tax incentives for innovation is largely anecdotal and empirical examination of the influence of innovation on firm-level taxation is still underexplored. Tax benefits applying to income derived from innovation (mainly patent boxes) are increasing. Such that, patent box schemes have come under scrutiny of the European Union (EU) and OECD because of the apparent lack of linkage between the tax advantage offered and the presence of research or innovation activity. Overall the aim of patent boxes is to encourage firms to innovate. With this in mind, discussions at both the OECD and the EU have led to an agreement on the requirement to establish a nexus between the income deriving from IP and the expenditure incurred to develop this asset.

Ireland was the first country in the world to adopt the OECD requirements for the modified nexus patent box, which subsequently became known as the Knowledge Development Box (KDB). Considering the KDB has come into effect since the first of January 2016, there are no current data available which captures its usage throughout the various industry sectors in Ireland. To this extent, the novelty and unique contribution of this work will evaluate the current literature and the views of Irish based companies regarding R&D Tax incentives with a focus on the KDB. And to the best of the Author's knowledge as well as confirmation from Revenue, the following work herein is the first study of its kind which explores the KDB from Irish based companies.

Research approach

This study utilised several methods in its approach such as desk research, consultation via a survey and an interview programme. The desk research reviewed and assessed recent

quantitative data from Government departments and the CSO as well as reviewing the relevant national and international literature. Consultation and guidance was provided by Professor Frank Barry, the DJEI and IBEC. The research strategy taken in this study utilises the archival research approach which was necessitated to complement the survey response as this study is the first to evaluate the views of industry regarding R&D Tax incentives, namely the KDB. This study had 122 respondents from 438 companies, which gave a 28% response rate.

Key findings

- 51% has said that R&D Tax credit has not been a strong factor in driving the company's innovation, with 25% saying it is an important factor.
- Administration was the main reason given by companies for not claiming the R&D Tax credit.
- 35% of the people surveyed said that the R&D Tax credit has helped create jobs, with 11% saying somewhat equally 44% said it did not create jobs in the organisation.
- About 50% of the barriers to protect IP as found by this survey are cost related.
- 71% of the responders from this survey were not aware of the KDB certificate.
- 70% of the responders said IP was a factor in the strategy of the company.
- 67% of the responders aware of the KDB after 1 year of its launch.
- 60% said No to the KDB been adequately promoted compared to 6% saying Yes.
- 20% said Yes to the attraction of the KDB make them reconsider applying for the R&D Tax credit, 10% said No and 25% were not sure.
- 38% would promote the KDB to other colleagues, with 9% saying No and 32% not sure.
- 13% of the responders said Yes that they are influenced by the KDB being OECD compliant whereas 37% saying No and a further 31% were not sure.
- 32% of the responders said the reduction in the Corporation Tax would be the main deciding factor in utilising the KDB and 55% said it would be a factor but not the only one and 8% said No. 3% of the responders have used Patent box schemes in other countries.
- 19% said the KDB would be a reason to locate R&D activity in Ireland, 23% said No and 30% of responders are no sure.
- 50% have said that the KDB was not part of their company strategy compared to 13% who said Yes that the KDB is in their R&D/company strategy?
- 26% of responders have said that the KDB would be a factor in project selection for new R&D projects in the pipeline, 21% said No and 31% saying they are not sure.

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- James O'Hagan from EY and Gerry Vahey from Mazars for their advice on Tax issues.
- To my friends who all thought I was mental for taking on another research project, sure it's done now.
- To my family for all their continued support throughout the years.

Abbreviations

BEPS	Base Erosion and Profit Shifting
BERD	Business Expenditure on Research and Development
CSO	Central Statistics Office
DJEI	Department of Jobs, Enterprise and Innovation
EI	Enterprise Ireland
EPO	European Patent Office
EU	European Union
FDI	Foreign Direct Investment
FHTP	Forum on Harmful Tax Practices
GDP	Gross Domestic Production
GNP	Gross National Product
IAS	International Accounting Standard
IP	Intellectual Property
IPR	Intellectual Property Rights
IBEC	Irish Business and Employers Confederation
KDB	Knowledge Development Box
KEI	Knowledge Economy Index
KTI	Knowledge Transfer Ireland
MFP	Multi-Factor Productivity
OECD	Organisation for Economic Co-operation and Development

R&D	Research and Development
SME	Small and Medium Enterprises
SPC	Special Protection Certificates
SFI	Science Foundation Ireland
TCD	Trinity College Dublin
UK	United Kingdom
US	United States

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¹ <http://www.hawkip.com/advice/what-are-intangible-assets>

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Chapter 1

1.0 Introduction

1.1 Background to the study

The Organisation for Economic Co-operation and Development (OECD) recognises the fundamental importance of research and development (R&D) as defined in its Frascati programme and the scale of opportunity that investment in innovation can bring (Irish Tax Institute, 2015). It is well known that research and development (R&D) tax policies are written to encourage firms to innovation, a crucial driver of business growth. However, evidence on the effectiveness of tax benefits for innovation is largely anecdotal and empirical examination of the influence of innovation on firm-level taxation is still underexplored (Gao, *et al.*, 2016). Looking towards R&D tax incentive schemes, they are widely adopted in advanced economies to promote innovation; thus, making companies more competitive and productive. Where, much of tax incentives are based on corporate income taxes, while certain countries have (additional) incentives that apply to social contributions and/or wage taxes.

R&D and innovation has been identified as one of the key pillars of growth by the Irish Government. This is also reflected in the Action Plan for Jobs 2015 “*The objective is to achieve best in class in the EU by enhancing support for firms, drive commercialisation through Enterprise Ireland (EI) / Knowledge Transfer Ireland (KTI) and introduce a Knowledge Development Box (KDB) to ensure the tax environment is optimised for innovative enterprises located here.*” (DJEI, 2015). One of the key enablers to driving R&D is a well-designed, competitive and sustainable tax policy to support the activity. To achieve such a policy for Ireland (particularly in a Base Erosion and Profit Shifting (BEPS) environment), it is important to be clear about the nature of the innovation activities that are carried out in Ireland both by the multinationals and domestic based companies (Irish Tax Institute, 2015).

However, Tax benefits applying to income from innovation (mostly patent boxes) are proliferating (Straathof, *et al.*, 2014). Such that, patent box schemes have come under scrutiny of the EU and OECD because of the apparent lack of linkage between the tax advantage offered and the presence of research or innovation activity (Alstadaeter *et al.*, 2015). Patent boxes seem more likely to relocate corporate income than to stimulate innovation. Unfortunately, tax planning and tax competition also complicate the possibilities for evaluation of the effectiveness of patent boxes with respect to innovation (CPB, 2015). So far, there is, however, no empirical evidence on how IP Box regimes affect the amount of R&D investment although some studies address this question (Evers, 2014). A study by Ernst *et al.* (2014), which uses

data on patent applications considers the IP Box regimes in place up to the year 2007 but does not provide evidence on the effects of a reduced tax rate for IP income on the amount of R&D investment in a certain location. Equally, it is questionable whether patent box mechanisms will have an impact in stimulating domestic R&D activity, as companies may easily benefit from the regimes without carrying out R&D activity in the country the patent box is being claimed.

To this extent, the unique contribution of this work will evaluate the views of Irish based companies regarding the KDB (a form of a Patent Box utilising the modified nexus approach). Considering this incentive has come into effect since the first of January 2016, there is no data readily available which shows the extent of its usage throughout the various industry sectors in Ireland. To this extent, and to the best of the Author's knowledge the following work herein is the first study which explore the views and operations of the KDB and how it impacts a company's direction to grow their R&D portfolio². An illustration of this process is presented in Figure 1.1.

The findings and literature herein provides a quantitative overview of the R&D tax incentive environment within Ireland and outlines key thoughts from known contributors within the field in relation to R&D economic theory and Patent Boxes.

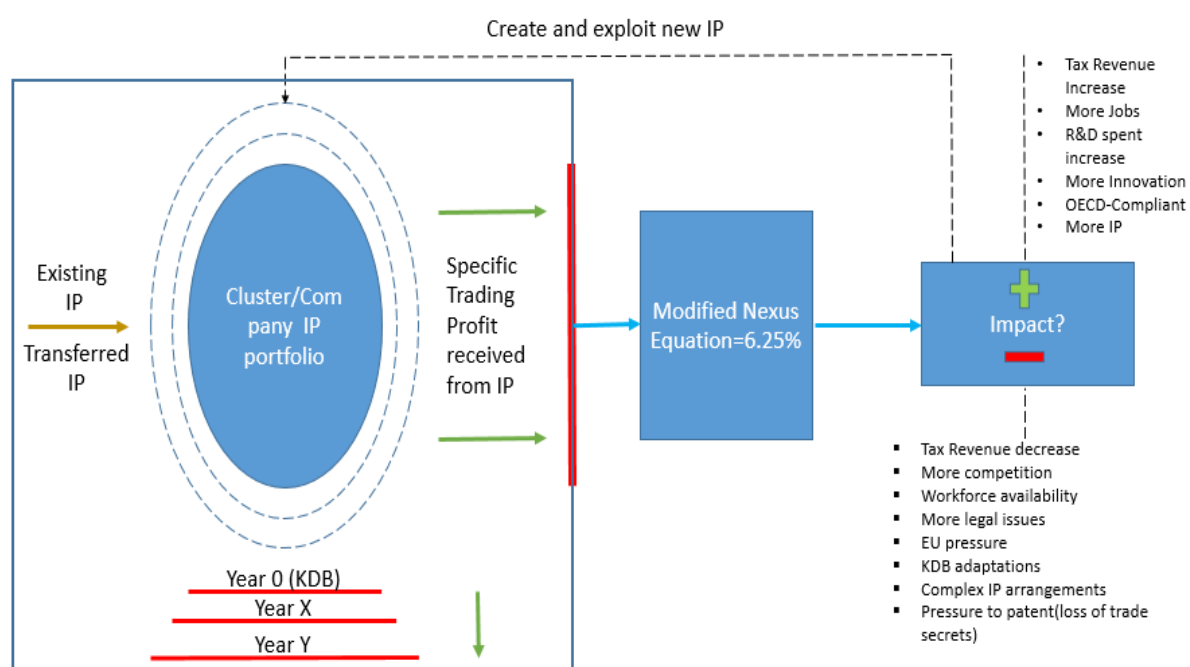


Figure 1.1 An illustration to conceptualise the Research proposal.

² Reply from Revenue in August 2017 regarding this body of work- "We haven't any data on the uptake other than anecdotally from discussions with agents, more so than taxpayers. Until they file tax returns this September, and more likely next September (they have 24 months to make the election) we won't have anything concrete. So its very interesting to see your figures as we're currently blind to that sort of data".

1.2 Report structure

The dissertation has been designed in accordance with the TCD guidelines as set out in the TCD postgraduate manual. In light of this, the structure of the document is divided into five Chapters. A snapshot illustrating the purpose of each Chapter is presented in Figure 1.2

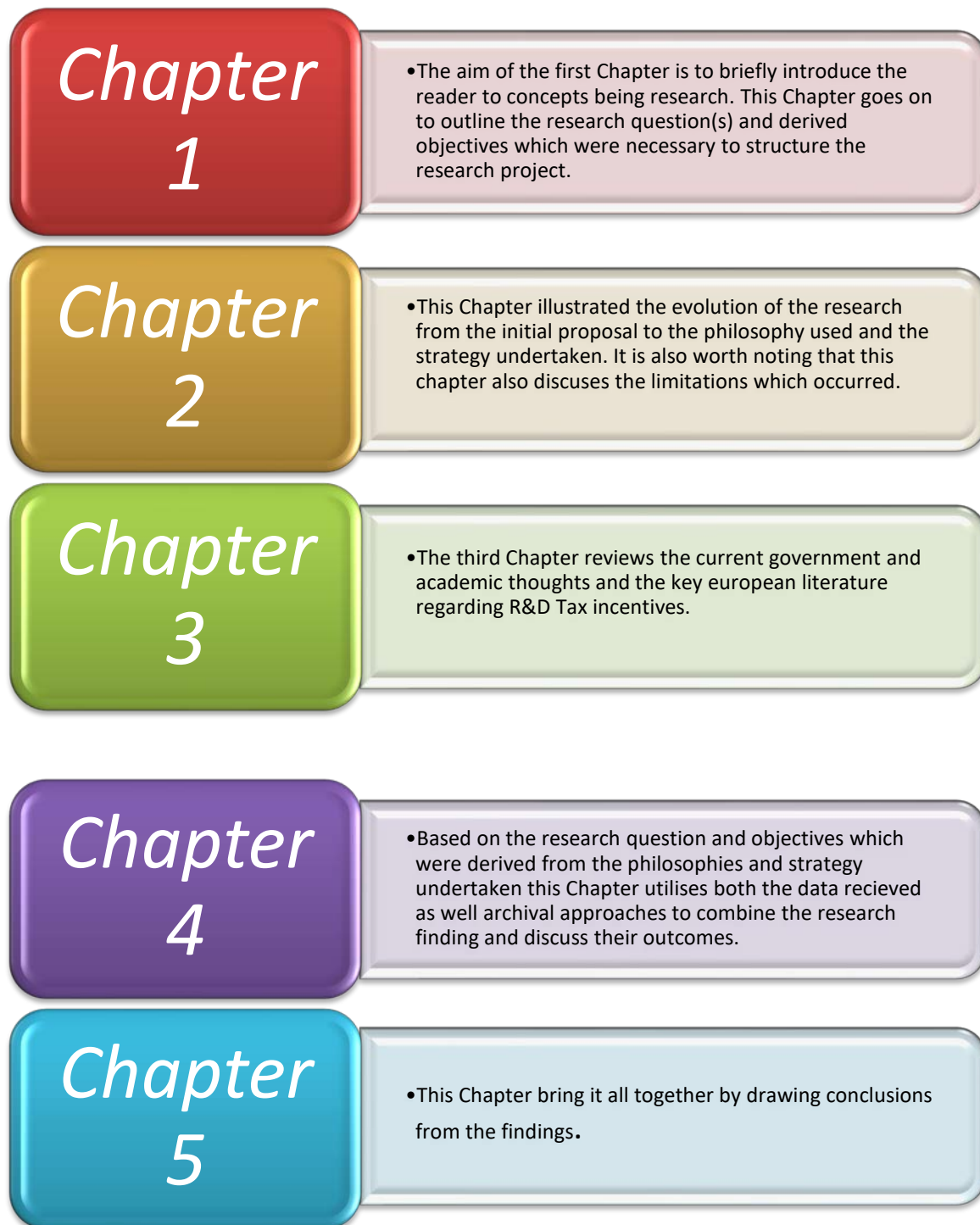


Figure 1.2 A snapshot of the main Chapters discussed within this work.

1.3 Research aim and objectives

The aim of the study is to investigate if the Knowledge Development Box (KDB) has a real impact on actual R&D by Irish based companies and how this might incentivise the creation of innovation. In this regard, if the hypothesis of this study is correct, then the KDB should promote more R&D based on the qualifying criteria as well as the favourable R&D Tax credits; thus, generating more intellectual property (IP) with a view to create an innovation ecosystem.

The key features of the research framework that will be used to guide the design and collection of relevant research data will be presented herein, however, several questions were first asked to develop the research question (*To investigate if the KDB has a real impact on actual R&D by Irish based companies and how this might incentivise the promotion and growth of innovation*);

- How well do I know the field and literature?
- What are the important research questions in my field?
- What areas need further exploration?
- Could my study fill a gap? Lead to greater understanding?
- Has a great deal of research already been conducted in this topic area?
- Has this study been done before? If so, is there room for improvement?
- Is the timing right for this question to be answered? Is it a hot topic, or is it becoming obsolete?
- Is the target community interested?
- Most importantly, will my study have a significant impact on the field?

Based on the questions which emerged, five objectives were derived to establish a clear sense of purpose and direction, these were;

- (1) Explore the views of industry regarding R&D Tax incentives.
- (2) Monitor trends in intellectual property within the economy.
- (3) Assess the awareness of the KDB from the business community.
- (4) Identify the barriers within the KDB.
- (5) Evaluate the KDB as a strategic innovation driver.

In relation to the specific research objectives, these will be addressed within the literature review (Chapter 3), discussion of results (Chapter 4) and conclusions (Chapter 5).

Apart from the research objectives; this work has given the author the opportunity to explore new areas of research which has proven to be both rewarding and challenging with reference to the methodology section. In terms of personal objectives/goals, the author has,

- Developed an understanding of alternative research methods.
- Gathered the necessary knowledge to prepare the literature review which has helped the author understand the taxation implications of research, development and innovation from a macro economical perspective.
- Acknowledged the difficulties of economic based research.

In summary, the process in which the research aim and objectives were formulated is presented in Figure 1.3. In relation to the research philosophy, the stance of a post-positivist combined with the pragmatist view was used with a combined research approach to answer the research objectives, as it was felt that this form was the most reliable method which best suited the research design. Therefore, by achieving the objectives, based on the methodology, data gathered and analysis, appropriate conclusions and recommendations were presented.

1.4 Methods of investigation

Regarding this dissertation and based on the research aim, objectives and literature review an exploratory approach was used to fit into the philosophical model. This method makes up the foundation for the research strategy, research choice, time horizons and the data collection and analysis. The research strategy taken in this study initially adopted the survey approach as well as being supplemented by the archival research approach. A full discussion illustrating the aforementioned techniques is presented in Chapter 2.

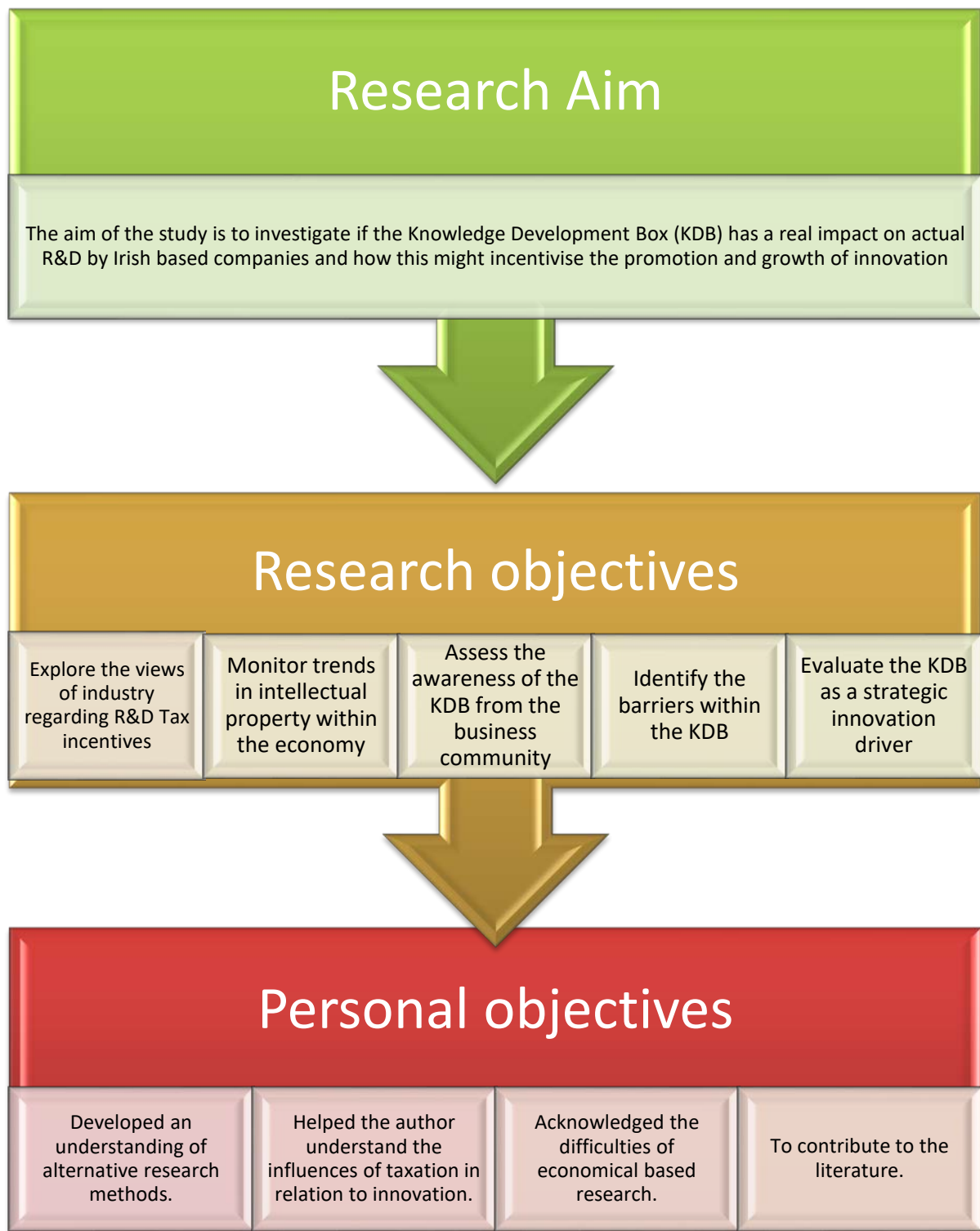


Figure 1.3 A graphical representation of the research aim and objectives in which this study sets out to answer.

Chapter 2

2.0 Research Methodology

2.1 Introduction

This Chapter looks at the process, both theoretical and applied, by which the research methodology was formulated. In doing so it has given the author the opportunity to break a personal bias towards research philosophies by exploring the different methods in which research can be conducted. The methods used and the style of questions initially derived was based on a combined (mainly deductive with some inductive) reasoning but due to the survey return, the inductive approach became the dominant method which helped answer the original hypothesis. In developing the research philosophy, it emerged that the post-positivist combined with the pragmatist view was the best research philosophy for the author to answer the research objectives. The research strategy taken in this study utilises the archival research approach which was necessitated to complement the survey response as this study is the first to evaluate the views of industry regarding R&D Tax incentives, namely the Knowledge development Box.

2.2 Formulating and clarifying the research aim

2.2.1 Introduction

In generating the initial research proposal, several techniques were used to find and select a topic of interest for the author to explore. According to Raimond (1993, cited in Saunders, Lewis & Thornhill 2007, p. 22) the use of both rational and creative techniques will ensure that the research topic has been clearly planned and evaluated. The techniques in question are presented in Figure 2.1 and per Saunders *et al.*, (2007) they will generate one of two potential outcomes:

- (i) One or more possible project ideas will evolve
- (ii) Absolute panic because nothing of interest or seems suitable comes to mind (Jankowicz, 2005).

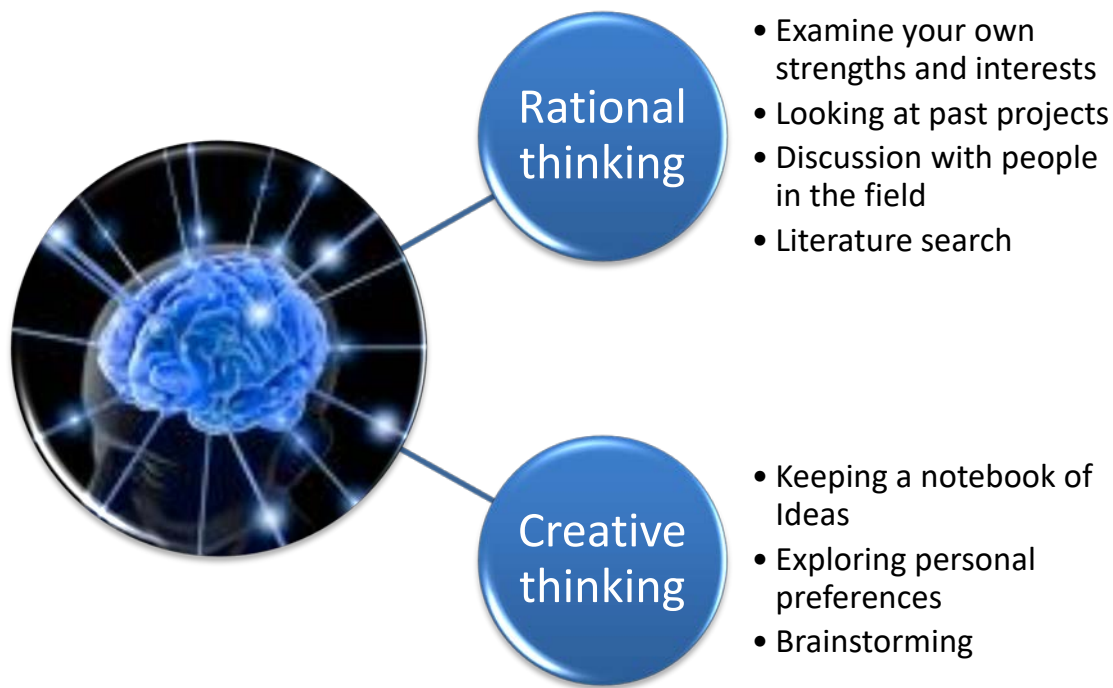


Figure 2.1 Techniques used for generating and refining research ideas.

2.2.2 Formulating the research aim

In developing of a strong research aim many questions were asked, based on secondary data, to narrow down the best potential candidate for the selected topic and these were;

- Do I know the field and its associated literature?
- What are the important research questions in my field?
- What areas need further exploration?
- Could my study fill a gap? Lead to greater understanding?
- Has a great deal of research already been conducted in this topic area?
- Has this study been done before? If so, is there room for improvement?
- Is the timing right for this question to be answered? Is it a hot topic, or is it becoming obsolete?
- Is the target community interested?
- Most importantly, will my study have a significant impact on the field?

2.2.3 Clarifying the research aim

At this stage of the process, the research aim was more apparent. However, in this study more refinement was necessary to turn the aim (...to investigate if the Knowledge Development Box (KDB) has a real impact on actual R&D by Irish based companies and how this might

incentivise the promotion and growth of innovation ...) into a project. Utilising the model shown in Figure 2.2, the above aim was assessed and several detailed research questions emerged;

- Are the companies innovating in terms of their research capabilities?
- How are their research outputs assessed i.e. products, patents/SPC, new trade secrets etc.?
- How is the Irish government implementing their tax incentives to achieve their R&D GDP requirements (new mechanisms, growing R&D infrastructure)?
- Who (if any) companies/sectors are availing of the R&D Tax mechanisms?



Figure 2.2 Using critical thinking to gain knowledge and understanding³.

Based on the questions which emerged, several research objectives were derived to establish a clear sense of purpose and direction, these were;

³ <https://www.pinterest.com/pin/360499145141974331/>

- (1) Explore the views of industry regarding R&D Tax incentives.
- (2) Monitor trends in intellectual property within the economy.
- (3) Assess the awareness of the KDB from the business community.
- (4) Identify the barriers within the KDB.
- (5) Evaluate the KDB as a strategic innovation driver.

In conclusion, the process in which the research objectives were formulated is presented in Figure 2.3. The methods used and the style of questions derived was based on a combined (deductive and inductive) reasoning and this will be discussed in more detail in the research philosophies and strategies sections which follow.

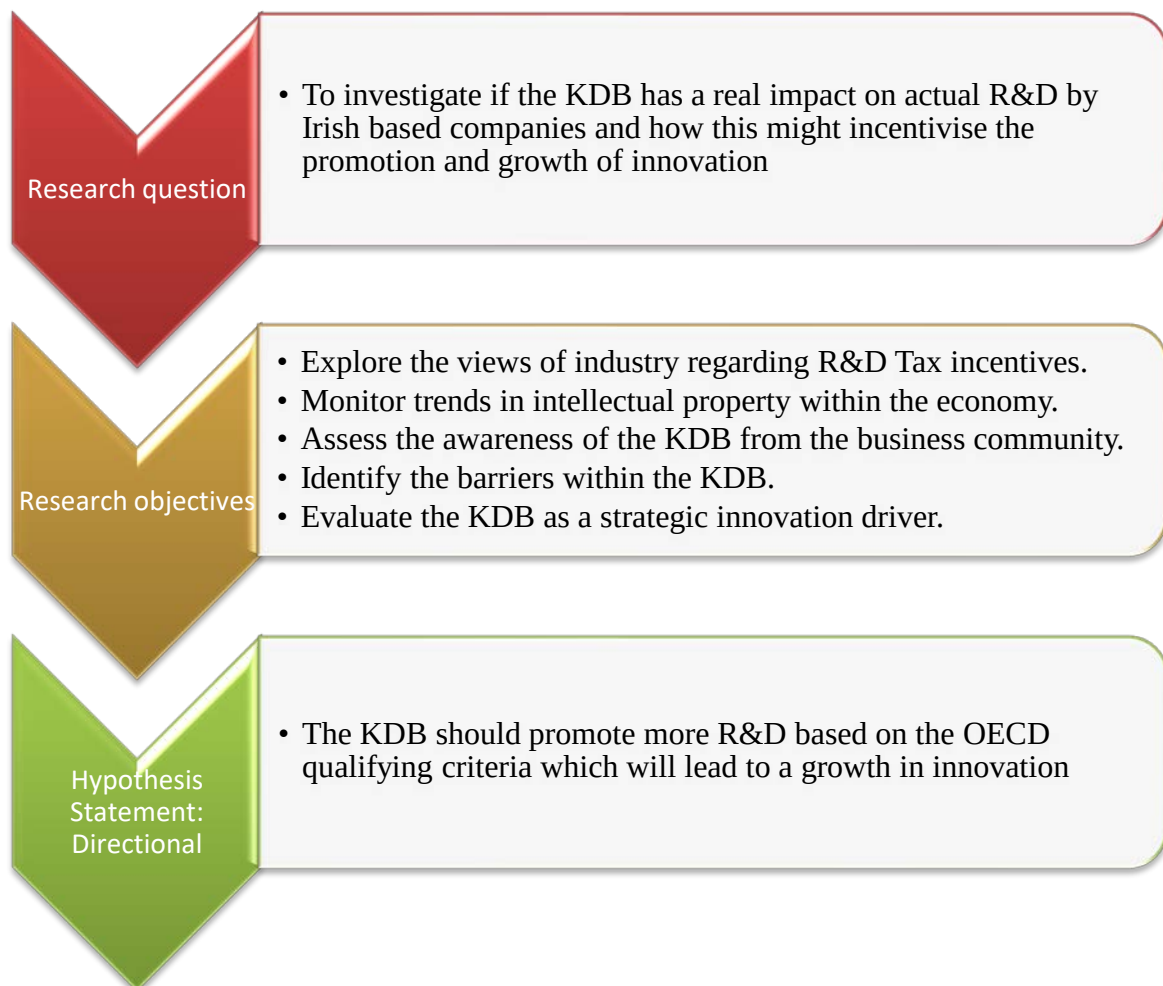


Figure 2.3 The gap between the research problem and the specific study design factors.

2.3 Research Philosophy and Approaches

2.3.1 Introduction

In initially approaching this section the author was some what cautious with the term research philosophy due to his background in engineering, however, with a drive to understand the theories of knowledge, the components which make up the research philosophy such as epistemology and methodology became more clearer. The term epistemology comes from the Greek word *epistêmê*, which is their term for knowledge. Put simply, epistemology is the philosophy of knowledge or how we come to know. Methodology is also concerned with how we come to know, but is much more practical in nature. Methodology is focused on the specific ways such as the methods use to try to understand our world better. Epistemology and methodology are intimately related: the former involves the philosophy of how we come to know the world and the latter involves the practice (Trochim, 2006). Thus, with an understanding of the underlining philosophy each component laid the foundation for which this study was based. The methodology will be discussed later in section 2.4 and the epistemology has evolved as follows.

2.3.1 Research Philosophy

In order to “make informed choices and reflect critically on their own work,” a researcher must “understand the theories of knowledge (the epistemologies) underlying the methods” (Spratt, Walker, & Robinson, 2004, p. 13). According to Saunders there are two types of researcher and they are:

- (i) The resources researcher, who is comfortable with the collection and analysis of facts.
- (ii) The feelings researcher who is concerned with the feelings and attitudes of people.

In determining the most appropriate research philosophy to use for this particular study the author was originally guided by three different but not mutually exclusive views and they are: Positivism, Interpretivism and Realism.

Positivism, a broad family of philosophical and social scientific views according to which knowledge must be grounded in the observation of experiential data (Bergmam, 2016), thus adopting the stance of the natural scientist which coinsides with the Author’s background. This point was also highlighted by Remenyi *et al* (1998, cited in Saunders, Lewis & Thornhill 2007, p. 103) who stated that a person’s research philosophy which reflects the principles of positivism will prefer “...*working with the observable social reality and that the end product*

of such research can be law-like generalisations similar to those produced by the physical and natural scientists..."

Interpretivism, is an epistemology that advocates that is necessary for the researcher to understand the differences between humans in our roles as social actors. According to Interpretivists individuals are intricate and complex and different people experience and understand the same objective reality in very different ways and have their own, often very different, reasons for acting in the world⁴. This emphasises the difference between conducting research among people rather than objectives (Saunders *et al*, 2007, p106). Interpretivism asserts that reality, as well as our knowledge is social products and hence incapable of being understood independent of the social actors, including the researchers, (Orlikowski & Baroudi, 1991: 13). Therefore, it is crucial to the interpretivist epistemology that the research should adopt an empathetic stance. In the case of this research the author did not adopt an interview process to acquire data, as an inductive approach was sought in answering the hypothesis as presented in Figure 2.3.

Realism, is another epistemological position which related to scientific enquiry. The essence of realism is that what the senses show us as reality is the truth: that objects have an existence independent of the human mind. Realism is a branch of epistemology which is similar to positivism in that it assumes a scientific approach to development (Saunders *et al*, 2007, p105).

Thus, in assessing the different research philosophies it would seem that the researcher is embracing what is called the positivism position to the development of knowledge whereas the feeling researcher is adopting the interpretivist perspective, whereas realism is very much adopting aspects of both positivism and interpretivism. However, according to Trochim (2006), in a positivist view of the world, science was seen as the way to get at truth, to understand the world well enough so that it can be predicted and controlled. Thus, positivism depends on quantifiable observations that lead themselves to statistical analysis. It has been noted that "as a philosophy, positivism is in accordance with the empiricist view that knowledge stems from human experience. It has an atomistic, ontological view of the world as comprising discrete, observable elements and events that interact in an observable, determined and regular manner" (Collins, 2010). By using deductive reasoning to postulate theories and based on the results obtained from such studies, it may come to light that the theory doesn't fit the facts, and so a revision is needed to revise the theory to better predict reality. The positivist

⁴ <https://revisesociology.com/2015/05/18/positivism-and-interpretivism-sociology/>

believed in empiricism i.e. the idea that observation and measurement was the core of the scientific endeavor. Basically speaking the key approach of the scientific method is the experiment, and the attempt to discern natural laws through direct manipulation and observation.

Linking this to the Author's ontological perspective, ontology is to do with the way things are noticed based on assumptions derived from a topic; the research philosophy used in this work, and based on the above theories of knowledge (the epistemologies), the author has slightly shifted his view point on positivism to a concept known as post-positivism. This concept is a wholesale rejection of the central tenets of positivism. A post-positivist might begin by recognising that the way scientists think and work and the way man kind thinks in everyday life are not distinctly different. Scientific reasoning and common sense reasoning are essentially the same process, as there is no difference in kind between the two, only a difference in degree.

Trochim(2006) goes on to say that one of the most common forms of post-positivism is a philosophy called critical realism. Although often compatible with different philosophies of science, methods incorporate specific ontological and epistemological assumptions that tend to make them resonate better with some philosophies of science than with others. Critical realism, argues that humans do experience the sensations and images of the real world. According to critical realism, sensations and images of the real world can be deceptive and they usually do not portray the real world (Novikov and Novikov, 2013). Critical realism is a philosophy of science that has gradually gained popularity throughout the social sciences(Buch-Hansen, 2014). A critical realist recognises that all observation is fallible and has error and that all theory is revisable. In other words, the critical realist is critical of mankind's ability to know reality with certainty. Where the positivist believed that the goal of science was to uncover the truth, the *post-positivist critical realist* believes that the goal of science is to hold steadfastly to the goal of getting it right about reality, even though this goal can never be achieved. Because all measurement is fallible, the post-positivist emphasises the importance of multiple measures and observations, each of which may possess different types of error, and the need to use triangulation across these multiple errorful sources to try to get a better understanding on what's happening in reality.

Bringing it all together, the author research philosophy is based on the concept of the post-positivist perspective in the sense that there is an understanding that different types of

error can occur which can be corrected using multiple sources of information such as that obtained for either scientific reasoning or social understanding (interpretivist). Essentially this view point can co-exist with that of a pragmatist. Pragmatism argues that the most important determinant of the research philosophy adopted is the research question, i.e. one approach may be better than the other for answering the particular research question to get a better understanding of what is happening (Saunders *et al*, 2007, p110).

2.3.2 Research Approach

According to Saunders *et al*,.(2007), the overall research approach will depend on the level of clarity at the start of the research project which is based on the theory being researched, this will determine if the research approach should be inductive or deductive. In both deductive and inductive approaches ‘data/facts’ are the key factor either to test theory or build theory. The main difference between inductive and deductive approaches to research is that whilst a deductive approach is aimed at testing theory, an inductive approach is concerned with the generation of new theory emerging from the data ⁵ In deduction, most occasions hypothesis tests by collecting quantitative data aiming large sample size. This is not to say that a deductive approach may not use quantitative data (Saunders *et al*, 2007). Further, deductive approach concepts in the hypothesis(es) that have been deduced from the theory determine the data that need to be collected (Blaikie, 2000). On the other hand, researcher using inductive approach is likely to be concerned with the context of specific events. Thus, a study may be based on small sample, but need different type of data in order to establish different views of phenomena and more likely to work with qualitative data (Saunders *et al*, 2007; Easterby-Smith *et al*, 2002).

In order to clarify the Author’s approach, the start of the research was fundamentally bases on deductive reasoning (Figure 2.4). In this situation, a theory was formulated followed by the hypothesis after which observations were collected to address the hypothesis. This ultimately lead to the ability to test the hypotheses with specific data i.e. a confirmation (or not) of the original theory based on the questionnaire.

⁵ <http://deborahgabriel.com/2013/03/17/inductive-and-deductive-approaches-to-research/>

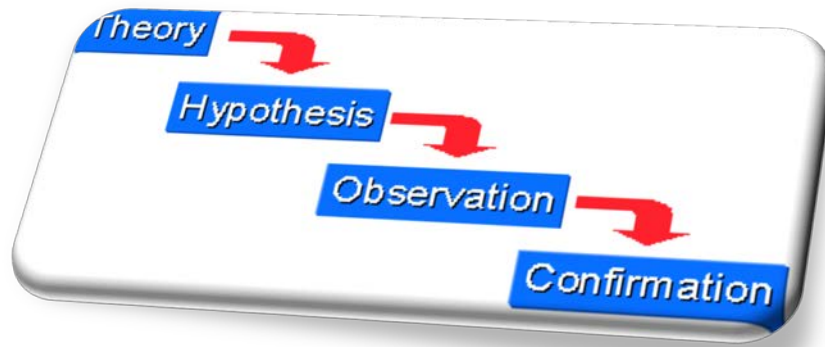


Figure 2.4 A graphical representation of the deductive approach (Trochim, 2006).

Inductive reasoning (Figure 2.5) works the other way, moving from specific observations to broader generalisations and theories. In inductive reasoning, specific observations and measures are evaluated, from these, patterns and regularities emerge which formulate some tentative hypotheses which finally develop conclusions or theories.

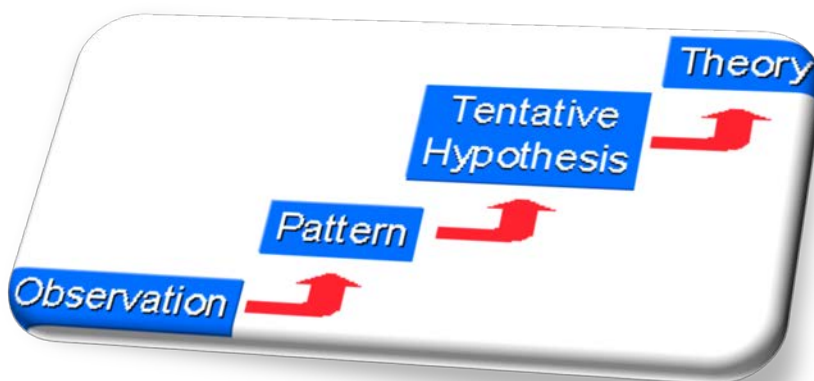


Figure 2.5 A graphical representation of the inductive approach (Trochim,2006).

These two methods of reasoning have a very different "feel" to them when conducting research (see Table 2.1). Inductive reasoning, by its very nature, is more open-ended and exploratory, especially at the beginning. Deductive reasoning is narrower in nature and is concerned with testing or confirming hypotheses. Even though a study may look like it's purely deductive (e.g., an experiment designed to test the hypothesised effects of some treatment on some outcome) the approach shifted to more of an inductive reasoning as the research progressed due to the unique timing of the work, where specific data was not available due to

the novelty of the research. However, most social research involves both inductive and deductive reasoning processes at some time in the project (Trochim, 2006). A graphic illustrating this concept is present in Figure 2.6.

Table 2.1 Deduction V's Induction (Saunders *et al*, 2007 , p120).

Deduction emphasises:	Induction emphasises:
▪ Scientific principles. ▪ Moving from theory to data. ▪ The need to explain causal relationships between variables. ▪ The collection of quantitative data. ▪ The application of controls to ensure validity of data. ▪ The operationalisation of concepts to ensure clarity of definition. ▪ A highly structured approach. ▪ Researcher independence of what is being researched. ▪ The necessity to select samples of sufficient size in order to generalise conclusions.	▪ Gaining an understanding of the meanings humans attach to events. ▪ A close understanding of the research context. ▪ The collection of qualitative data. ▪ A more flexible structure to permit changes if research emphasis as the research progress. ▪ A realisation that the researcher is part of the process. ▪ A less concern with the need to generalise

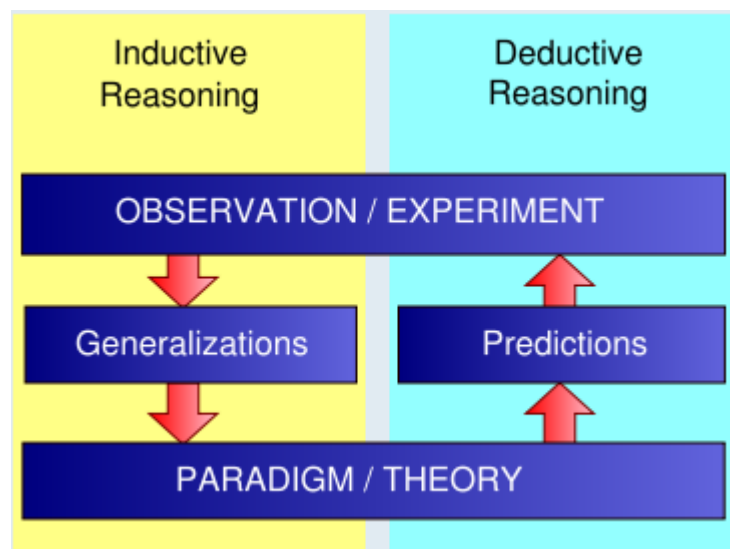


Figure 2.6 A graphic illustrating both deduction and induction reasoning.

In conclusion either of these approaches could be used in the study but based on the Author's background there was a tendency to be inductive. However, it is important to clarify that essentially both methods have been used as this was a key component in deriving the original research aim and objectives to answer the hypothesis. The philosophy of the post-

positivist combined with the pragmatist view allows the use of the combined research approach to answer the research objectives (Figure 2.3) as it was felt that this form the most reliable method of knowledge there is, even if it is conditional.

2.4 Formulating the research design

2.4.1 Introduction

It is important to emphasise the research project in terms of the aim and objectives needed to be answered as graphically illustrated in Figure 2.7. As previously discussed in section 2.3, the epistemology is essentially made of the research philosophy and methodology. In the development of the latter, it was essential that a clear and concise understanding of the research philosophies was necessary to tailor the approach needed to reflect on the purpose of the research. However, in the same way as the research can be both descriptive and explanatory, the research project may have more than one purpose. Indeed, as Robson (2002, cited in Saunders, Lewis & Thornhill 2007, p. 133) pointed out; the purpose of the enquiry may change over time. The classification of research purpose most often used in the research methods literature (Saunders *et al*, 2007, p133) is the threefold one of exploratory, descriptive and explanatory. Briefly, these are explained as follows:

Exploratory studies An exploratory study is a valuable means of finding out “...*What is happening; to seek new insights; to ask questions and to assess phenomena in a new light...*”(Robson, 2002, p59). In essence exploratory studies are undertaken to better comprehend the nature of the problem since very few studies might have been considered in that area. Extensive interviews with many people might be been undertaken to get a handle on the situation and understand the phenomena. More rigorous research could then proceed. Some qualitative studies where data are collected through observation or interviews are exploratory in nature. When the data reveals some pattern regarding the phenomena of interest theories are developed and hypothesis formulated for subsequent testing. Exploratory studies are also necessary when some facts are known but more information is needed for developing a viable theoretical framework. There are three principle ways of conducting exploratory research

- Search the literature
- Interview the experts in the field
- Conduct focus group interviews

Descriptive studies The object of descriptive research is “...to portray an accurate profile of persons, events or situations...” (Robson 2002, p59, cited in Saunders, Lewis & Thornhill 2007, p. 133). Put simply, its an investigation aimed at ascertaining the status of a set of variables, such as the number and variety of persons with specific conditions in a specified population, but without any critical analysis or attempt to test casual hypotheses. This may be an extension of, or a forerunner to, a piece of of exploratory research or a piece of explanatory research.

Explanatory studies The emphasis here is on studying a situation or problem in order to explain the relationships between variables (Saunders *et al* 2007, p134). This method of study is geared towards the quantatitive analysis.

Regarding this study, it would seem that, based on the research objectives and literature review; an exploratory study would be the logical choice. This study makes up the foundation for the research strategy, research choice, time horizons and the data collection and analysis.

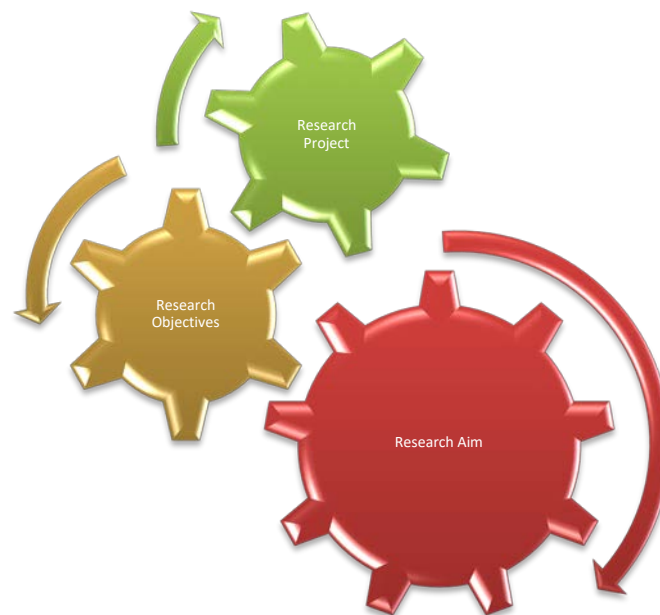


Figure 2.7 A graphical representation of the research project in terms of the aim and objectives.

2.4.2 Research Strategies

The research strategy is the general plan of how the researcher will go about answering the research aim and objectives. The choice of strategy has being guided by the extent of

existing knowledge, the amount of time and other resources as well as the philosophical underpinnings. Due to constraints within the thesis structure only the strategies highlighted as depicted in Table 2.2 will be discussed.

Table 2.2 Various research strategies.

Experiment,
survey
case study,
action research,
grounded theory,
ethnography
archival research

2.4.2.1 Survey strategy

The survey strategy is usually associated with the deductive approach. It is a popular and common strategy in business and management research and is most frequently used to answer who, what, where how much and how many questions. This method allows to collect quantitative data which can be analysed quantitatively using descriptive and inferential statistics. In addition the data collected using a survey strategy can be used to suggest possible reasons for particular relationships between variables and to produce models for these relationships (Saunders *et al*, 2007). Based on the research aim and subsequent research objectives (Figure 2.3), the survey was the main method used to gather information within this study. Brannick (in Brannick and Roache, 1997) defines a structured questionnaire as an efficient data-collection mechanism when the researcher knows exactly what information is required and how to measure the variables of interest. A detailed survey (see Appendix 1) was formulated to reflect each of the objectives.

Regarding choosing a sample size, there was a decision made to sample over 400 companies with a view to maximising the response rate, this will be discussed later in section 2.5.3. According to Brannick and Roche (1997), “the nature of the sample to be drawn will depend to a large extent on the availability of a suitable sampling frame. This term simply refers to lists or other records of the population from which a sample can be selected”. Each survey were send out as e-mail attachments as the author felt this was the best method to contact the target audience (see Appendix 2). The information was then collected via Survey Monkey.

2.4.2.2 Archival research

The author has employed this method to make use of administrative records and documents as a principle source of data. Although the term archival has historical connections, it can refer to recent as well as historical documents (Bryman 1989, cited in Saunders, Lewis & Thornhill 2007, p. 143). Its important to note that an archival research strategy is not conflated with secondary data analysis. All research that makes use of data contained in administrative records is inevitably secondary data analysis. However, when this data is used in an archival research strategy they are analysed because they are a product of day to day activities (Hakim, 2000). According to Saunder *et al* (2007), an archival research strategy allows research questions which focuses upon the past and changes over time to be answered be they exploratory, descriptive or explanatory. In conclusion, the approach taken in this work utilises the archival research approach to supplement the lack of responcees from the survey findings.

2.4.3 Research choices

A multi-method strategy was implemented to get a better understanding of the available data. The term multi-method refers to those combinations where more than one data collection technique is used with associated analysis techniques, but this is restricted within either a quantitative or qualitative world view (Tashakkori and Teddlie, 2003). Within this work, data collection initially involved primary data followed by secondary data. By combining these two methods using, both questionnaires and structured observation analysis a multi-method quantitative study, Figure 2.8,emerged.

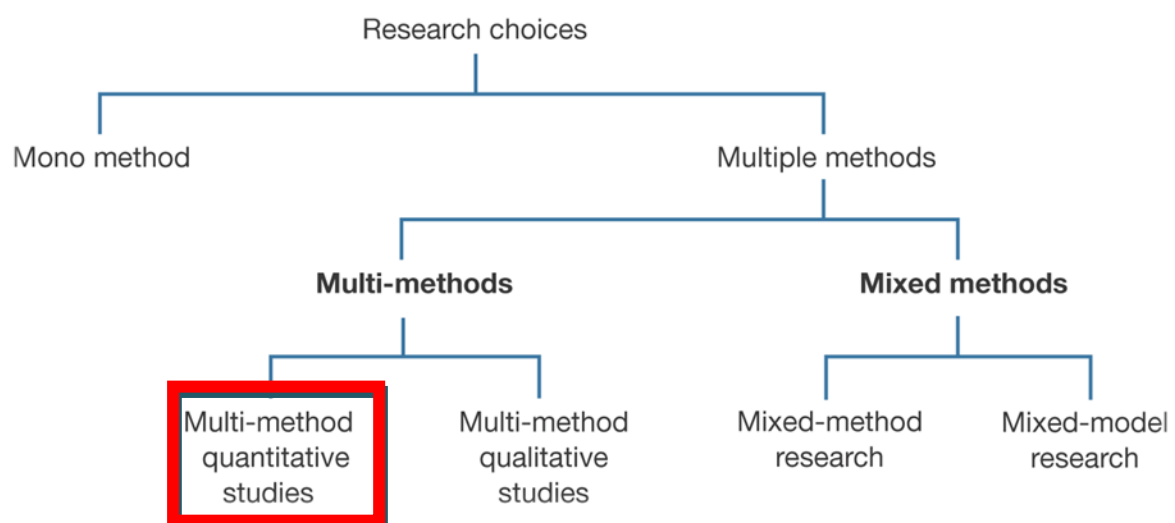


Figure 2.8 Research choices available to the author (Saunders *et al*, 2007).

2.4.4 Time horizons

The time horizon for a research project is driven by the research question and refers to the time window to which the research happened either as a snap-shot picture of a particular time or else a representation of changes over a period of time. These are referred to as cross-sectional and longitudinal respectively. In relation to this study and from an academic perspective the time line for this project was between August 2016 when the proposal was officially accepted and October 2017 when the dissertation is to be submitted. Because of this, a cross sectional study was performed, which is also reflected using a survey strategy. Data collection and analysis were limited to methods which utilised the maximum available time, and thus the true scope and potential of this work may have been limited as this work would be more suited to a longitudinal study.

2.5 Data collection methods

2.5.1 Introduction

Data Collection is an important aspect of any type of research study. Inaccurate data collection can impact the results of a study and ultimately lead to invalid results. As previously outlined, secondary data was used in formulating the research question. Primary data was obtained from both a semi-structured survey based on quantitative techniques and administrative records, documents and meetings with the Department of Jobs, Enterprise and Innovation. These methods fit into the research philosophy and strategy undertaken and to the Author's best knowledge these methods were the best source of assessing the primary data in the time available.

Saunders *et al.*, (2007) have stated that the design of the questionnaire has a huge bearing on the response rate, reliability and validity of the data collected and these can be maximised by:

- Careful design of individual questions.
- Clear layout in the questionnaire form.
- Lucid explanation of the purpose of the questionnaire.
- Pilot testing.
- Careful planned and executed administration.

2.5.2 Questionnaire design

The extent to which the questionnaire is structured will depend on its purpose in the evaluation and how it is being used with other data collection methods. Thus, the design of the questionnaire within this study (see Appendix 1) promotes a process by which the use of different collection methods is utilised to ensure that the data can be validated, this is known as triangulation. This semi-structure approach allowed a range of quantitative data to be collected as well as the view points of the responders, which, when combined with both secondary and archive data generates a clearer picture in answering the research aim.

2.5.3 Sample selection and size

“...Sampling is the process of selecting units (e.g., people, organisations) from a population of interest so that by studying the sample we may fairly generalise our results back to the population from which they were chosen...” (Trochim, 2006).

Saunders (2007) stated that sampling techniques fall into two broad categories namely probability and non-probability. In probability sampling the likelihood of each case being selected from the population is known and usually equal and it is possible to estimate statistically the characteristics of the targeted population Where the latter is based on techniques that include quota sampling, convenience sampling, judgement sampling, self-selection sampling and snowball sampling. Due to the nature of this study and the population the probability technique somewhat applies.

This study had 122 respondents from 438 companies, which gave a 28% response rate. To put this in to perspective the response rate for DJEI report on IP by Technopolis covers 128 respondents from a total of 517 businesses giving a 25% response rate. And IBEC, in conjunction with other organisations, undertook an extensive survey of the views of Irish business on the R&D tax credit scheme in March/April 2013. There survey achieved a response from almost 250 firms.

2.5.4 Pilot study

According to Saunders *et al* (2007, p386), the purpose of the pilot test is to refine the questionnaire so that the respondents will have no problem in answering the question and there will be no problem in recording the data. In designing the questionnaire, numerous meeting took place with different experts such as Revenue, Enterprise Ireland, IDA and patent attorneys. Each of the experts made valuable suggestions and these were implemented into the survey design. As a final check, IBEC read through the questionnaire and deemed it worthy.

2.5.5 Administration of the survey

The survey was sent out as a survey monkey link via e-mail which included a short personalised note and a generic introduction explaining the purpose of the study, and the option to receive a copy of the findings to all who are willing to participate.

2.6 Limitations of the research methodology

Considering the research methodology, the only limitation was the timing of the work. There is no information available regarding the uptake of companies who have used the KDB as it only came active in January 2016. In conclusion and based on the above limitation, the reliability of the research is ensured based on the structured research methodology. Using the process of triangulation, the validity of the research is achieved via the findings of both the secondary information from the literature review and that of the semi structured questionnaire.

2.7 Ethical considerations

Given the importance of ethics for the conduct of research, Saunders *et al* (2007) refers to ethics as "...the appropriateness of behaviour in relation to the rights of those who become the subject of the study or are affected by it...". The conduct in which this dissertation is based is guided by Trinity College Dublin's ethical guidelines as well as the author's personal ethical code of practice. Each of the recipients of the e-mail that contained the survey were made aware of why the information is required and how it would add value to the sector. The author has ensured that at all times the source of information, primary or secondary, will be identified and referenced in accordance to the Harvard referencing system.

Chapter 3

3.0 Evolution of the knowledge Development Box

3.1 A brief overview

Knowledge Development Box- “This puts Ireland in a unique position to offer long-term certainty to innovative industries planning their research and development investments,” Minister for Finance, Michael Noonan⁶

The introduction of the Knowledge Development Box (KDB) is designed to increase Ireland’s attractiveness as an innovation hub by complementing the R&D tax credit regime through targeting the different stages of a company’s intellectual property development. According to DJEIs Statement of Strategy 2011 – 2014, in the last decade Ireland has trebled the level of investment in research and development, underpinned enterprise demand for R&D, invested in human capital, physical infrastructure and the commercialisation of research. This public investment is now leveraging twice its value from business investment, and has contributed significantly to an increase in foreign direct investment, the competitiveness of indigenous enterprise and to the creation and application of new knowledge and technologies⁷.

Taking this into account, developing new innovative products is high risk and can often take time to implement. Therefore, R&D tax incentives allow a company to re-invest into their business as they will be able to retain a greater proportion of their earnings. This Chapter aims to assess the evolution of the Knowledge Development Box (KDB) from R&D economic theories, to early I.P box incarnations *via* the relevant literature and benchmarks. The literature review is based on a model developed by the author (Figure 3.1) to gauge the complexity of the R&D tax incentives.

⁶ <http://www.irishtimes.com/business/economy/new-corporation-tax-rate-of-6-25-for-r-d-1.2388977>

⁷ <https://www.djei.ie/en/Publications/Publication-files/Statement-of-Strategy-2011-2014.pdf>

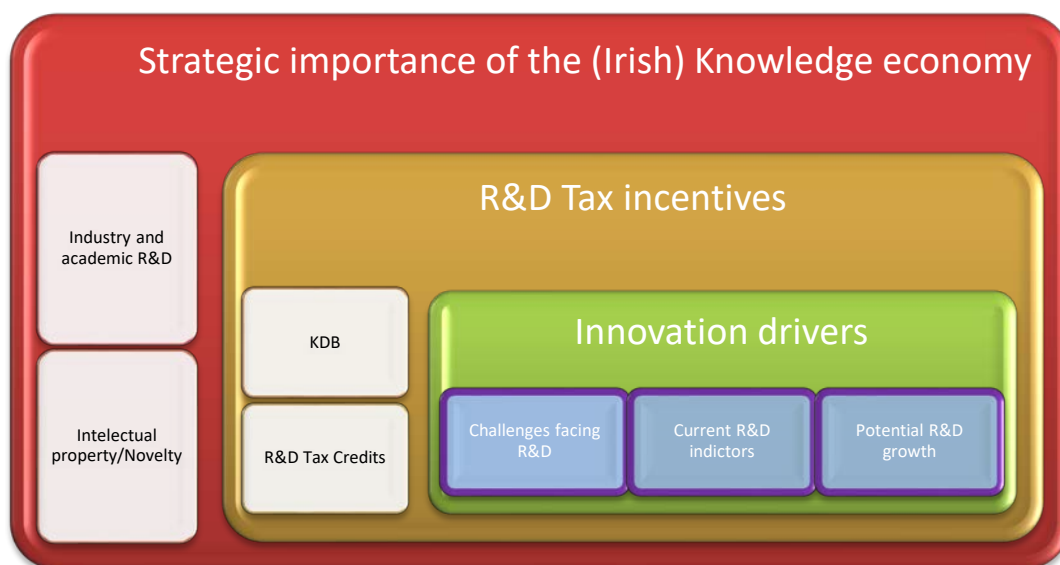


Figure 3.1 An assessment model used to evaluate the R&D Tax incentives in the (Irish) knowledge economy.

3.2 R&D Government support

In terms of R&D and innovation, the main justification for public intervention resides in the lack of incentives for private agents to invest, as well as in their lack of means (Martin & Scott 2000). Thus, economic theory provides a strong justification for government support for R&D, including subsidies and incentives for business research. Without such support, companies are likely to underinvest in research (from the standpoint of the economy) because the results of R&D cannot be fully appropriated by the investing firm (Tyson and Linden, 2012). The role of R&D in fuelling economic growth has been estimated in terms of its contribution to multi-factor productivity (MFP). Multifactor productivity is best explained by the OECD⁸, whereby MFP reflects the overall efficiency with which labour and capital inputs are used together in the production process. Changes in MFP reflect the effects of changes in management practices, brand names, organisational change, general knowledge, network effects, spill overs from production factors, adjustment costs, economies of scale, the effects of imperfect competition and measurement errors. Growth in MFP is measured as a residual, i.e. that part of GDP growth that cannot be explained by changes in labour and capital inputs. In simple terms, if labour and capital inputs remained unchanged between two periods, any changes in output would reflect changes in the MFP. This indicator is measured as an index and in annual growth rates. However, it is important to note that a substantial share of Irish

⁸ <https://data.oecd.org/lprdy/multifactor-productivity.htm>

GDP is made up of the profits of foreign-owned MNCs, which reduces the value of this measure.

Helpman and Coe (1993), investigated the effects of R&D capital stocks in increasing MFP, finding that both domestic and foreign R&D make large contributions to MFP and importantly for Ireland; that foreign-owned R&D capital stocks have a particularly large effect on smaller, open economies (Department of Finance, 2014). For illustrative purposes, Table 3.1 presented the Multifactor productivity from 2005 to 2015 for selected countries as quantified by the OECD. In 2014, Ireland surpasses all the evaluated countries by some margin.

Table 3.1 Multifactor productivity Total, Annual growth rate (%), 2005 – 2015⁹

Location ▼	▼ 2005	▼ 2006	▼ 2007	▼ 2008	▼ 2009	▼ 2010	▼ 2011	▼ 2012	▼ 2013	▼ 2014	▼ 2015
Australia	-0.28	0.10	-0.25	-0.61	0.40	-0.94	0.72	0.67	0.80	0.72	0.78
Austria	1.50	2.09	1.90	-0.30	-1.70	1.05	0.60	0.33	-0.15	-0.11	0.93
Belgium	0.23	0.28	0.80	-1.33	-1.95	1.56	-0.63	-0.82	-0.22	0.88	0.47
Canada	1.35	0.29	-0.50	-0.82	-0.77	0.91	1.36	-0.38	1.01	1.72	-0.34
Denmark	0.77	0.90	-0.63	-2.21	-2.82	2.69	0.31	1.02	0.44	1.16	0.43
Finland	1.39	2.23	2.77	-1.36	-6.28	2.83	1.54	-1.79	0.12	-0.22	0.26
France	0.72	2.03	-0.33	-1.30	-1.66	1.15	0.90	-0.27	0.80	0.31	0.26
Germany	0.88	1.83	1.36	-0.15	-3.65	2.58	2.08	0.33	0.51	0.47	0.76
Ireland	-0.45	0.30	-1.01	-4.86	0.75	4.01	2.91	-2.55	-2.32	4.97	..
Italy	-0.01	-0.16	-0.39	-1.35	-3.46	1.76	0.28	-1.14	0.17	0.28	0.23
Japan	0.98	0.03	0.52	-0.84	-2.56	3.49	0.14	1.06	1.92	-0.01	1.22
Korea	2.75	2.96	4.33	3.11	0.33	5.51	4.17	-2.63	3.11	-0.82	0.75
Netherlands	1.60	1.10	0.49	-0.47	-3.30	1.45	0.39	-0.89	0.07	0.62	1.06

Using a panel of 12 countries Griffith, Redding and Van Reenen (2004) examined whether a country's investment in R&D influences MFP growth and on whether the effect of R&D on MFP growth is dependent on that country's distance from the technological frontier. The Author's found that the further a country lies behind the technological frontier, the greater the potential for R&D to increase MFP growth through technology transfer from more advanced countries. Although an educated labour force and a high-quality infrastructure have been documented as important factors in determining the location of R&D, studies suggest that tax incentives, such as generous rules surrounding the deductibility and creditability of expenditures, can affect the location of R&D activity (Bradley *et al.*, 2015).

⁹ <https://data.oecd.org/lprdy/multifactor-productivity.htm>

In a counter observation, Siedschlag *et al.* (2013), analysed 446 location decisions of R&D activities by multinational firms incorporated in the European Union between the periods 1999–2006. From their work they found, on average, the location probability of a representative R&D foreign affiliate increased with agglomeration economies from foreign R&D activities, human capital, proximity to centres of research excellence and the research and innovation capacity of the region. The Author's also noted that corporate taxation rates are not significant in attracting R&D activity to a region, partially because multinational enterprises locate foreign subsidiaries in multiple regions and taxation is optimised on a global, rather than regional, basis. They conclude that policy initiatives to increase a region's knowledge are more likely to increase that region's attractiveness to foreign R&D investors.

Tax legislators increasingly struggle to tax income from intangible assets in a way that prevents IP income from being shifted abroad. Moreover, policy makers are concerned that research and development as well as innovative activities, which are associated with positive spill overs, are relocated to other countries for tax reasons (Evers, 2014). In recent years, the introduction of dedicated Tax policies to promote innovation is now widely perceived as a mechanism for economic growth and productivity. Ernst, Richter, and Riedel (2014) extend this view by assessing the effects of taxation on the quality rather than the quantity of R&D activity. Using patent applications to construct various measures of R&D project quality, they found that tax incentives subsidising investments in innovation increase the quantity but not the quality of R&D, while tax incentives subsidising the income stream from successful innovation increase both quantity and quality (Bradley *et al.*, 2015).

3.3 Private and social returns to R&D

While the market is supposed to reward commercialisation after IP development, market failure may still exist because competitors may reap the benefits of innovation without incurring the development costs. Despite the presence of R&D tax benefits, one firm's efforts bringing an innovation to market can create a spill over effect to firms that did not commit the investment in R&D (Atkinson, 2011). Apple's iPad offers an example: Despite being protected by patents in the United States and Europe, once the device became popular, similar competing tablets quickly emerged, suggesting that Apple was not able to capture anywhere near all of them returns from its innovation (Jones *et al.*, 2016).

The impact of R&D on growth through spill overs has been a major topic of economic research over the last thirty years (Bloom *et al.*, 2013). Spill overs are generally measured as

the decline in costs or the increase in productivity of firms that occurs because of R & D undertaken by other firms (Lester, 2012). Economists and other social scientists have demonstrated that the R&D activities of private firms generate widespread benefits enjoyed by consumers and society at large. Thus, the overall economic value to society often exceeds the economic benefits enjoyed by innovating firms because of their research efforts. This excess of the social rate of return over the private rate of return enjoyed by innovating firms is described by economists as a positive externality or spill over.

Knowledge spill overs are particularly likely to result from basic research, but they are also produced by applied research and technology development (Jaffe, 1996). However, despite their best efforts and the benefits of patent protection, firms cannot prevent the knowledge gained through their R & D from leaking out, or spilling over, to other firms. These spill overs occur, for example, as researchers exchange ideas at professional meetings and as they move from firm to firm. More generally, discovery in one firm can trigger new avenues of research, inspire new research projects, or find new applications in other firms (Lester, 2012).

In the work by Bloom *et al.*, (2013), a central problem they found in the literature was that a firm's performance is affected by two countervailing spill overs: (1) a positive effect from technology (knowledge) spill overs and (2) a negative business stealing effects from product market rivals. Using panel data on US firms, they showed that technology spill overs quantitatively dominate, so that the gross social returns to R&D are at least twice as high as the private returns. They also found that smaller firms generate lower social returns to R&D because they operate more in technological niches. According to Rao (2016), companies have long performed the lion's share of R&D and this has been the primary funder since the late 1970s with the US federal government playing a significant role in promoting private R&D. Federal support is motivated by both potential spill overs from privately conducted R&D and a notion that R&D affords U.S. firms a competitive advantage in global markets. While the earlier literature focused on a few countries only, and in particular the US, an increasing number of micro-econometric studies on many economies have been presented during the last few years (Castellacci & Lie, 2015). Parsons and Phillips (2007), use the median result from eight Canadian studies, which implies that a dollar of R & D spending by one firm reduces costs of other firms by 56 cents in selected sectors. This result is consistent with a much larger body of international literature, particularly for the US (Lester, 2012).

Spill overs can also arise from knowledge gained in incorporating innovations in the production of commercial products (OECD, 2013 A) or from network externalities that arise when the value of a new idea or product is dependent on the development of related

technologies (Lev, 2003; Evers, 2014). Therefore, the effect of spill overs is to create a gap between the private rate of return to R&D (the return or profit earned by the firm undertaking the research) and the social rate of return, which includes the private return but also includes benefits to the firms' customers and to other firms. The nature of this spill over gap in the context of market and knowledge spill overs is illustrated in Figure 3.2.

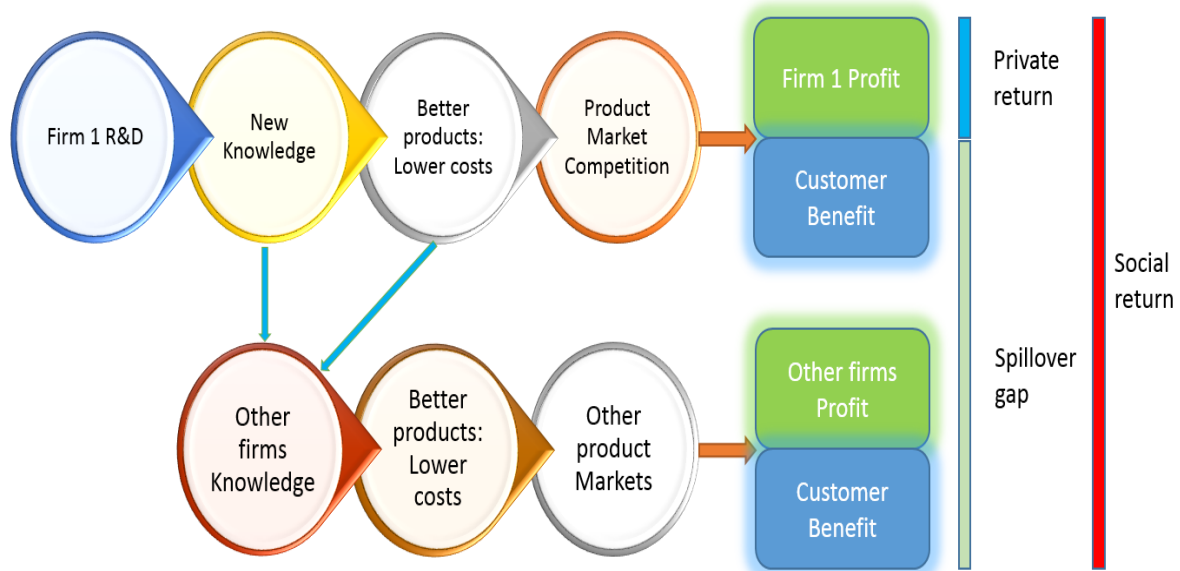


Figure 3.2 Market and Knowledge spill over mechanism (adapted from Jaffe, 1996).

Figure 3.2 indicates that the knowledge spill overs flow to some extent from firm 1's creation of new knowledge, and to some extent from firm 1's commercialisation efforts. This reflects the idea that other firms may learn to some extent from papers, patents, departing employees, and other disembodied outputs of firm 1's research, but they are likely to learn more when firm 1's research results are embodied in new commercial products and processes (Jaffe, 1996). Therefore, the promotion of R&D and innovative activity is playing a central part in stimulating economic development (Fagerberg, Mowery, and Nelson 2006; Becker and Pain 2008; Ramstad 2009; Edquist 2011; Innovation Union 2014; Haapanen, 2014). However, Aghion *et al.* (2005) have argued that the relationship between market structure and innovation depends on the type of rivalry. When firms innovate in a 'step-by-step' fashion (i.e. no leapfrogging is allowed) and rivals can compete 'neck-and-neck' for customers, increasing competition leads to innovation because it increases the differential between pre-and post-innovation profits. Within this context, the relationship between concentration and innovation is negative as innovation is a way to escape competition (Freitasa *et al.*, 2017).

3.4 An overview of European R&D expenditure

*Europe 2020*¹⁰—the strategy for growth set out by the European Commission, puts investment in research and development as one of the five priorities for Europe to become more competitive. Gross domestic expenditure on R & D (GERD) stood at EUR 299 billion in the EU-28 in 2015, which was a 4.4 % increase on the year before, and 47.8 % higher than 10 years earlier (in 2005) — note that these rates of change are in current prices and so reflect price changes as well as real changes in the level of expenditure. By the year 2020, it was expected that European investment in R&D should reach at least three percent of gross domestic production (GDP). The target of three percent is ambitious given that expenditure on R&D was about 2.1 percent in 2012.

The financial crisis has stressed the requirements for reaching the aforementioned target, such as, the crisis obliged many governments to introduce tough fiscal consolidation measures, and prioritising other issues over R&D. Government support for R & D is appropriate because the private market fails to provide the socially optimal amount of investment (Lester, 2012). In 2012 the share of public R&D expenditure in total government spending was lower than in 2007 for half of the EU member states¹¹. However, progress has been made in the period before 2007, expenditure was 0.3 percentage point smaller than it currently is (Straathof, *et al.*, 2014).

Therefore, competition among nations to attract business R&D and to develop technology intensive industries is growing (Tyson and Linden, 2012). As part of the Irish Government's strategy for meeting R&D targets under the Europe 2020 strategy, Ireland is aiming to invest 2% of GDP in R&D by 2020 (Department of Finance, 2014). Regarding the Eurostat study (Euro Stat, 2016) as presented in Figure 3.3, the R&D intensity for Ireland in 2015 was 1.51% compared to 1.19% in 2004 which is below the EU-28 average of 2.03% in 2015. Please note that in order to make figures more comparable, GERD is often expressed relative to GDP. The ratio of GERD to GDP, one of five key Europe 2020 strategy indicators, is also known as R & D intensity.

¹⁰ <http://ec.europa.eu/eu2020/pdf/COMPLET%20EN%20BARROSO%20%20%20007%20-%20Europe%202020%20-%20EN%20version.pdf>

¹¹ Eurostat data on “Share of government budget appropriations or outlays on research and development as % of total general government expenditure”, available at:
<http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcod=e=tsc00007&plugin=0>

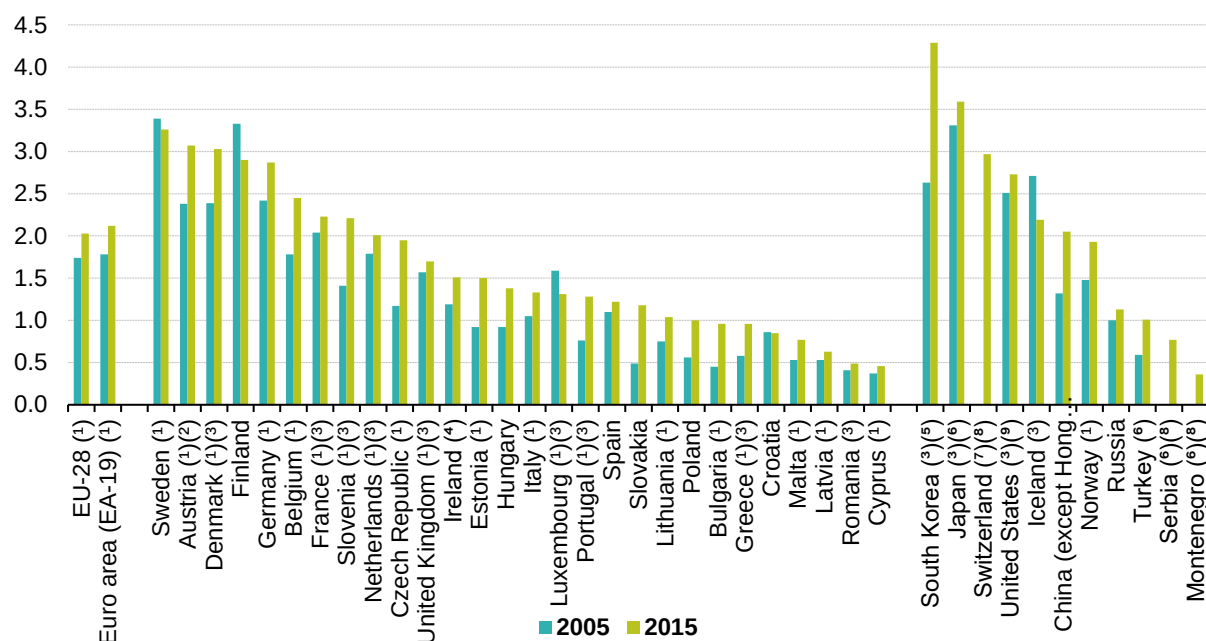


Figure 3.3 Gross domestic expenditure on R & D by sector (% of GDP), 2005 and 2015 (Eurostat, 2016).

The urgency to balance expenditure on innovation against expenditure on other policies calls for clarity on the performance of the different innovation policy instruments (Straathof, *et al.*, 2014). Throughout this period, most R&D expenditure in the Eurozone was in the business enterprise sector, and its R&D intensity rose from 1.12 % of GDP in 2004 to 1.30 % in 2014. The second largest sector performing R & D was the higher education sector, whose R & D intensity increased 17.5 % between 2004 and 2014, to reach 0.47 % of GDP (Euro Stat, 2016).

Considering the increase in government budget constraints, it is more important than ever that a sufficient rationale exists for government intervention with respect to such R&D policy interventions (with respect to market failure and recent evolutionary perspectives) (Haapanen *et al.*, 2014). Based on the 2014 Eurostat data, Ireland's Business Expenditure on Research and Development (BERD), in relation to GDP was 1.11% when compared to the EU-28 average of 1.3%. 2015 data for the EU28 is not available at time of publication. Comparable figures for 2015 show that the R&D intensity for Ireland has decreased to 0.8%. This was not due to a fall in R&D spend but rather due to a large increase in GDP in 2015 (CSO, 2017). Looking at the actual information collected from the CSO, the Business Expenditure on Research and Development survey show that more than €2.2bn was spent on research and development (R&D) activities by enterprises in Ireland in 2015. This represents an increase of

10% compared with actual expenditure in 2013. Current expenditure, which comprises of labour costs and other current costs, accounted for 93% of all expenditure in 2015, with capital expenditure accounting for the remaining 7% or €157m of total expenditure. Enterprises were also asked for their estimated R&D expenditure in 2016. These estimates indicate that R&D expenditure increased to €2.3bn in 2016 (CSO, 2017).

However, while R&D expenditure is an important driver of innovation there are many factors beyond R&D expenditure which serve to induce or provide the framework conditions for innovation and productivity, such as broader tax policy, human capital accumulation, competition policy etc. In addition, Irish firms benefit from R&D expenditure in other countries through inter-country spill overs. One commonly observed channel for this exists where R&D activity in the USA is embedded in Irish production processes (Department of Finance, 2014).

3.5 R&D Tax incentives

Innovation is essentially about bringing new ideas to the market. If the purpose of R&D tax incentives is to foster innovation, it is not only relevant what type of R&D costs are eligible, but also whether R&D is primarily intended for true innovation or primarily for learning from other firms (Straathof *et al.*, 2014). Continuing from the work by Straathof *et al.* (2014), they have found that countries which have introduced the R&D tax incentives at different points in time, have shaped them in various ways. Even for such a generic policy instrument, the specific design, type and number of R&D tax incentives differ substantially across countries. These differences can be divided into three main categories:

- 1) Scope of the policy, including the type of R&D tax incentive and costs covered.
- 2) Targeting of specific groups of firms, per their size, age, region, etc.
- 3) Organisation, including administrative practices and generosity.

The amount of additional R & D induced by government support is a key evaluation consideration: everything else being equal, the higher the responsiveness to a subsidy, the higher the net benefit (Lester, 2012). More than 20 OECD countries currently support private R&D investments through this type of schemes, including not only advanced countries but also developing economies such as Brazil, India, China and South Africa ¹²(OECD, 2010). R&D tax incentives are tax deductions that firms can claim if they are involved in R&D activities, thus providing them with an incentive to increase their innovation efforts. Tax credits are

¹² Please note these four countries are not members of OECD

typically directed to all firms in the economy and hence let private agents decide what type of project to apply for (Castellacci & Lie, 2015).

Tax incentives are a market-orientated means of delivering an increase in private R&D expenditures which also allows the support offered by the credit flexibility to respond to market demand. Tax credits allow expenditure to be directed by market aware firms rather than a centralised authority. While the flexibility of a credit to respond to market demand is useful it also creates an uncertain and unlimited demand on the exchequer. Their operation varies between countries but in general companies can deduct a percentage of eligible R&D expenditure from Corporation Tax liability (Department of Finance, 2013).

3.5.1 R&D Tax incentive schemes

The main economic rationale for using any of these tools rests on the notion that market failures reduce or may even deter private R&D investment. These failures derive mostly from knowledge spill overs and from asymmetric information. This can lead to appropriability difficulties because of imitation by rivals; asymmetric information between investors and inventors may result in financing constraints (Busom *et al.*, 2014). Although tax credits may provide a stimulus to overall R&D activity, some Author's have stressed that they are less suitable than grants to address the sources of market failure i.e. due to the lack of capital to be invested (Czarnitzki, Hanel, and Rosa 2011); in addition, they are likely to encourage firms to undertake R&D activities resulting in short-term revenues, rather than projects with high rates of social return or long-term exploratory activities (Hall and van Reenen 2000).

Ernst & Spengel (2011), analysing a set of European firms, found that R&D tax incentives motivate firms to start investing in R&D. Thus, the goal of the R&D tax credit is to encourage R&D investment by indigenous and foreign owned firms of all sizes by rewarding qualified research. This tax mechanism offsets against tax liability because the credits can help companies increase their cash flow and earnings per share, reduce their effective tax rate, hire more staff, develop new products, and finance other business objectives.

The R&D tax credit in Ireland has a generic nature, covering a wide scope of eligible expenditures and offering a common rate to all types of firms, including foreign companies. This is important for a small and open economy like Ireland, as it maintains a level playing field for foreign direct investment (FDI) inflows and facilitates knowledge transfer from innovative multinationals (Straathof *et al.*, 2014). The natural follow on from the R&D tax credit is the Patent Box or as it is known outside of Ireland, the Knowledge Development Box (discussed in detail latter in the document). A variety of approaches coexist in the way countries

shape R&D tax incentives. Every scheme might have some particularities, but broadly four approaches can be distinguished: tax credits, enhanced allowances, accelerated depreciation and reduced rates. Figure 3.4 gives an overview of which tax incentives are in use.



**Note that various countries have more than one type of R&D tax incentive*

Figure 3.4 R&D tax incentives schemes (CPB, 2015).

Tax credits are the most widely used tax incentive (in 21 countries), but also enhanced allowances (in 16 countries) and accelerated depreciations (in 13 countries) are used in a substantial number of countries. These policies target the cost-side of R&D investment, as they

are linked to the amount of R&D expenditures, whereas IP/Patent Box regimes target the income-side. Patent boxes (discussed later) are a relatively new policy instrument, which has been introduced in eleven countries: first the Benelux states, followed by United Kingdom and others (CPB, 2015). While some countries have only one type of instrument, several others use a mix of different types. In relation to Ireland, the Author has graphically represented the Irish approach which is presented in Figure 3.5 which emphasises both the R&D Tax credit and the KDB.

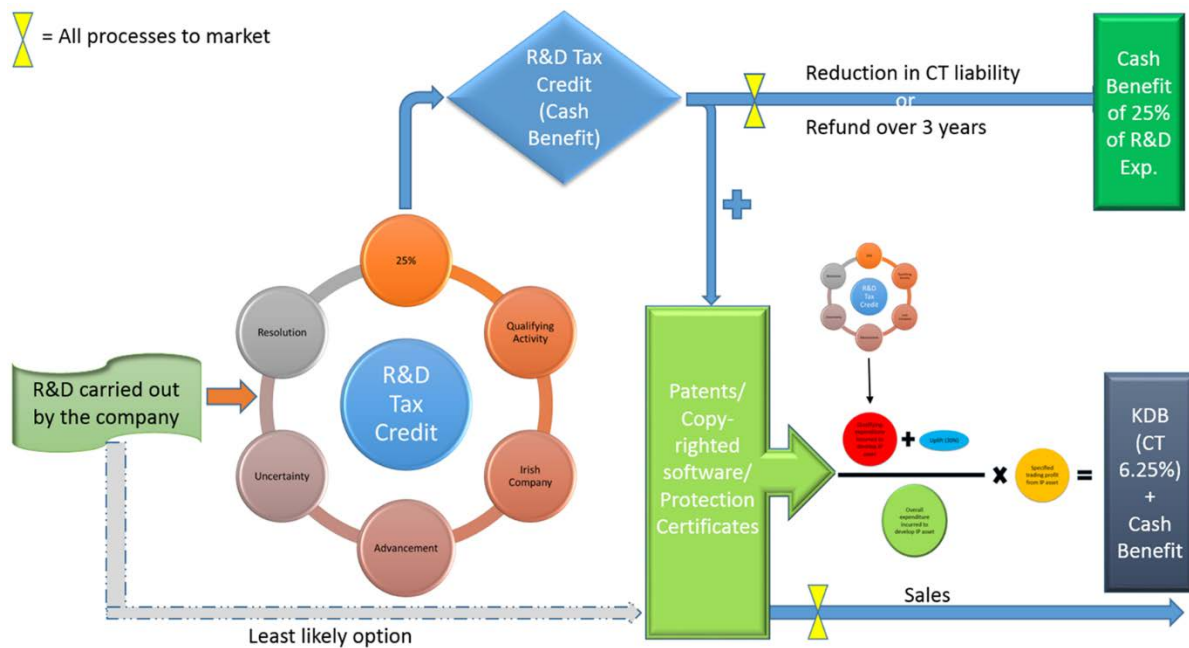


Figure 3.5 R&D tax credit and KDB mechanism.

R&D tax incentives are one of the most popular innovation policy tools. Essentially, they reduce taxes for firms that have R&D expenditure (input-related R&D tax incentives) or for firms that have income from commercialising intellectual property rights (output-related R&D tax incentives)¹³. Input-related R&D tax incentives decrease the price of R&D inputs faced by firms, which makes it more attractive to engage in R&D. Output-related R&D tax incentives increase the returns from innovative products that are protected by intellectual property rights. This should motivate firms to invest in innovation or to attract foreign R&D firms (Straathof, *et al.*, 2014).

¹³ Input-related tax incentives (tax credits, enhanced allowances, accelerated depreciation) apply to expenditure on R&D, while output-related incentives (patent boxes, tax benefits for IP-related expenditure) apply to the income or assets generated from R&D.

However, although there is substantial evidence that R&D tax incentives do increase the amount of R&D investment, studies' estimations of the effect's intensity vary considerably (Evers, 2014). In addition, empirical evidence indicates that R&D tax incentives might mainly induce R&D investment to be shifted between different locations instead of increasing the overall level of investment (Bloom and Griffith, 2001; Hines, 1995; Wilson, 2009; Baumann *et al.*, 2015).

3.5.2 R&D Tax credits in Ireland

The Research and Development (R&D) tax credit, administered by the Irish Revenue Commissioners is open to all companies in Ireland that are undertaking qualifying research and development activities in Ireland or within the European Economic Area. Qualifying R&D expenditure will generate a 25% tax credit for offset against corporate taxes in addition to a tax deduction at 12.5%. This means that companies undertaking qualifying R&D can claim a refund from the Revenue of €37.50 for every €100 worth of R&D expenditure. So, effectively, the R&D tax credit reduces the real cost of R&D by up to 37.5%¹⁴.

The share of research and development work done in the private sector in Ireland is among the highest in Europe, essentially meaning that BERD is high relative to total R&D in Ireland. Over 60pc of all workers involved in R&D are working full-time in the private sector, making Ireland only second to Sweden in the 28-member bloc¹⁵. To help offset the R&D cost to companies and to promote innovation and competitiveness, the R&D tax credit and the Knowledge Development Box are valuable tax resources which encourage companies to create new and improve existing products and processes and intellectual capital in Ireland. The R&D tax credit provides a 25% refundable tax credit on the qualifying R&D expenditure, where the company can offset current and previous years' CT liabilities. Alternatively, if a company does not have a tax liability in the current or immediate prior period, it can claim a repayment in cash of R&D tax credits in three equal instalments over a three-year cycle. Otherwise, the tax credit will be offset against future tax liabilities. The refund is limited to the greater of the corporation tax payable by the company in the preceding ten years or the payroll liabilities for the period in which the relevant R&D expenditure is undertaken¹⁶.

¹⁴ <https://www.enterprise-ireland.com/en/start-a-business-in-ireland/food-investment-from-outside-ireland/why-ireland/food-research-and-innovation/r-d-tax-credit.html>

¹⁵ Irish Independent, 2/11/2016- Ireland's private R&D sector one of the strongest in Europe. Available at <http://www.independent.ie/business/irish/irelands-private-rd-sector-one-of-the-strongest-in-europe-35181009.html>

¹⁶ <https://www.enterprise-ireland.com/en/start-a-business-in-ireland/food-investment-from-outside-ireland/why-ireland/food-research-and-innovation/r-d-tax-credit.html>

This tax credit system for R&D is preferred by some Author's and policy-makers; because it requires no discretion and (ex-ante) involvement by government or bureaucracy, it can benefit all businesses that have incurred eligible R&D Policy Studies expenditures (Griffith 2000). To put this into perspective, R&D active enterprises are those enterprises who reported they either performed in-house R&D, had R&D performed on their behalf, or controlled branches engaged in R&D activity. There were nearly 1,900 enterprises engaged in R&D activities in Ireland in 2015. More than 73% of all enterprises spent less than €500,000 on R&D activities. Just over one sixth spent between €500,000 and €2m, whilst only 10% of enterprises spent €2m or more on R&D activities (CSO, 2017).

The Irish Finance Act 2014 introduced changes to improve the tax credit available for expenditure incurred by companies on R&D activities. Of note is the change to a volume-based regime. Previously, the tax credit available for qualifying R&D expenditure was only available on an incremental basis. The credit was limited to the amount by which expenditure on R&D exceeded the expenditure incurred in 2003, which was the designated base year. A volume-based scheme applies to the whole stock of qualified R&D expenditures carried out by a firm, and it is better suited to provide support to large and R&D intensive companies and hence increase the overall R&D intensity of the economy. This is the approach that is currently adopted by many European countries, such as UK, Netherlands, Denmark, Norway and Italy. On the other hand, an incremental scheme only applies to the additional amount of R&D that the company does above a given base amount, and it may therefore be more appealing for smaller and non-R&D intensive enterprises. With regards to the latter, if they have previously carried out R&D investments and sustained the related sunk costs, they will typically start from a lower level of R&D expenditures than larger companies in R&D intensive industries for this reason, they may find it easier to increase this low initial level to qualify for the fiscal benefits under an incremental scheme (Castellacci & Lie, 2015).

Although the base year threshold had been incrementally eroded in recent years, its complete removal means that the Irish R&D tax credit can now be claimed in respect of all qualifying expenditure incurred in accounting periods commencing on or after January 1, 2015 (Duffy & Bailey, 2015). On review, the R&D tax credit provides a provision for a tax credit for qualifying expenditure on R&D activities, equipment, plant and buildings. Salaries paid to employees who conduct qualified activities are generally the largest component of qualifying R&D expenses. Over €1.3bn was spent on labour costs, which accounted for 61% of all R&D expenditure in Ireland in 2015 (CSO, 2017).

Tax incentives based on the salary paid to researchers can be considered a good indicator because they are likely to generate higher knowledge spill overs than other types of R&D expenditure. Knowledge spill overs are effectively knowledge created by one agent can be used by another without compensation, or with compensation less than the value of the knowledge. In Ireland's case, Siedschlag *et al.* (2010) found evidence that all types of innovation and especially organisational innovation has a positive effect on labour productivity. Doran *et al.* (2012) present evidence that R&D expenditure increases the probability of a firm innovating. Their work finds that Irish firms are more likely to generate innovation from R&D expenditure than foreign firms.

Therefore, it is important to note that globalisation spurs the knowledge diffusion and encourages firms to incorporate investments in innovation in their portfolios because knowledge based capital [research & development, intellectual property, organisational capital, skills etc.] is a key driver for competitiveness at all levels (Cozmei & Rusu, 2015). A large body of literature has identified that multinational firms engage in profit shifting activities to decrease their overall tax liabilities. Intangible assets, like patents, play an important role as their location of origin can be quite arbitrary. Evidence presented in Bloom, Griffith and Van Reenen (1999) suggests that the location of R&D may be affected by tax-induced changes in the cost of R&D. So, while tax credits may demonstrate themselves to increase R&D activity within a given jurisdiction, this may not result in as large a net increase globally (Department of Finance, 2014). Therefore, many tax jurisdictions have established R & D tax incentive programs which reduce the tax burden of companies conducting R & D and thereby spur R & D investment. R & D tax incentives can either be linked to R & D expenditures such as super-deductions and tax credits or to R & D income such as patent boxes (Bachmann *et al.*, 2016).

However, a tax credit can only rectify the market failure of under-investment in R&D if the root of the problem is financing. If, for example, the greatest barrier is insufficient human capital, the tax credit will not solve the failure and in addition runs the risk of considerable deadweight. The Irish R&D tax credit in its current form can be considered a reasonably successful policy tool, in that it does stimulate additional R&D, but the deadweight inherent in the scheme should not be ignored (Department of Finance, 2016). The associated cost to Revenue regarding the R&D Tax credit is presented in Table 3.2.

Table 3.2 The cost of the R&D tax credit since 2009¹⁷

Year	Exchequer Cost (Millions €)	Of which (Millions €):		
		Offset against current year tax liability	Offset against previous year tax liability	Repayable credit
2009	216	153	30	33
2010	224	142	16	65
2011	261	152	3	106
2012	282	142	4	137
2013	421	182	4	236
2014	553	227	1	326

Source: Revenue Commissioners

3.6 Principles of taxation of intangible assets

3.6.1 Definition of an intangible asset

Before investigating into the principles of patent boxes, it is important at this stage of the work to take a step back to get an understanding of what defines an intangible asset. Per the International Accounting Standard (IAS), an intangible asset is defined as “*an identifiable non-monetary asset without physical substance*” (IAS 38.8, 2014). Corporate intellectual property, including items such as patents, trademarks, copyrights and business methodologies, are intangible assets, as are goodwill and brand recognition. Intangible assets exist in opposition to tangible assets which include land, vehicles, equipment, inventory, stocks, bonds and cash¹⁸. The three critical attributes of an intangible asset are (IAS 38.8, 2014):

1. Identifiability.
2. Control (power to obtain benefits from the asset).
3. Future economic benefits (such as revenues or reduced future costs).

To distinguish intangible assets from goodwill arising on business combinations, an asset is identifiable when it is separable (capable of being separated from the entity and sold) and it arises from contractual or other legal rights. The second condition is designed to cover assets that are not separable, but are nevertheless valuable. If, in the future, economic benefit

¹⁷ http://www.budget.gov.ie/Budgets/2017/Documents/Tax_Expenditures_Report%202016_final.pdf

¹⁸ <http://www.investopedia.com/terms/i/intangibleasset.asp>

is expected to flow to the entity because of incurring R&D costs, then it can be argued that these costs should be treated as an asset rather than an expense. However, their future benefit is usually highly uncertain (Carey *et al.*, 2012, p. 3, Lev (2003), p. 37, Evers, 2014).

Thus, an intangible asset must be under the control of the entity so the entity has the power to obtain the future economic benefits from the asset. This control will usually (but not necessarily) stem from legally enforceable rights. In the absence of such rights, it is more difficult to prove that an asset exists¹⁹. Intellectual property law, accounting standards, national tax codes, and sources of bilateral and multilateral tax law all provide for their own definitions of intangible assets and special IP rights (Verlinden and Smits (2009), pp. 30).

3.6.2 Internally generated intangible assets

Goodwill which has been generated internally can never be recognised as an asset [as per IAS 38]. The main problems in deciding whether internally generated assets are to be recognised are in terms of determining when an intangible comes into existence and measuring its cost reliably. IAS 38 has therefore introduced additional requirements such that the internal generation of an asset should be classified into a *research phase* and a *development phase*. It is important to note that these phrases relate to all intangibles, not just what would normally be regarded as research and development expenditure. Therefore, any expenditure that arises in the research phase should be recognised as an expense when incurred. The rationale being, there is insufficient certainty as to whether future economic benefits will occur. Examples of this type of activity are specifically outlined in the standard and include: Activities aimed at obtaining new knowledge; search for, evaluation and final selection of applications of research findings or other knowledge; search for alternatives for materials devices, products, processes or services.

IAS 38 states that development costs qualify for recognition as intangible assets provided the following strict criteria apply. These include (IAS 38.8, 2014):

- Technical feasibility of completing the intangible asset so it can be used or sold.
- Intention of entity to complete the asset and use or sell it.
- How the intangible asset will generate future economic benefits.
- Availability of adequate technical, financial and other resources to complete the development and to use or sell asset.

¹⁹ Study aid by Martin & Mary Kelly, <http://www.cpaireland.ie/docs/default-source/Students/Study-Support/P1-Corporate-Reporting/intangible-assets.pdf?sfvrsn=0>

- Its ability to measure reliably the expenditure attributable to the asset.

3.6.3 Intangible asset differentiation

Intangible assets (see Figure 3.6), can be categorised by the kind of activity that led to their creation (Evers, 2014). Accordingly, the OECD transfer pricing guidelines differentiate between 'marketing intangibles' and 'trade intangibles'. Trade intangibles are "usually created through risky and costly R&D activities" (OECD, 2010a). This category comprises of patents, software, designs, models, and trade secrets. In turn, 'marketing intangibles' comprise trademarks and trade names, customer lists, and distribution channels among others. It is important to make this difference in economic terms, as it is mainly R&D activity which is associated with positive spill overs. Due to the presence of spill overs, private markets tend to under-invest in R&D activities relative to the socially optimal level of investment. This is the traditional policy rationale for tax incentives for R&D and innovation (Evers, 2014). However, Base Erosion and Profit-Shifting (BEPS) negotiators have paid special attention to the vast intangible assets that multinationals hold these days: brands, copyrights, patents and so on. Much of their profit-shifting to cut tax bills, and many of the tax breaks that government's offer, relate to such intellectual property (IP) and its accompanying royalties²⁰. This will be discussed in detail later in the Chapter.

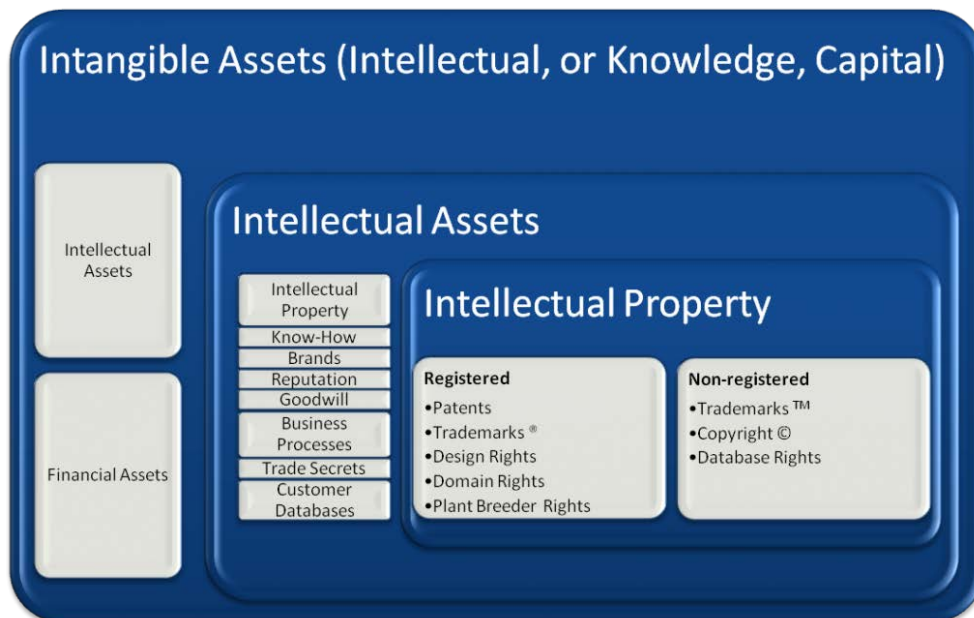


Figure 3.6 Hierarchical diagram of the world of intangible assets²¹

²⁰ <http://www.economist.com/news/business/21662552-proposals-consistent-global-rules-company-tax-cause-worries-all-round-patently>

²¹ <http://www.hawkip.com/advice/what-are-intangible-assets>

3.7 Patent Box

3.7.1 Patent Box design

Intellectual Property (IP) is a topic of high global importance for fostering innovation, doing business and succeeding in markets and for creating jobs and growth. Recent studies show that 39% of total economic activity and 26% of employment in the EU is generated by IP-intensive sectors, and jobs in these sectors enjoy a wage premium, with 40% higher remuneration compared to non-IP-intensive sectors²². Income derived from intellectual property, whether by way of internal use, e.g. in the production of goods, or by licensing to third or related parties, is generally subject to the ordinary corporate income tax rate. However, patent box regimes are an exception to this, as they provide a reduced tax rate for income from the exploitation of IP. Patent box regimes, which first emerged in 2000 and are now found in 13 European countries features mechanisms which offers a lower rate of Tax on the income derived from the commercialisation of patented products. The rationale for patent boxes to stimulate innovation seems to be absent as it is not clear which market failures patent boxes address (Straathof *et al.*, 2014).

Once patented, an invention is protected from imitation, such that firms no longer have a disincentive to innovate. It is not clear why especially innovations for which clear property rights are defined should receive a tax incentive. By subsidising inventions that do not need a subsidy, patent boxes would induce inventions that are difficult to patent (and therefore might have high spill overs) relatively less attractive (Straathof *et al.*, 2014). Patent boxes are a distinct category of R&D tax incentives because they offer a large scope for tax planning by firms. There are (at least) three reasons that a government may introduce a Patent Box: (i) to incentivise firms to increase investment in innovative activities; (ii) to attract (or retain) mobile investments that may be associated with high-skilled jobs and knowledge creation; (iii) to raise revenue more efficiently by differentiating tax rates on more mobile income streams (Evers *et al.*, 2015). A study by Hassbring and Erdwall that covered active patent boxes found that patent boxes have a statistically positive effect on both foreign and domestic patent applications in Europe, indicating increases of 10% to 20%, and promoting commercialisation of R&D (Hassbring and Erdwall, 2013).

Several European countries currently offer patent box regime for income derived from patents and, in many cases, from other forms of IP such as software or trademarks. These are,

²² <https://www.djei.ie/en/Publications/Publication-files/Enhancing-the-Intellectual-Property-Activities-in-the-Firm-Base-in-Ireland.pdf>

in chronological order with the financial year in which they were first applied given in brackets (Evers, 2014), France [2000], Hungary [2003], the Netherlands [2007], Belgium [2007], Luxembourg [2008], Spain [2008], Malta [2010], Liechtenstein [2011], the Swiss Canton of Nidwalden [2011], Cyprus [2012], the United Kingdom [2013], Portugal [2014], Italy [2015]²³ and, most recently Ireland [KDB-2016]. However, a key concern is the role that patent boxes may play in increased tax competition between European countries.

In a 2015 European Commission taxation working paper by Alstadaeter *et al.* (2015), the Author's examined the use of patent boxes by the global top 2,000 corporate R&D investors. This sample covers firms from the pharmaceutical, automotive, and information and communications technology (ICT) industries, and accounts for approximately 90% of all global R&D spending²⁴. The report's four main findings are that:

- i. Patent boxes have a strong effect on attracting patent filings, predominantly due to the favourable tax treatment they receive, although there is some variation by industry sector and patent quality.
- ii. High-quality patents (as defined by value) are more influenced by patent box tax advantages than patents of lower quality.
- iii. In most cases, the existence of patent box regimes provides an incentive for multi-national companies to shift the location of their patents, but there is no corresponding growth in levels of local inventorship, or shifts in the locality of research activity.
- iv. Where development conditions have been imposed, these appear to counter the primary taxation advantage effects, while still encouraging local inventorship.

The share of patenting firms is much lower than expected given that around 20% of firms that invest in R&D report product innovations. Findings are similar for the US as only 5.5% of US manufacturing firms own a patent (Balasubramanian and Sivadasan, 2011). Per the research by Bradley *et al.* (2015), they found that patent boxes may increase new patenting activity by three percent for each percentage point decrease in taxation, but that patent boxes have been relatively unsuccessful in preventing the relocation of R&D activity. The Author's also note that patent box regimes are in their infancy, and an increase in patenting activity is most likely to be attributed to the patenting of pre-existing unprotected IP, given the lead times

²³ <https://www.lexology.com/library/detail.aspx?g=9aeb1be6-844c-48f6-8d56-c8a8b824b50c>

²⁴ <http://www.apf.gov.au/DocumentStore.ashx?id=fd803c5d-de4d-4060-9d79-68d9f4ce5354&subId=408835>.

for R&D activity and product development. They suggest that patenting increases may be a result of license shifting by co-located patent owners.

3.7.2 Patent Box design and associated spill over effects

The ability of firms to absorb and innovate using knowledge developed in other firms is a positive externality often described as a knowledge spill over (Department of Finance, 2014). Tax incentives should ideally apply to those types of expenditures that bring about strong knowledge spill overs (Straathof *et al.*, 2014). As previously discussed, spill overs are largely associated with research including that which fails commercially.

However, patent boxes provide a tax reduction for the income from successful projects and not for the underlying research (Graetz and Doud (2013), p. 409, Griffith and Miller (2011), p. 232). Evers (2014), noted that the correlation between the extent of any spill overs and the resulting income stream could be positive because both are driven by the quality of an idea. But, they could also be negative because returns are higher when firms can maintain the exclusivity of an idea. Besides this, the returns from exploiting intangible assets will also reflect any market power associated with intellectual property, such that the size of the tax break is not directly linked to the scale of spill overs from the underlying innovative activities. Summing up, the market failure argument, which supports traditional R&D tax incentives, does not unconditionally apply to IP Box regimes which involve a beneficial tax treatment of the returns from successful investment (European Commission (2014c), pp. 22 and 45, Griffith and Miller (2011), p. 232, Evers, 2014)

3.7.3 Patent Boxes: A European perspective

The clear majority of tax incentives are based on corporate income taxes, while eight countries have (additional) incentives that apply to social contributions and/or wage taxes. Tax benefits applying to income from innovation (mostly patent boxes) are proliferating CPB (2015). One of the benefits of the patent box is that the technology is being held for use in a country that has infrastructure to support the development and use of the technology and that has access to markets (Ciccatelli, 2016). It is undeniable that the UK was successful with its patent box structure, with government statistics suggesting 639 companies had taken advantage of the system, and other countries were therefore keen to not be left behind (How patent boxes became the new normal, 2016). Regarding the detailed findings by Alstadaeter *et al.* (2015), they have stated that Tax competition seems to have changed from a focus on statutory rates to one on tax bases, with Patent boxes being singled out as an important driver. To illustrate this point, Figure 3.7 shows that the number of patent boxes in the EU has grown from 2 in 1995

to 11 in 2015 with a clear acceleration in recent years. The tax reduction that patent boxes offer varies across countries but the average tax advantage over the period has been about a 75% reduction in the corporation income tax (CIT) rate (or equivalently, 17.9 percentage points) (Alstadaeter *et al.*, 2015).

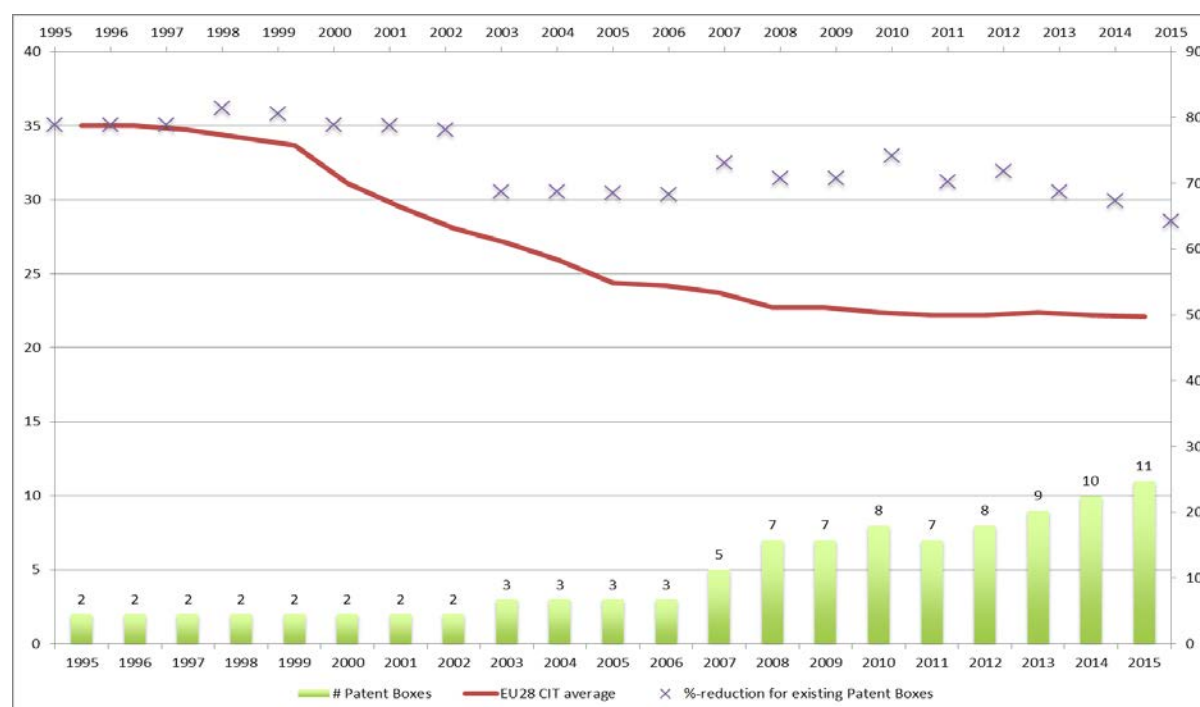


Figure 3.7 Average Corporate Tax Rate and Patent Boxes in the EU-28²⁵.

The most prominent feature of such IP Box regimes is the tax rate, which ranges from 0% in Malta to 15.5% in France. Other key features that determine the generosity of the policies are (i) the types of IP that are eligible; (ii) the scope of qualifying income; and (iii) the treatment of expenses relating to qualifying IP income (Evers *et al.*, 2015).

On assessment of the literature, there is a consensus that the IP box mechanism (non-OECD compliant) has only promoted the location or relocation of IP to the specific country with the favourable tax regime and that the actual R&D has remained in the host country. Results suggest that patent boxes have a strong effect on attracting high-value patents mainly due to the favourable tax treatment they offer (Alstadaeter *et al.*, 2015). They are also part of the strategy of at least some countries to increase tax revenues from foreign companies as countries offering lower corporate tax rates attract more capital and profits from multinationals.

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http://iri.jrc.ec.europa.eu/documents/10180/608300/presentation_Alstadaeter_Barrios_Nicodeme_Skonieczna_Vezzani.pdf.

But it is important to note that other factors, such as quality of infrastructure etc, also attracts MNC capital.

In the European context, it has been discussed whether such special tax regimes could mainly benefit highly mobile businesses without triggering significant additional R&D activity (CPB, 2015). However, after statistics revealed the extent of the migration of patent registrations from Germany to the UK (per the UK Patent Office 2012 saw the UK attract 27% more German patents to the UK than the previous year) in anticipation of the new UK regime entering into force on January 1, 2013 (Gilleard, 2013). In July 2013, German Finance Minister Schäuble publicly criticised patent box regimes saying “*That’s no European spirit. You could get the idea they are doing it just to attract companies.*” And “*patent box schemes were at odds with EU rules designed to deter discriminatory tax rules*”²⁶. However, regarding Minister Schäuble concerns, recent press and business decisions have created anecdotal evidence. Examples of which are presented as follows;

1. The hotel reservation company Booking.com was expected to reduce its tax rate by around four percentage points thanks to the Dutch patent box regime²⁷.
2. The failed Pfizer’s attempt to takeover Astra Zeneca- Pfizer wanted to use the acquisition of AstraZeneca to shift its tax base to Britain²⁸ taking advantage of a reduced corporate tax rate of 10% (instead of a standard rate of 21%) over future profits generated from patents.
3. The UK company GlaxoSmithKline has recently centralised all its vaccine-related IP in Belgium mainly for fiscal reasons while carrying its physical capital investment at home (Alstadaeter *et al.*, 2015).
4. Recently, companies moving their intellectual properties to Ireland is the likely cause behind a surge in corporate tax receipts in 2016, resulting in more than €3 billion in corporate tax. The Department of Finance said that corporation tax receipts during June were “strong”, up by €21 million more than was expected. For the six-month period, the tax took in almost €3.2 billion, 19%, or €505 million more than the state had anticipated²⁹.

²⁶ Reuters, 9 July 2013, <http://uk.reuters.com/article/2013/07/09/uk-europe-taxes-idUKBRE9680KY20130709>

²⁷ <https://www.theguardian.com/business/2014/nov/06/pfizer-unlikely-astrazeneca-takeover-tax-inversion-clampdown>

²⁸ <https://www.theguardian.com/business/2014/nov/06/pfizer-unlikely-astrazeneca-takeover-tax-inversion-clampdown>

²⁹ <https://fora.ie/corporation-tax-exchequer-receipts-ireland-2861504-Jul2016/>

The previous examples seem to suggest that the decisions on patent registration by firms may have little to do with developing research and innovation but a lot to do with tax planning, echoing Minister Schäuble's worries that patent boxes are simply there to "*to attract companies*" (Alstadaeter *et al.*, 2015). In the spring of 2014 the European Commission has probed into those schemes and requested information from several member states to analyse the true potential of patent boxes³⁰. Using firm-level data from multiple European countries, Ernst and Spengel (2011), have combine financial data on firms with firm-level patent data to test how a firm's patenting activity responds to a change in R&D tax incentives and corporate tax burdens. They suggest that R&D tax incentives are found to have a positive effect on patenting while a statutory corporate income tax rate has a negative impact on patenting.

Westmore (2013) showed that R&D tax incentives are positively related with patenting in a country-level, from his analysis of 19 OECD states. He estimated that a decrease in the B index³¹ of 0.05 raises the number of patents per capita by around 2.5 percent. Karkinsky and Riedel (2012) estimated that an increase of one percentage point in the corporate tax rate results in a fall in the number of patent applications of 3.5 to 3.8 percent. In contrast, Ernst *et al.* (2014) finds that R&D tax credits and tax allowances have a negative impact on patent quality for European corporations between 1998 and 2007. The previous study could indicate that while R&D tax incentives appear to be effective in increasing incremental innovations, they might not result in more radical innovations. For patent boxes, they find a positive impact on the quality of patents. Overall, studies on the effectiveness of R&D tax incentives tend to find a positive impact on innovation (CPB, 2015).

In their concluding remarks from their working paper on Patent boxes design, patent Location and Local R&D, Alstadaeter *et al.* (2015), note the following;

- Patent Boxes have been criticised for offering additional tax advantages to income already profiting from an intellectual property protection and having potentially little effects on the level of R&D.
- Patent Box development has raised concerns over the fact that they could exert a significant effect on patent location without a change in real research activity, aiming only at the tax benefits.

³⁰ Press release: http://europa.eu/rapid/press-release_IP-14-309_en.htm

³¹ The B-index is defined as the net present value of after-tax costs of spending one euro on R&D divided by one minus the corporate income tax rate.

Their findings confirm the fears, with the tax attractiveness of patent boxes being larger the broader their scope. Such that, patent box regimes will often be in jurisdictions that are central to markets, have well educated populations, and good universities and research facilities. Thus, it is easier for companies to integrate patent boxes into their business operations (Ciccatelli, 2016).

Despite the OECD taking a dim view of patent box regimes, they have remained popular with countries looking to increase foreign direct investment (FDI). Countries like the UK and the Netherlands are or have adapted their existing regimes to comply with the OECD guidelines whereas Ireland and India, are using the guidelines as an opportunity to create 'compliant' regimes from scratch (How patent boxes became the new normal, 2016).

3.7.4 Location of the exploitation of intangible assets

Global tax competition is a major reason behind the implementation of patent boxes. However, tax system competition is of interest to governments not only because of a loss in tax revenue, but also because of its wider social and economic impact. Encouraging companies to hold patents locally, governments hope, will, in addition to reducing tax avoidance, establish and retain high value development, manufacturing, and jobs. (Jones *et al.*, 2016). The aim of patent box regimes is to attract or retain IP income. None of the IP Box regimes require that the R&D and innovation activity be carried out within national borders (Graetz & Doud, 2013, p. 374). Empirical evidence suggests that R&D investment and patent ownership are indeed located in separate countries to a considerable extent. In the study by Alstadaeter *et al.*, (2015), they used firm level data from 2000-2011, and found that the favourable tax treatment afforded by patent boxes had a strong effect on attracting patents, especially "high quality" patents. Complementing this, a study by Bohm *et al.* (2014), which exploits the European Patent Office's data on patent applications, indicates that this geographical split is to some extent driven by tax considerations. They find that countries which tax patent income at low rates attract foreign-invented patents, whereas countries with high tax rates for patent income face the relocation of patents abroad. By providing R&D-favourable infrastructure such as public research institutions, universities, and a high-skilled labour force, the R&D country provides public goods which contribute to the success of R&D investments of companies and the value of any resulting intangible assets.

Therefore, the benefit principle is often perceived to support the R&D country in its claim to tax the income relating to intangible assets created in its jurisdiction (Schon, 2009, pp. 75; Boos, 2003, p. 186; Evers, 2014). Many popular strategic tax planning models aim at

disentangling the location of the creation and the location for the use of intangible assets. This may be necessary if the preferred locations for these two activities differ, considering tax and non-tax factors (Russo, 2007, and Walsh, 2001). In fact, one of the reasons why using intangible assets for tax planning purposes is so attractive is that the ownership of intangibles can be separated from the R&D activity (Evers, 2014).

3.7.5 IP Tax planning

Fundamentally, IP tax management aims to minimise the overall tax burden of a company or group without violating the law. In the seminal work carried out by Evers (2014), she noted that intangible assets are important value drivers but lack physical substance facilitates tax planning. She continued to expand this view in 3 points:

1. Due to their intangible nature, they do not have a clear geographical connection and can therefore be relocated without [non-tax] costs.
2. Theoretically and more in practice it is very difficult to determine the value of intangible assets. As comparables rarely exist, taxpayers face a considerable amount of discretion when it comes to valuing intangible assets for transfer pricing purposes. They may exploit this to their advantage.
3. As intangible assets are important value drivers, a relocation of intangibles entails that a significant share of the group's [future] profits is shifted. Tax planning with intangible assets therefore provides significant profit shifting potential in comparison to other profit shifting channels such as intra-group financing.

3.8 Review of Base Erosion and Profit Shifting associated with Patent Boxes

3.8.1 Introduction

Such concerns were also voiced in the context of the OECD Base Erosion and Profit Shifting discussion and at the EU code of conduct on business taxation (OECD, 2014). The need to align taxation with "substantial" research activity being developed by companies is now indeed seen as a key factor to ensure that such preferential regimes reached their goal of fostering innovation and economic growth (Van der Made, 2015). The OECD identified patent boxes as a harmful tax practice, since they allowed many companies to take advantage of extremely low effective tax rates, without supporting their IP with economic substance. Taking this into account, IP-related tax benefits such as patent boxes are not about to disappear. BEPS

will help to regularise some of them, albeit in diluted form. Perversely, this is encouraging countries that previously shunned them to give them a try³².

To address the issue, the guidelines for patent box regimes that the OECD released rely on the 'modified nexus approach' to make sure a low tax rate can only be secured with significant R&D activity in a jurisdiction (How patent boxes became the new normal, 2016). The nexus approach (discussed in detail later in this work) offers some potential to mitigate the role of patent boxes as new tax competition tools.

3.8.2 Policy driven approach

When R & D income qualifies for a patent box, a reduced corporate tax rate is applied to such income. In 2015, 28 of 34 OECD and partner economies provided tax incentives on R&D expenditure and 17 provided tax incentives on R&D income (OECD, 2015a). From 2005 to 2015, the number of EU-28 countries providing patent boxes almost quadrupled (Alstadsaeter *et al.*, 2015). Tax incentives for income generated by R&D, mostly patent boxes, can result in large decreases in tax revenue for all governments, including those engaging in such a policy (CPB, 2015), see Figure 3.8.

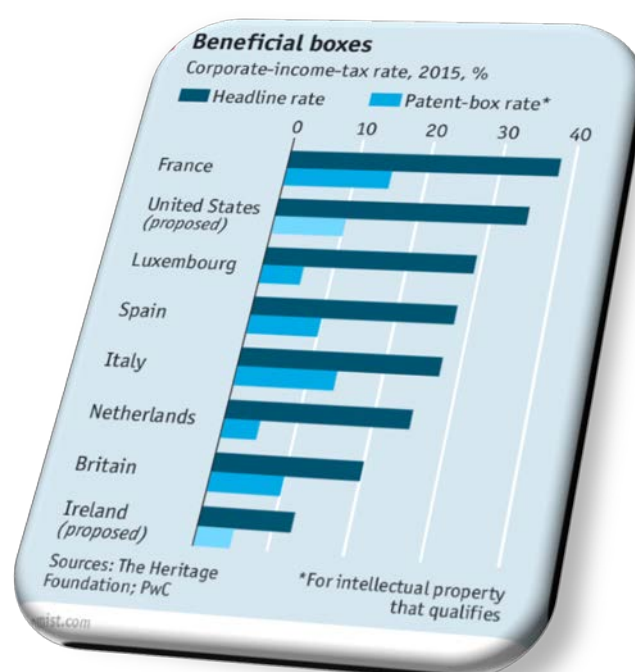


Figure 3.8 Overview of the corporate tax rated for selected countries versus the patent box rate.

³² <http://www.economist.com/news/business/21662552-proposals-consistent-global-rules-company-tax-cause-worries-all-round-patently>

Firms operating in some markets or using certain technologies might respond differently, because, transfer pricing rules may be easier to circumvent for firms operating in markets where a high share of transactions are intra-firm; meaning it is difficult for tax authorities to accurately assess what is a fair market price (Griffith *et al.*, 2014). Several empirical studies show that tax incentives on R & D expenditures influence the R & D location decision of companies (Hall, 1993; Guellec/van Pottelsberghe de la Potterie, 2003, Bachmann, 2016). A much-debated aspect in international taxation is the determination of an appropriate transfer price to avoid profit shifting of internationally operating companies. To help governments and companies in determining such transfer price, the OECD provides guidelines for the calculation of an appropriate, arm's length transfer price (Bachmann *et al.*, 2016).

This concern was raised recently by the OECD when they discussed the consequences of incentives created by multiple tax systems to produce knowledge-based capital, while holding the patent rights in different jurisdictions. In this scenario, it is unclear how the spill over benefits from R&D are distributed between economies. In addition, the OECD argue that domestic firms will be at a disadvantage due to their limitations in accessing the benefits of tax-planning via multiple jurisdictions which would limit their ability to compete and grow in a globalised world (Department of Finance, 2014).

Competitive IP regimes have been a feature seen in many countries in recent times. Where, IP migration to actual or perceived tax havens is the biggest problem in transfer pricing, enabling certain companies to minimise tax in their markets. Moreover, policy makers are concerned that research and development (R&D) as well as innovative activities, which are associated with positive spill overs, are relocated to other countries for tax reasons. One policy response to profit shifting and tax base erosion involving intangible assets is to tighten transfer pricing rules and introduce targeted anti-avoidance provisions (Evers, 2014). The OECD Action Plan on Base Erosion and Profit Shifting (BEPS) identifies preferential tax regimes such as IP Box regimes as a 'key pressure area' in tax policy and calls for measures to counter harmful tax practices more effectively (OECD, 2013a, action no. 5).

3.8.3 Factors influencing BEPS

Recent empirical results show that European firms' intangible assets are more likely to be held in low-tax subsidiaries than tangible assets (Dischinger and Riedel, 2011) and that the location of patents is responsive to corporate income tax (Griffith *et al.*, 2014). A sentiment reflected in the work of Huizinga and Leavens (2008), which found that profit shifting leads to

significant revenue losses for high-tax countries. Grubert (2003) formalises how intangible assets can be used to shift income to lower tax countries and provides empirical evidence that about half of the income shifted from high-tax to low-tax countries by US manufacturing firms can be accounted for by income from intangibles linked to research & development (R&D). Both firm size and industry have been highlighted as important in the context of firm decision making over how to organise offshore activities (Graham and Tucker, 2006 and Desai *et al.*, 2006). Indeed, the value of a patent, the relative attractiveness of a location and a firm's strategies and organisational structures are likely to vary across industries and, within industries, across firms (Griffith *et al.*, 2014).

However, intangible assets constitute a major input and value driver for multinational companies. Often, the related intellectual property, including patents, trademarks, brands and copyrights, does not have a clear geographical location (Lipsey, 2010). Corporate income taxes, of course, are not the only determinant of location of intangible assets. The strength of intellectual property rights, market size and degree of technological innovativeness were also found to play an important role. All these factors are found relate positively with the share of patent applications in most of the subgroups analysed (Griffith *et al.*, 2014). The number of patents registered in a country is not necessarily indicative of a country's innovativeness for two reasons (CPB, 2015);

1. Patents are very heterogeneous in terms of the novelty and value of the underlying invention. Patents are also heterogeneous with respect to their sensitivity to corporate taxation. The valuable patents were found to be the more sensitive to corporate tax rates than patents that are not valuable.
2. The second reason why the number of patents registered in a country does not reflect its innovativeness is that the country from which a patent is applied for not necessarily the country (or countries) where the invention originated. For patents applications at the European Patent Office (EPO) the country of the inventor also is not a reliable source as applicants are not legally required to inform the EPO about the addresses of inventors. Especially larger companies might apply for patents from countries other than those where they perform their R&D as they tend to have a subsidiary dedicated to IP-issues and because it is sometimes more advantageous to apply for a patent from a country with a patent box.

Straathof and his colleagues (2014), have approached the issue of novelty and how its use will have implications for the expected impact of an R&D tax incentive. They note that there are four types of novelty requirements encountered: (1) new to the world; (2) new to the country; (3) new to the product market; (4) and new to the firm. Following from this, the Author's suggest that if R&D is targeted to products that are new to the world, i.e. the incentive promotes pure innovation. However, if new to the country is sufficient, then the incentive also stimulates imitation from abroad. Finally, if there is hardly any novelty requirement, domestic imitation is encouraged. Thus, creating a risk to provide disincentives for firms to invest in radical innovations. The results found by Alstadaeter *et al.* (2015), show that the tax-sensitivity of patent location is reduced when such specific conditionality is imposed would suggest that the nexus approach could (at least partly) inhibit the still dominant tax competition dimension of patent boxes.

Overall the aim of patent boxes is to encourage firms to innovate. With this in mind, discussions at both the OECD and the EU (see next section), have led to an agreement on the requirement to establish a nexus between the income deriving from IP and the expenditure incurred to develop this asset, for the income to qualify for the patent box preferential regime (OECD, 2014). While one of the overarching themes of the BEPS project is to align the location of taxable profits with related economic activities, the nexus approach does not require that R&D activities physically take place in the jurisdiction where the IP is owned. Therefore, the existence of development conditions in some patent boxes may shed light on the potential effect of the nexus condition developed by the OECD and the EU, notably with regards to its effect on patent location, tax revenues and local R&D.

3.8.4 Modified nexus approach

In September 2014, a report on Action 5 of the OECD's BEPS action plan was released: 'Countering harmful tax practices more effectively, taking into account transparency and substance'. The report refers to the work of the Forum on Harmful Tax Practices (FHTP). Action 5 requires the FHTP to revamp the work on harmful tax practices, with a priority and renewed focus on requiring substantial activity for any preferential regime. The report focuses on the preferential tax treatment given to certain income arising from qualifying IP (Schmitz-Merle, 2015). This modified nexus approach was originally developed by Germany and the United Kingdom and its fundamental principle is to establish a nexus between the IP Box benefit and the R&D activity of the taxpayer receiving this benefit. Under the nexus approach, a preferential tax regime satisfies the Code's substantial activity requirement if the regime's

benefit is made conditional on the extent of R&D activity performed by the taxpayer (OECD (2014a), p29). It aims at limiting the IP Box benefit to income stemming from R&D activity in which the taxpayer was engaged. In turn, pure IP holding companies which do not carry out R&D activity themselves but solely commission other group companies to perform R&D may not benefit from the IP Box treatment under the [modified] nexus approach (Evers, 2014). Under the Modified Nexus Approach, businesses using already existing Patent Box regimes might see a reduction in income receiving preferential treatment, as R&D expenditure to develop the patent must be undertaken in a more limited number of entities, including the company holding the relevant patent, to qualify. This could impose restructuring costs on groups which have dedicated R&D companies for them to retain the relief in future (TEI, 2015).

Despite general concerns that IP Box regimes might not be very effective in incentivising R&D, the modified nexus approach allows the design of the regimes to strengthen the link between the tax benefit and real activity, by linking the patent box to IP created through domestic R&D activity. The OECD member states are required to abolish or amend their regimes to align them with the modified nexus approach by the end of June 2021.

3.9 The Knowledge Development Box

3.9.1 Introduction

On the 14th of October 2014, the Irish Finance Minister, Michael Noonan, announced in his budget the abolition of the controversial “Double Irish” structure and the subsequent introduction of the Knowledge Development Box, a system based on existing patent and innovation boxes within other countries. Ireland's introduction of its Knowledge Development Box was to fill the gap in tax policy from where the OECD had forced it to close the option for companies to use the 'double Irish' structuring mechanism (How patents became the new norm, 2016). From an international perspective, the main features contained in his Budget address concerned the Knowledge Development Box (KDB), which forms part of Ireland's response to the BEPS actions, and the release of an Update to Ireland's International Tax Strategy by the Department of Finance.

The KDB was introduced by Finance Act 2015 for companies whose accounting period commences on or after 1st of January 2016 and is an important element in the Road Map for Ireland's Tax Competitiveness. In relation to the KDB or Patent Box, it is a regime for the taxation of income which arises from patents, copyrighted software and, in relation to smaller companies, other intellectual property (IP) that is similar to an invention which could be

patented. Most claims under the KDB, are expected to be in relation to income arising from inventions protected by patents granted following substantive examination for novelty and inventive step. To ensure that that Irish long-term patents can qualify for KDB, the Patents Act 1992 has been amended (by Part 6 of the Knowledge Development Box (Certification of inventions) Act 2017 (the KDB Act) to facilitate the granting of Irish long-term patents following substantive examination for novelty and inventive step. The Patents Rules have also been amended by the Patents (Amendment) Rules, 2017(S.I. No. 206 of 2017) in consequence of the amendments to the Patents Act³³.

Discussions at both the OECD and the EU have led to an agreement on the requirement to establish a nexus between the income deriving from IP and the expenditure incurred to develop this asset, for the income to qualify for the patent box preferential regime (OECD, 2014 & van der Made, 2015). The Irish system was the first KDB (Knowledge Box or Patent Box) in the world to meet the Organisation for Economic Co-operation and Development (OECD) ‘modified nexus’ standard, with the UK following from June 2016. With the modified nexus approach, the KDB is directly related to the qualifying expenditure associated with the R&D and in Ireland’s case the R&D Tax credit regime.

In brief, a company which qualifies for the KDB will be entitled to a deduction equal to 50% of its qualifying profits in computing the profits of its specified trade. Profits of this specified trade should be calculated separately from the other activities of the company. Where, the relief is obtained in the form of an additional trading expense against the profits of the specified trade. In effect, the profits arising from patents, copyrighted software or IP equivalent to a patentable invention are taxed at 6.25% rather than the 12.5%. The modified nexus approach requires that the income from intellectual property that can be taxed at the preferential rate of 6.25%, is limited by the proportion of income arising from R&D activities, significantly lower than the UK's 10%.

The formula proposed by the OECD is designed to ensure that only income from the exploitation of intangible assets which have been created through R&D activity performed by the taxpayers themselves [or an unrelated contractor] enjoys the IP Box benefit. It entails that income relating to IP created via R&D activity outsourced to related parties or relating to acquired IP does not obtain the IP Box benefit (Evers, 2014). The calculation used is presented in Figure 3.9.

³³ <https://www.patentsoffice.ie/en/About-Us/IP-for-Business/Knowledge-Development-Box/>

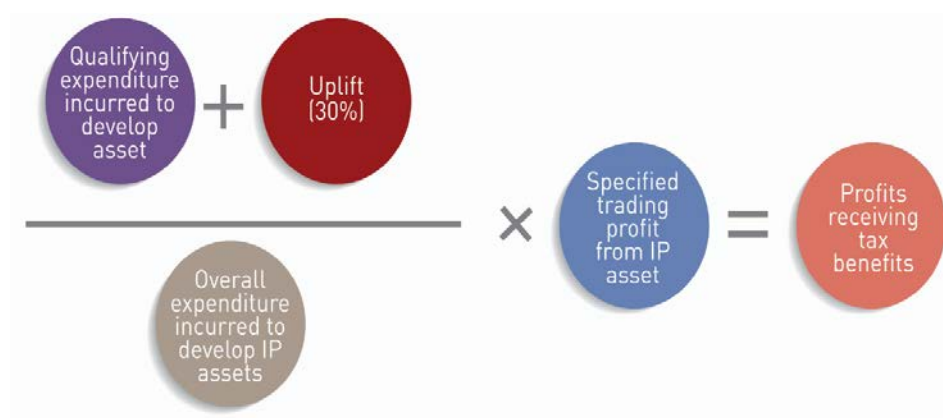


Figure 3.9 Modified Nexus formula used to calculate the KDB.

The application of the modified nexus approach involves that the amount of eligible income must be limited to the share which relates to qualifying expenditures incurred for in-house R&D and R&D outsourced to third parties increased by an uplift as presented in Figure 3.9. This mechanism has not been found in most patent (IP) Boxes. The calculation of qualifying expenditure is essentially the same as the calculation of qualifying expenditure for R&D purposes with the main exception being that no restriction is in place in relation to the inclusion of 3rd party costs in qualifying expenditure for the purposes of the KDB. The modified nexus approach has important implications for IP tax planning making use of intra-group contract R&D. Under IP Box regimes which are in line with the modified nexus approach, intra-group contract R&D would be less attractive as the amount of contract R&D fees paid to related parties negatively (Evers, 2014).

However, Siedschlag (2015) in her Submission on Public Consultation Paper: The Knowledge Development Box to the Department of Finance has stated that an important consideration in evaluating the potential benefits and costs of the KDB is that patents represent only one form of IP. Furthermore, the propensity of firms to use patents is in general concentrated in certain industries and types of firms. Large countries and a small number of large firms account for a large share of patent applications. In a recent study by Squicciarini & Dernis (2013), they found that in 2009, 1.6 % of all firms applied for patents in Ireland. The patenting propensity of firms in the same year was higher in other small open economies such as Switzerland (8.5%); Finland (7.2%) Sweden (5.7%); Belgium (3.9%); the Netherlands (2.9%).

3.9.2 Certificate of Invention

The Knowledge Development Box (Certification of Inventions) Act 2017 (No 6 of 2017) came into operation on 19 May 2017. This Act allows small and medium sized enterprises (SMEs) apply to the Controller of Patents, Designs and Trade Marks for a Knowledge Development Box Certificate. This Bill is aimed at eligible SMEs involved in R&D activities in Ireland with income arising from intellectual property of less than €7.5m and with global turnover of less than €50m where the profits result from R&D. This Certificate will form part of the eligibility criteria set out in the KDB tax legislation for SMEs wishing to avail of the lower rate of corporation tax. The IP asset must be novel, non-obvious and useful. The Knowledge Development Box (Certification of Inventions) Act 2017 also provides for the re-introduction of substantive examination of Irish patents. Patents granted following substantive examination will also be eligible to qualify for the lower rate of corporation tax.

Under the scheme, a relevant company may make an application to the Controller of Patents, Designs and Trade Marks to avail of special tax treatment for such inventions i.e. the reduced corporate tax rate of 6.25% under the Knowledge Development Box (KDB). To qualify for the Knowledge Development Box Certificate (“KDB Certificate”), the invention must: (i) not be publicly available in any manner prior to the application, (ii) not be obvious to someone ‘skilled in the art’, and (iii) have a specific, credible and substantial utility, i.e. be capable of being made or used in one or more industries. An application for a KDB Certificate should be accompanied by an opinion and supporting evidence from a patent agent attesting to the invention being novel, non-obvious and useful. Where the Controller is satisfied that the invention meets all the requirements, he or she shall issue a KDB certificate in the specified form to the applicant. It is important to note that a KDB Certificate does not confer any additional intellectual property rights or protections on the invention. However, the Bill is intended to incentivise companies to undertake innovative activities in Ireland.

3.9.3 A illustrated example

To illustrate the mechanics associated with the KDB, a simplified example is presented herein:

- An Irish tax resident company in a global group of companies was engaged in R&D activities in partnership with an American partner group company in relation to the development of a new product in 2014 and 2015.

- The Irish company incurred €15 million in qualifying R&D expenditure and incurred outsourced expenditure to the American partner group company in the amount of €6 million, which represented the cost of the R&D activities to the American partner. Resulting in a total of €21 million in overall expenditure incurred to develop the IP asset.
- The R&D activities were successful and the invention was awarded a 20-year patent in late 2015 and commercial sales of the product began in early 2016. Sales related to the qualifying asset (patent) in the year ended 31 December 2016 were €7m with related costs of €3m.

Under the proposed regime, the following amount of income would benefit from the 6.25% rate:

I.P. related income	€ 7,000,000
I.P. related expenditure	€ <u>(3,000,000)</u>
Qualifying profits	€ 4,000,000

The income allowable for the 6.25% rate is then calculated as follows:

$$\frac{(\text{€15m} + \text{€4.5m}^*)}{\text{€21m}} \times \text{€4m} = \text{€3.7m}$$

This €3.7m is then reduced by 50 % (taken as a deduction) and taxed at 12.5% resulting in an effective rate of 6.25% and a liability of €231,250 as opposed to €462,500. The uplift expenditure is calculated as the lower of 30% of the qualifying expenditure (€15m x 30% = €4.5m*) or the acquisition costs + the group outsourcing costs (€6m).

3.10 Location decision from Patent Box regimes

Although the modified nexus approach might be effective in preventing multinationals to locate IP and IP income in IP Box countries without locating the associated R&D activity there as well, it might also affect intra-group contract R&D arrangements which are set up for non-tax reasons. Even this extremely low rate, the KDB may not be the critical factor that brings FDI to Ireland. The combination of the much narrower breadth of what is covered by the patent box system and the complicated documentation necessary to benefit from the regime, may prompt multinationals to avail of other incentives when assessing where to base their R&D activities (How patents became the new norm, 2016).

Indeed, it is debatable that IP management does in general not go along with substantial activity as implied by the modified nexus approach (Felder (2013), p. 169). Remember there

are two main reasons that have motivated governments to introduce IP Box regimes: (i) to incentivise firms to increase investment in R&D and innovation and to attract or retain such investment in the country's territory, and (ii) to raise or retain tax revenue on mobile IP income. Whereas the first aspect views IP Box regimes as innovative policies, the second aspect implies that IP Boxes may serve to attract or retain IP income (Evers, 2014). Such income is presumed to be particularly mobile and thereby tax-sensitive. This implies that the IP Box regimes explicitly aim to influence the location of IP. This is problematic to the extent that this contravenes the objective of the State aid rules, namely to safeguard the competition within the internal market (Bartosch, 2010). In the work by Dischinger and Riedel (2011), their empirical evidence suggests that the holding of patents within multinational groups is negatively affected by the size of the income tax rate.

Chapter 4

4.0 Discussion of results

This Chapter aims to investigate if the KDB has a real impact on actual R&D by Irish based companies and how this might incentivise the promotion and growth of innovation. Between January and June 2017, interviews with the DJEI and IBEC took place after which a questionnaire was developed. Subsequently a survey of Irish firms was conducted regarding their experience, knowledge and awareness of both the R&D tax credits and the KDB. The following Chapter presents a profile of these firms, their views and experiences and the recommendations which can be drawn from this. Characteristics of the sample are based on the findings of the survey as well as published secondary data available; this Chapter is subdivided into 4 thematic areas; which include (1) Overview and sample characteristics, (2) R&D Tax credits, (3) Intellectual property, and (4) the KDB. These areas are intricately linked to the research objectives and align to the current views from literature as presented in Chapter 3. The findings presented herein will be sectioned (where relevant) to reflect the views from companies' sector, location, category and function, within each of the thematic areas, see Figure 4.1. Once again to highlight the novelty of this work, this is the first study carried out which evaluates industries views regarding the KDB.

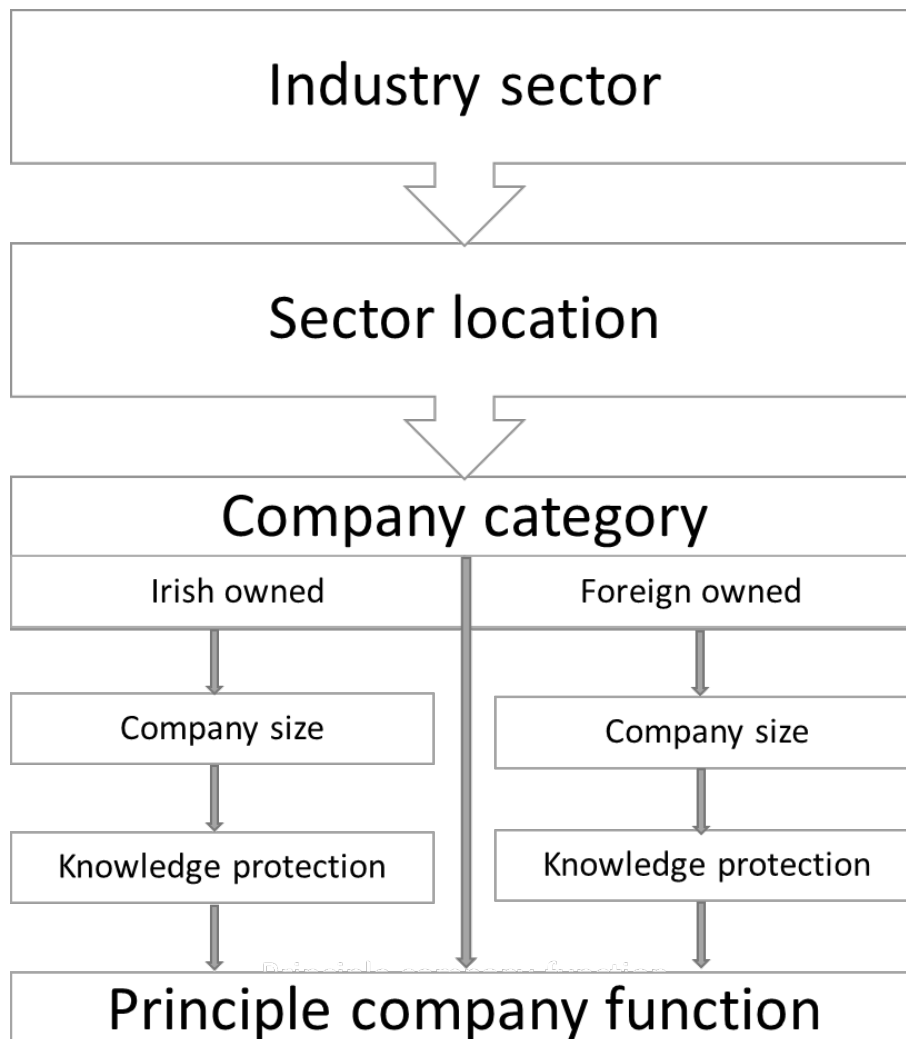


Figure 4.1 Section overview.

Regarding this survey, a breakdown of the roles of 83% of the responders is presented in Figure 4.2. With a 38% response from the CEO's, this gives validation to the relevance of this work and its timing.

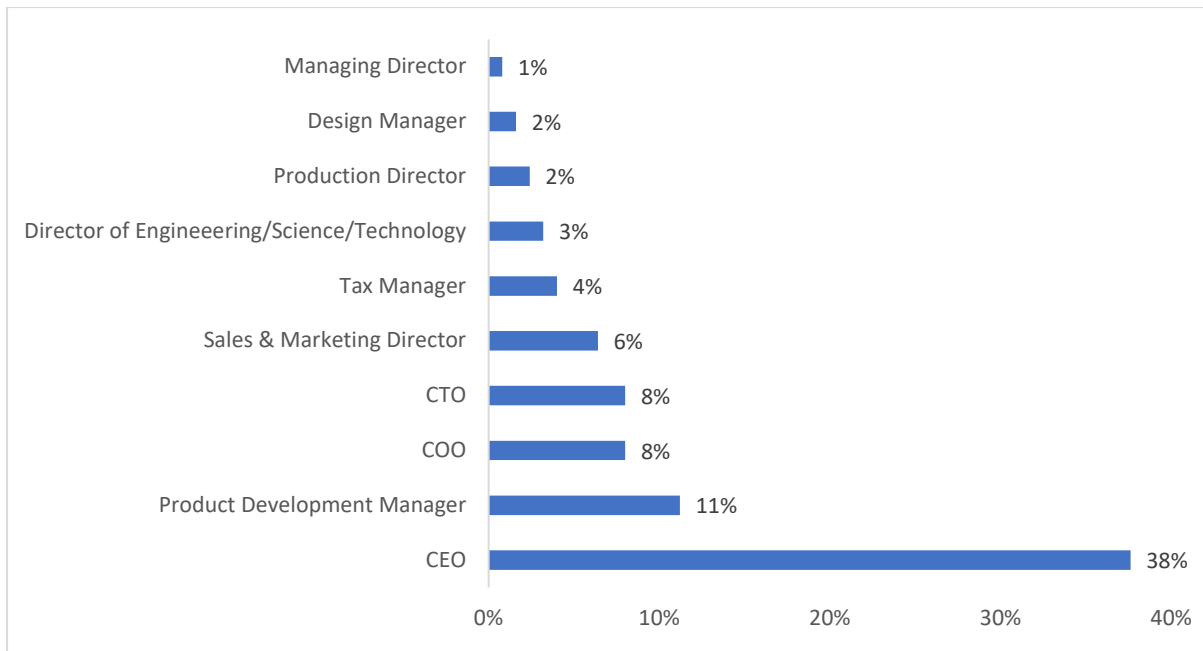


Figure 4.2 Breakdown of the survey responders.

4.1 Overview and sample characteristics

The analysis with regards to the findings from this survey as well as comparable published secondary data is utilised to give an overview of the companies and the sectors they represent. Where possible, the information has been dissected and the core components of each section will be used to assess the thematic areas (2-4) to gain an insight into views regarding R&D business incentives offered by the Irish Government. A strong focus will be on the KDB but it is important to include the R&D Tax credits, as elements of this process feeds into the mechanics of the KDB.

4.1.1 Sample representation

The sample consisted of 122 responses out of a list of 438 companies, which gave a 28% response rate. Unless otherwise stated the values presented herein will be the percentage values associated with the 122 responses. This survey received an excellent response and the representative pool of businesses is presented in Figure 4.3.

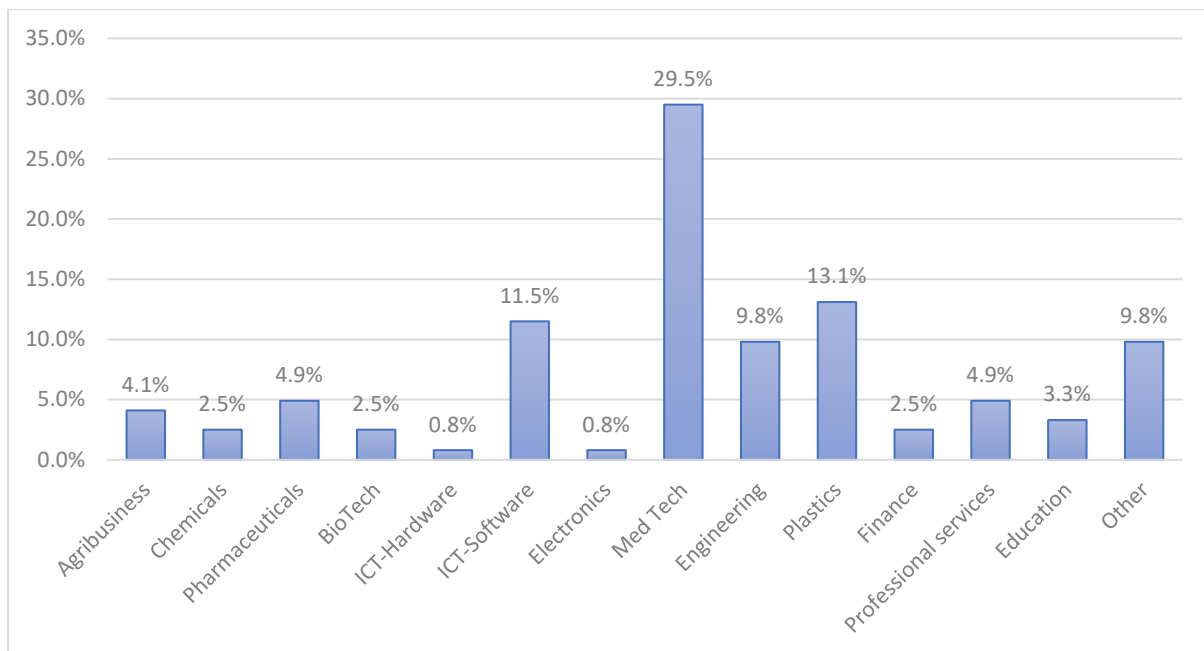


Figure 4.3 Breakdown of the company sectors represented within the study.

Looking at the representative sample, by far the largest response was from the Med Tech sector (36 companies) followed by the Plastics sector (16 companies) and the ICT-Software (14 companies). The author acknowledges that there is a slight personal bias as he previously worked in the Med tech and Plastics sectors. However, this can be utilised as an advantage to understand addressing issues. An overview of the selected sectors is presented below;

Med tech

To put this into context, the medical technology sector in Ireland is recognised as one of the five global emerging hubs. The sector employs over 29,000 people and is the second largest employer of medtech professionals in Europe. Ireland is one of the largest exporters of medical products in Europe with annual exports of €12.6 billion; companies directly export to over 100 countries worldwide. As many as 18 of the world's top 25 medical technology companies have a base in Ireland and 50% of the 450 medtech companies are indigenous³⁴. Interestingly, this 50% breakdown was also evident within this survey, where there was an equal split between indigenous and foreign owned companies.

³⁴ http://www.irishmedtechassoc.ie/Sectors/IMDA/IMDA.nsf/vPages/Medtech_sector~about-the-medtech-sector!OpenDocument

Plastics

Ireland's polymer industry is incredibly diverse with more than 6,500 people working across more than 200 businesses with companies specialising in key manufacturing areas such as medtech, biopharma, aerospace as well as food and drink³⁵. The sector has an annual turnover of 1.7 billion of which 75% of the sales in the industry are exported. Within this survey, 9 companies were Irish and 7 were foreign owned.

ICT Sector

Ireland's reputation as a centre of Software excellence is unrivalled in Europe. It is home to over 900 Software companies, including both multinational and indigenous firms, employing 24,000 people and generating €16 billion of exports annually³⁶. The sector's wide-ranging activities include Software Development, R&D, Business Services and EMEA/International headquarters. 14 companies who responded were all indigenous.

4.1.2 Presence in Ireland

Turner and D'Art (2007) state that the application of knowledge is the driving force in the development and growth of advanced economies. As part of this study, it was deemed important to evaluate when companies were established or were set up in Ireland. This information gives an understanding into the emergence of traditional and non-traditional high value sectors such as med tech and ICT-Software and how these sectors are being incentivised to carrying out R&D.

As shown in Figure 4.4, there was a steady increase in the growth in companies and sector activity, predominantly from the 90's. By deconstructing Figure 4.4, of the manufacturing firms represented within the survey [45 companies], 31% were established between 1981-1990, 18% between 1991 and 2000, 16% between 2001 and 2010 and 18% between 2011 and 2016. In comparison to the companies who are R&D based or operated a R&D function [68 companies], 10% were established between 1981-1990, 15% between 1991 and 2000, 22% between 2001 and 2010 and 40% between 2011 and 2016. This growth in companies coincides with the emergence of the R&D Tax credit in 2003 and an increase in government appreciation and spending on R&D to create a knowledge based economy.

³⁵ <https://www.ibec.ie/IBEC/Press/PressPublicationsdoclib3.nsf/vPages/Newsroom~1,100-new-manufacturing-and-polymer-apprentices-by-2025-01-06-2017?OpenDocument?OpenDocument>

³⁶ <http://www.idaireland.com/business-in-ireland/industry-sectors/software/>

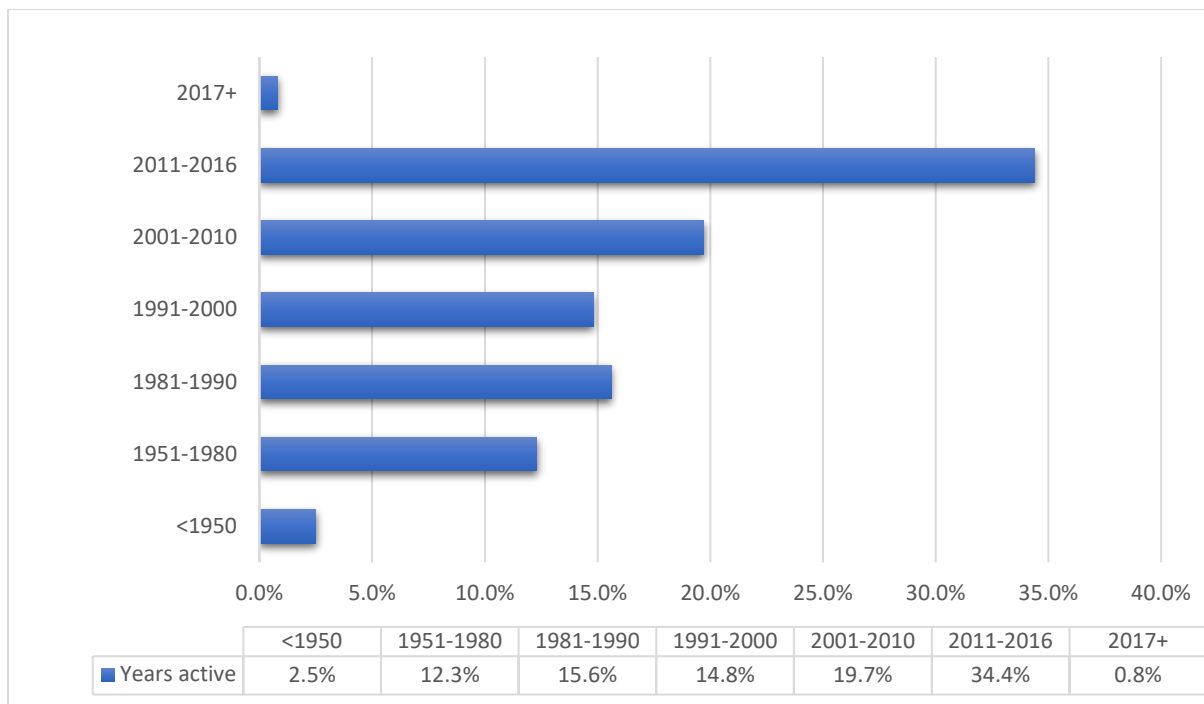


Figure 4.4 Company presence in Ireland.

From the information gathered from this study as well as the data provided by the CSO, the increase in growth of high value companies through the economic crash, can be attributed to many factors, such as tax incentives, young educated work force, competitiveness, open approach to innovation and business, and where recognition is due; the strategic direction of the government to transform the Irish economy to that of a Knowledge economy. Taking a step back and looking at the 2004 report Building Ireland’s knowledge economy, the Irish action plan for promoting investment in R&D to 2010, an interesting quote emerged “...Ireland by 2013 will be internationally renowned for the excellence of its research, and will be at the forefront in generating and using new knowledge for economic and social progress, within an innovation driven culture...” (Building Ireland’s knowledge economy, 2004). It is now clear that this has been the case, in particular with the accelerated growth in the ICT, Biotech and Medtech sectors. Equally important in the strategic direction to create a Knowledge economy was the 2006 Strategy for Science, Technology and Innovation [SSTI] 2006-2013³⁷ policy document. The emphasis was to look towards the Irish economy, where global competition was creating pressure for improvements in efficiency, quality and productivity and there was a growing need to innovate and add value across all aspects of business.

³⁷ http://www.hrb.ie/fileadmin/Staging/Documents/RSF/PEER/Policy_Docs/Relevant_reports/SSTI.pdf

Looking at the 14 indigenous ICT-Software companies within this study, 11 were formed between 2011 and 2016 and this reflects the strong start up culture within this sector (discussed later in this section). Considering 900 software companies³⁸ occupy this space (a large majority are based in Dublin), it would lend itself to a very interesting study regarding influencing factors of growth, however, this is outside the scope of this study. Traditions industries such as Pharma and Plastics have a lineage which traces back to the 1950 and there has been a steady growth in numbers. As expected, the Med Tech sector has seen a real emergence and this is evident in the steady growth of the sector. As previously outlined, there are 450 companies in this space and this has seen rapid growth in the 2000's.

4.1.3 Company size and location

To get into the mindset of the responders, it was important to get an understanding of their company size and location. It is often (unjustly) discussed that Tax is the only reason why foreign companies set up Ireland, but with investment in education and a strong IDA presence and Enterprise Ireland support, there is a growth in industry and entrepreneurial spirit. To back up this view, IBEC from a survey of 247 companies found that 42% of firms ranked the availability of qualified staff as the most important factor in their decision to locate R&D investment in Ireland. To put this into perspective, in 2015, enterprises reported that over €1.3bn was spent on labour costs, which accounted for 61% of all R&D expenditure (CSO, 2017). In relation to Tax incentives, at 24% of the companies surveyed by IBEC this was ranked the second most important issue (IBEC, 2014).

Looking at R&D expenditure, from the recent CSO report on business expenditure on R&D (2017), enterprises that employ 250 persons or more had the greatest share of R&D expenditure in 2015 with 55% of all actual expenditure, this accounted for €1.2bn of the total spend. Small enterprises with less than 50 persons engaged spent almost €502m on R&D in 2015 which accounted for over 22% of the spend. Medium sized enterprises employing between 50 and 249 persons spent just over €503m in the same period which represented 23% of total spend. The breakdown of R&D expenditure in 2016 by employment size class shows a similar distribution to 2015, with small enterprises estimating that they would spend approximately €580m. Medium enterprises forecast a spend of €522m. Large enterprises estimated they would spend nearly €1.2bn in 2016.

Small and medium sized enterprises accounted for 99.8% of the total enterprise population for 2015 [249,000 active enterprises, with 1.4 million employed]. They also

³⁸ <http://www.idaireland.com/business-in-ireland/industry-sectors/software/>

accounted for 69.1% of total persons engaged, with large enterprises (employing 250 or more persons) employing 30.9% of persons engaged despite accounting for only a small fraction (0.2%) of total enterprise numbers³⁹. Of the 13,954 enterprises birthed in 2010, 9,331 or 66.9% survived to reference year 2015⁴⁰. The backbone of the Irish economy is the SME sector and it is interesting to note that 60% of the responders operated in business environments with 50 or less employees (see Figure 4.5). A full distribution is presented in Figure 4.6.

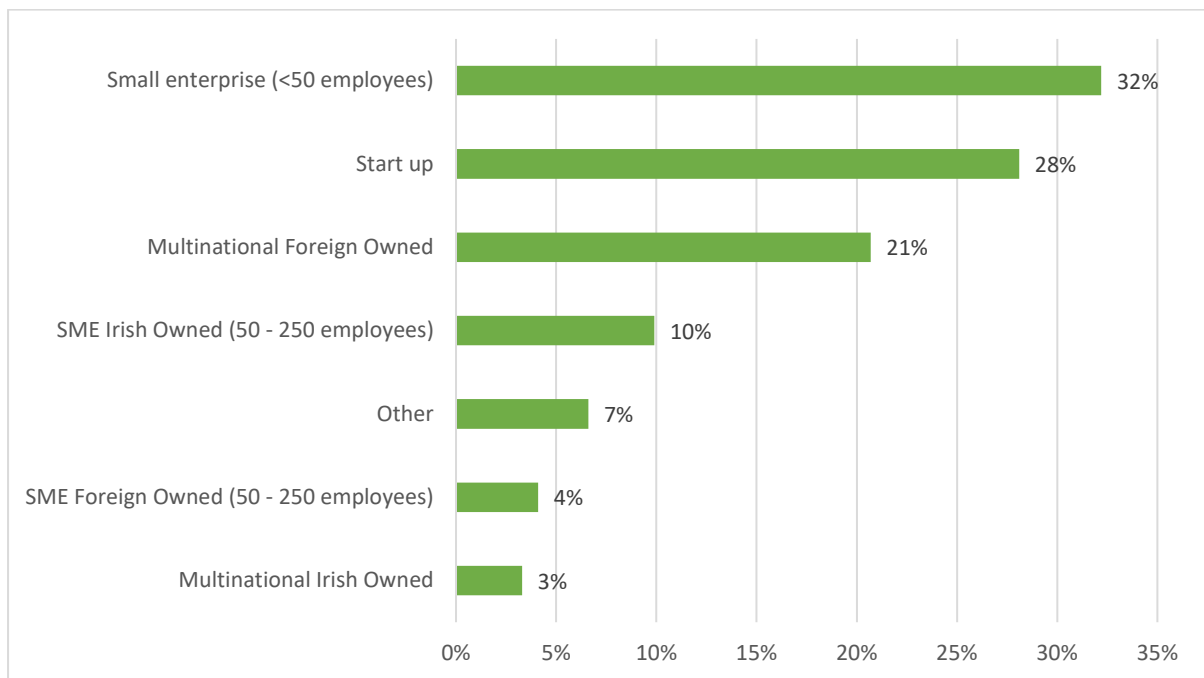


Figure 4.5 Breakdown of company size and ownership.

³⁹ <http://www.cso.ie/en/releasesandpublications/er/bd/businessdemography2015/>

⁴⁰ <http://www.cso.ie/en/releasesandpublications/er/bd/businessdemography2015/>

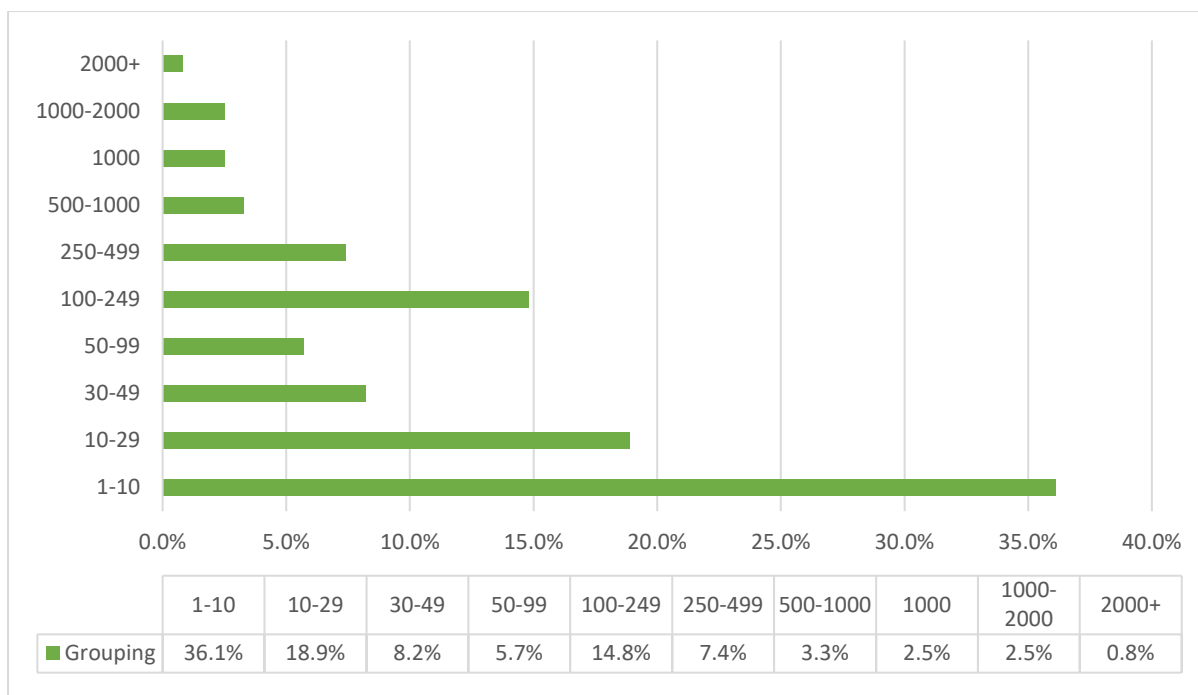


Figure 4.6 Distribution of employee numbers.

Delving into Figure 4.5, five dominant industries emerged, where, Med tech companies were the most representative (Figure 4.7).

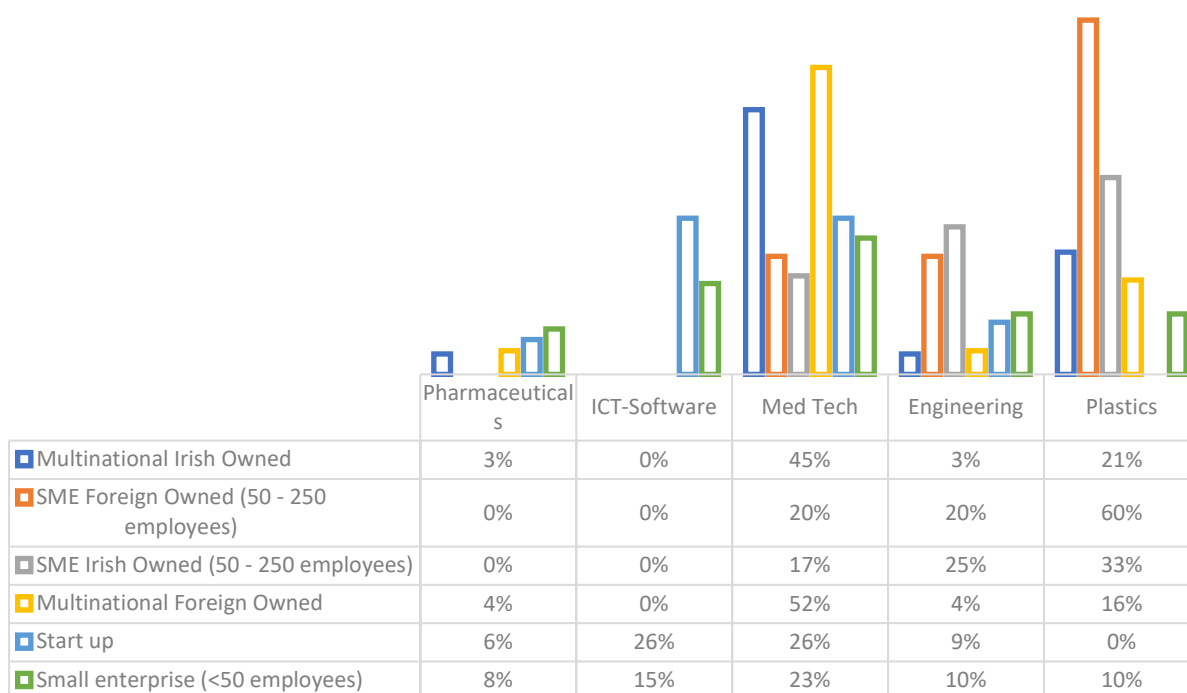


Figure 4.7 Distribution of 5 industrial sectors.

Considering the very nature of those companies rely on strong R&D pipelines and patent protection. It is important to note that earlier foreign companies which set up Ireland (the genesis of this sector) were mainly focused on manufacturing. Of the manufacturing firms represented within the survey [45 companies], 58% were Irish owned and 42% were foreign owned. Of the 1900 registered R&D active firm in 2015(CSO, 2017), 694 or 37% of R&D active firms had spent of under €100,000 which was the most popular spend category for manufacturing firms.

Therefore, with strong reputations build up in the manufacturing sector as well as the formation of clusters, the emergence of strong multidisciplinary approached has lend itself to unpresented growth in this sector. Traditional engineering and plastics companies, tend to be more generic and rely much more on manufacturing with, if any, elements of basic research but one can argue they possess strong development culture, which is critical to the survival, growth and sustainability.

To give some context to the importance of the manufacturing sector; the financial crash of 2007-2008 caused upheaval and shrinkage in the European manufacturing sector. Manufacturing dropped from 34 million employees and €1,711 billion value added in 2006 to 29.7 million employed and €1,630 billion value added in 2013. The numbers employed in manufacturing, and the contribution to the European economy overall, are still recovering from the losses sustained during the financial crisis. Whilst employment numbers and losses sustained during the crisis are recovering, the European Union wants to return to a world-leading position in manufacturing and plans to do so through the development of advanced and sustainable methods and applications supported by investing in research, development and innovation through its funding instruments (Bayliss-Brown, *et al.* 2017).

Of the research based or research performing firms represented within the survey [68 companies], 73% were Irish owned and 27% were foreign owned. In reality, a small I (if any) and a large D is where most of the sectors operating in Ireland function. However, this is open to interpretation as one companies view of research is different to another companies view and both maybe different to the views of academia. But one certainty is, that the view must align to is that of Revenue, if availing of the R&D tax incentives, which is discussed in more detail in Section 4.2.

The author wishes to acknowledge that due to the nature of the responses the views of the entire individual sectors cannot be quantified, but non-the less, similar trends are emerging between the sectors and this will be discussed in later sections regarding the R&D business

incentives. In relation to the geographical distribution of the survey responses, a breakdown is presented in Table 4.1.

Table 4.1 Geographical distribution of the survey responses.

Distribution	
South-West Region (Kerry, Cork and Cork City)	5.0%
Border Region (Cavan, Donegal, Leitrim, Louth, Monaghan, Sligo)	6.6%
Mid-East Region (Kildare, Meath, Wicklow)	7.4%
Mid-West Region (Clare, North Tipperary, Limerick City & County)	8.3%
South-East Region (Carlow, Kilkenny, South Tipperary, Wexford, Waterford City & County)	9.9%
Midland Region (Laois, Longford, Offaly, Westmeath)	15.7%
West Region (Mayo, Roscommon, Galway and Galway City)	18.2%
Dublin Region (Dún Laoghaire–Rathdown, Fingal, South Dublin and Dublin City)	31.4%

To put this into perspective, the total R&D spending in the Southern and Eastern region was more than €1.8bn in 2015 which accounted for 83% of all R&D expenditure. The remainder of all R&D expenditure (17%), which accounted for €384m of the total spend, was spent in the Border, Midland and Western region (CSO, 2017).

4.1.4 Company ownership

Foreign owned enterprises accounted for 64% of all R&D expenditure, with just over €1.3bn being spent on current expenditure, which represented 93% of all their R&D expenditure. The remaining 7% or €98m was spent on capital expenditure. Irish owned enterprises in comparison spent over €800m on R&D, with current expenditure at €751m accounting for nearly 93% of this expenditure. The remaining 7% or €59m was spent on capital expenditure (CSO, 2017).

Much of response to this survey was from Irish owned firms which equated to 72% (86 out of 122 companies). Of the remaining 28% from this study, 34 were foreign owned

companies, a breakdown of 29 of those companies showed that the majority were US owned (Figure 4.8), 47% were from the Med Tech sector. The high number of US firms presented in this work is indicative to the overall Irish economy, which has over 700 US companies operating in Ireland, equating to 150,000 people directly and a further 100,000 indirectly employed.

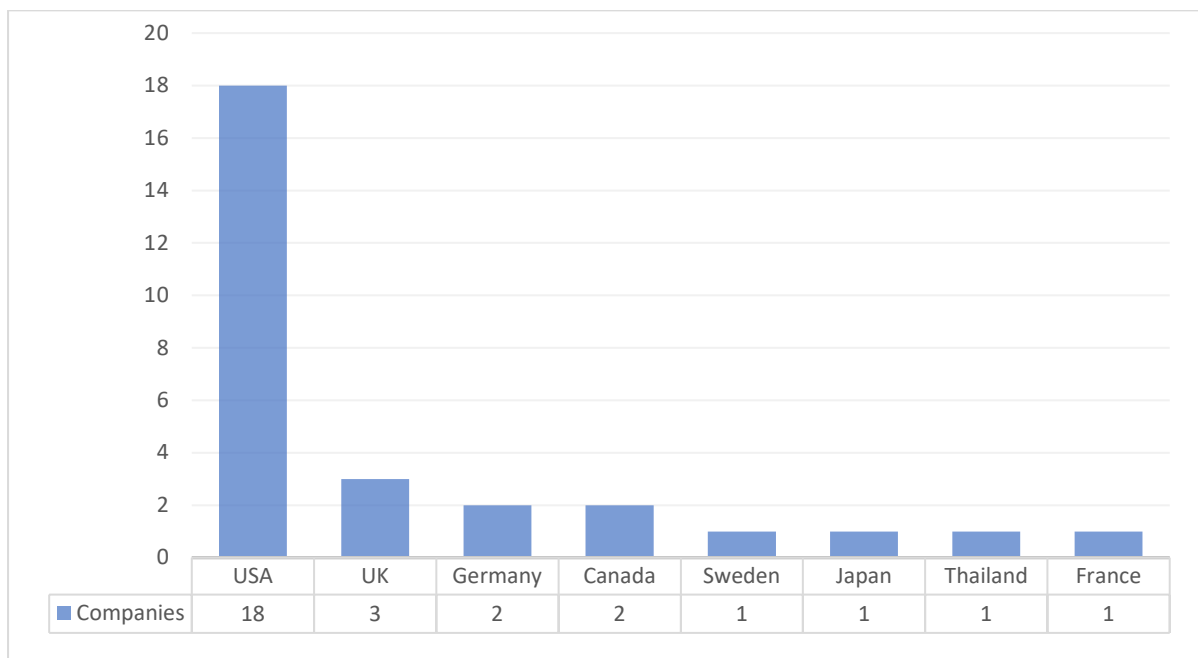


Figure 4.8 Distribution of foreign ownership from the companies surveyed.

4.1.5 Main company functions

From an Irish perspective, R&D spending was highest in the services sector which accounted for 61% of all expenditure. Spending in this sector was just under €1.4bn in 2015 while the manufacturing sector spent over €876m on R&D (CSO, 2017). When asked to categorise what the responders felt was the core function of their Irish operation (Table 4.2); of the 112 responses, some interesting information emerged. It is important to note that multiple choices were available, hence the 156 selections.

Table 4.2 Irish operations core function.

Irish Operations (112 responses- 156 selections)	
The strategic R&D centre of the global company	14.3%
The strategic R&D centre of the company	25.0%
A strategic R&D centre for a region, product or service	23.2%
Higher value support function	8.0%
Basic product or service	11.6%
Manufacturing	40.2%
Financial Services	5.4%

As evident, there is a strong focus on R&D and manufacturing. However, as previously noted there are interpretations of what R&D means to a company. But it's a great indication that R&D is vital, which lends itself to manufacturing and further innovations, thus, at a macro level this is a real indicator of an innovation lead economy. In 2015, Enterprises were asked to report on how R&D expenditure was funded. 88% of all R&D expenditure was funded by enterprises' own company/internal funds, while 6% of expenditure was funded from public funds. Small enterprises were more likely to use public funds, with 7% of funding for these enterprises attributed to public funding (CSO, 2017).

As an interesting side note, when asked if they have an R&D or innovation link on their website 71% said no and only 18% said yes, considering over 60% of the respondents say they see their company operating in a strategic R&D environment.

4.1.6 Summary

In summary, section 4.1 gives the reader an appreciation for the depth, breadth and integration of the various industrial sectors operating in Ireland by Irish or Foreign owned companies. In assessing the four thematic areas the information derived from the industry(survey) subsets will be used to break out the views of the sectors in relation to R&D funding instruments.

4.2 R&D Tax credits

4.2.1 Introduction

As previously discussed in the literature review, there is a global body of work completed in relation to R&D Tax credits which delve into the merits of the scheme as well as the variations adopted by numerous governments to integrate into their tax systems and knowledge economies. This body of work will not replicate the previous studies, but will draw on their findings.

To coincide with the global studies, the 2016 Department of Finance report on the evaluation of the R&D Tax credit, have calculated that for each euro in foregone revenue, an additional €2.40 is generated in R&D. This suggests that the policy is achieving its aim of increasing R&D, but with considerable deadweight. Fundamentally the calculations have shown that roughly 40% of the R&D observed over the period would have occurred anyway, i.e. in the absence of the tax credit, while 60% of the R&D observed was due to the tax credit i.e. additional R&D. However, they do acknowledge that until updated work is performed on R&D grants, preferably using a non- self-assessment method they cannot conclude on whether the tax credit, with 40% deadweight, is more efficient than R&D grants (Department of Finance, 2016).

In a recent IBEC survey (IBEC, 2014) which comprised of 247 firms, participation in the tax credit scheme has led to improvement of R&D process in firms. Almost two-thirds of firms saw an improvement in how they planned R&D activities, 70% improved on the recording of their activities, while 69% improved in how they retained their R&D related documentation. Also, it is seen among most firms to be a key element in their decision to invest in Ireland. In several cases it was noted that the R&D function would be under threat within the country without it. SMEs and multinationals said it was an essential part of increasing their productivity and improving offerings for customers and increasing employment (IBEC,2014). Comments on the impact of the scheme were almost wholly positive,which can be expected as the scheme, if used, can save a company money.

These improvements are important, as they may lead not only to greater returns to R&D in the future but also to an enhanced Irish R&D environment. With that in mind, the premise of this section will look at business expenditure on research and development (BERD) via published data from the CSO and government agencies and how the R&D Tax credit mechanism has grown with the increase in BERD.

Following from this, the views from the survey responders will be assessed to reflect the challenges and merits of the R&D Tax credit scheme. This scheme is a key driver for many companies and the Author has previously consulted and worked with companies in availing of the credit. This gives the author a unique perspective and understanding having worked in research in academia, accounting practice and industry.

4.2.2 BERD and the associated R&D tax credit

Assessing the findings from a 2017 published CSO study on business expenditure on research and development between 2015 – 2016, the CSO survey showed that more than €2.2bn was spent on R&D activities by enterprises in Ireland in 2015, with €2.3bn estimated for 2016. Some key findings from this 2017 CSO survey include;

- Enterprises that employ 250 persons or more had the greatest share of R&D expenditure in 2015 with just under 55% of all actual expenditure.
- Medium sized enterprises employing between 50 and 249 persons spent €503 m in the same period which represents over 23% of total spend.
- Small enterprises with less than 50 persons engaged spent almost €502m on R&D in 2015 which accounted for 22% of the spend.
- Over €1.3bn was spent on labour costs, which accounted for 61% of all R&D expenditure.
- Current costs, which include materials, supplies, equipment and overheads associated with R&D, had an associated cost of nearly €726m which accounted for 33% of total expenditure.
- The remaining expenditure of €157m was accounted for by capital expenditure with just over 53% of capital expenditure being spent on Instruments and Equipment wholly acquired for R&D purposes.
- R&D spending was highest in the services sector which accounted for 61% of all expenditure. Spending in this sector was just under €1.4bn in 2015 while the manufacturing sector spent over €876m on R&D.
- 88% of all R&D expenditure was funded by enterprises' own company/internal funds, while 6% of expenditure was funded from public funds. Small enterprises were more likely to use public funds, with 7% of funding for these enterprises attributed to public funding.
- There were nearly 1,900 enterprises engaged in R&D activities in Ireland in 2015. More than 73% of all enterprises spent less than €500,000 on R&D activities. Just over one

sixth spent between €500,000 and €2m, while only 10% of enterprises spent €2m or more on R&D activities.

- In 2015, nearly 1,300 small enterprises were engaged in R&D. They accounted for 71% of all R&D active enterprises compared with 386 medium enterprises which accounted for 21% of R&D active enterprises and 166 large enterprises which accounted for 9% of all R&D active enterprises

The above information presents a snapshot of the R&D environment from a business perspective and gives the reader an appreciation of the associated costs of R&D. However, when compared to the 2013-2014 figures (See Appendix 4 for comparison Table) there are changes across all sectors, the main one being the reduction from 2000 enterprises engaged in R&D activities in 2013, to 1900 in 2015. Other noted changes are:

- 2013-2014
 - Enterprises that employ 250 persons or more had the greatest share of R&D expenditure in 2013 with just under 50% of all actual expenditure.
- 2015-2016
 - Enterprises that employ 250 persons or more had the greatest share of R&D expenditure in 2015 with just under 55% of all actual expenditure.
- 2013-2014
 - Medium sized enterprises employing between 50 and 249 persons spent €576m in the same period which represents over 28% of total spend.
- 2015-2016
 - Medium sized enterprises employing between 50 and 249 persons spent €503 m in the same period which represents over 23% of total spend.
- 2013-2014
 - In 2013, nearly 1,500 small enterprises were engaged in R&D. They accounted for 73% of all R&D active enterprises compared with 378 medium enterprises which accounted for 19% of R&D active enterprises and 143 large enterprises which accounted for 7% of all R&D active enterprises
- 2015-2016
 - In 2015, nearly 1,300 small enterprises were engaged in R&D. They accounted for 71% of all R&D active enterprises compared with 386

medium enterprises which accounted for 21% of R&D active enterprises and 166 large enterprises which accounted for 9% of all R&D active enterprises

As with most R&D projects there is an associated risk, hence the cost, and to reduce such risk and promote innovation, government incentives such as R&D tax credits are a mechanism by which risky projects can be justified. However, in practice they are used to reduce the corporation tax burden by established companies or to generate cash flow back into smaller or start-up companies, depending on the sector they still maybe in r&d phase. Therefore, the purpose of this section of work is to evaluate the trends associated with the R&D Tax credits with the aim to gain a strategical understanding of the environment. Specific data was collated from several official sources and the information is presented in Table 4.3.

Table 4.3 Collected data with the base year set at 2004.

Year	Credit paid out by revenue €m*	No of Company claims to revenue*	BERD €m^	Companies involved in R&D
2004	70.5	75	1210	1200
2009	216	900	1869	1282
2010	224	1172	1834	-
2011	261	1409	1757	1600
2012	282	1543	1962	-
2013	421	1576	2022	2000
2014	553	1570	2107	-

Please note that for 2014, the full data is not currently available but expected to be adjusted upwards-CSO, 2016. Where there is a blank, data was not available. Sources of information obtained from Revenue 2016, an analysis of corporate Tax Receipts in 2014-2015*-2004 figures from Department of Finance 2013, DJEI ^, Forfas and CSO.

The information presented in Table 4.3 (where applicable) is graphically represented in Figure 4.9. As shown there has been an €897m increase in BERD within this period. Although not included in the graph, the BERD figures for 2015 and 2016 were €m 2233 and 2293 respectively. From this data, it can be reasonable postulated that the main driver of growth has been attributed to the introduction of the credit. Other factors included the increase in Government R&D expenditure into the third level sector, the growth of the ICT, Med tech and Pharma sectors as well as favourable grants from EU, Enterprise Ireland and Science foundation Ireland. Interestingly, 376 of the companies availing of the payable credit in 2011

were profit-making according to their accounts⁴¹. However, it is interesting to note that during the period in BERD growth in Ireland there has been a decline in patenting (2006 onwards). This will be discussed in detail in section 4.3.

Looking within the information presented in Figure 4.9, there has been an 8-fold increase in the amount of credit claimed in 2004 compared to 2014. What is also of interest, is that the size of the claims are increasing but the number of claims are stabilising, which may be due to;

- (1) More growth in R&D activities.
- (2) Companies interpretations of what can qualify especially in the Development phase.
- (3) An increase in the start-up community which are in early R or D phases of growth.
- (4) Companies no longer availing of the credit.
- (5) Companies which have resolved their technology uncertainties and can no longer qualify.

This increase from 75 million in 2004 to 553 million in 2014 has a significant impact on the tax take. This has alarmed the Department of Finance and in their 2016 report which evaluated the R&D Tax credit scheme, they noted that the value of the outstanding credits in 2014 and the effects of its associated size of this future liability to the Exchequer. However, they also acknowledge that many reviews of tax incentives from international organisations suggest that a cash refund, in the form of a repayable credit option, is good for new firms. The Departments own findings have shown that, such an approach can result in notable deadweight. They go on to say that this does not make a repayable credit a bad thing in and of itself (for example it protects R&D spending during a recession) but suggests careful design is needed to avoid a large cost to the exchequer with little additional R&D from young or other firms to show for it.

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<http://budget.gov.ie/Budgets/2014/Documents/Department%20of%20Finance%20Review%20of%20R&D%20Tax%20Credit%202013.pdf>

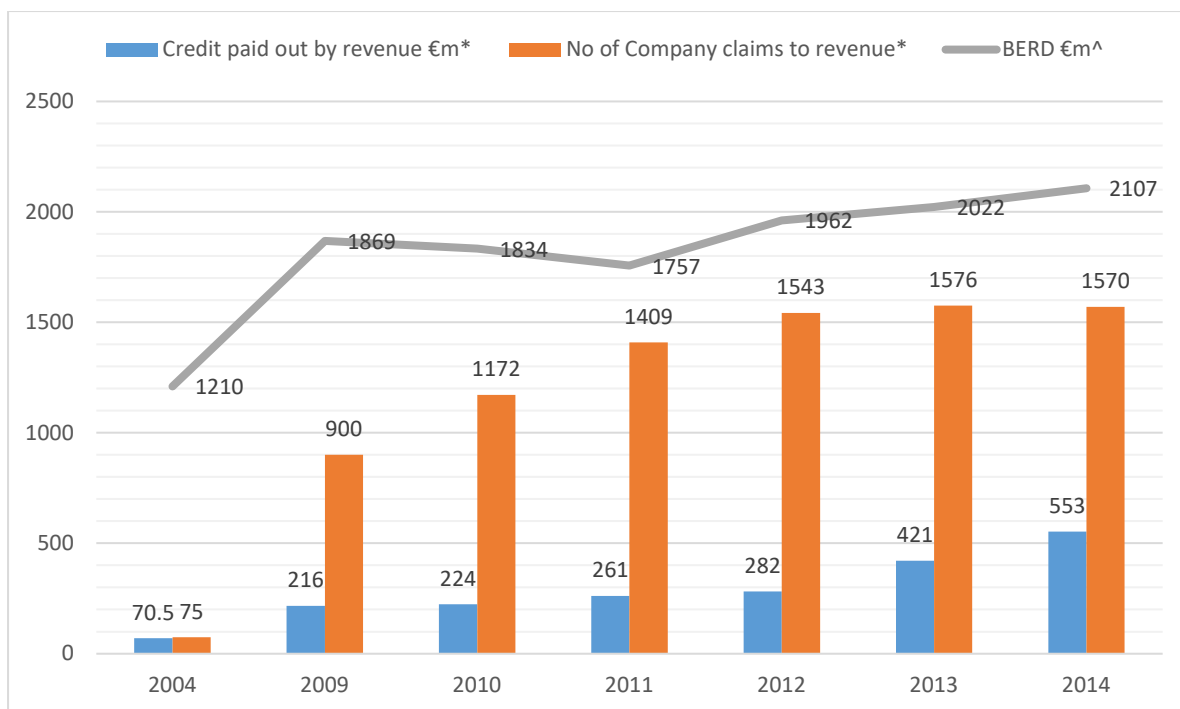


Figure 4.9 An overview of the main indicators associated with the R&D Tax credit.

Being mindful of the above and briefly overlooking all the positive effects of the R&D tax credit as discussed in the literature review, fundamentally, the interpretation of what R&D is and what can qualify varies between sectors; thus, in the principle of the law, companies must work within the set guidelines of Revenue. As of 2016, companies must agree to allow the qualifying R&D to be examined by an independent academic assessor appointed by the Revenue Commissioners.

4.2.3 An assessment of R&D tax credit when compared to BERD

As presented in Figure 4.10, the R&D tax credit is presented as a percentage of the BERD. From the analysis, the initial credit in 2004 represented 6% of the BERD rising to 26% in 2014. In 2013, the first audits on claims were carried out (in its 10th year) and problems occurred with 26 out of 32 firms examined, resulting in €6m being returned to the Exchequer⁴². If the 32 firms were chosen at random, then this must have been a worrying sign for Revenue.

⁴² http://www.finfacts.ie/irishfinancenews/article_1028656.shtml

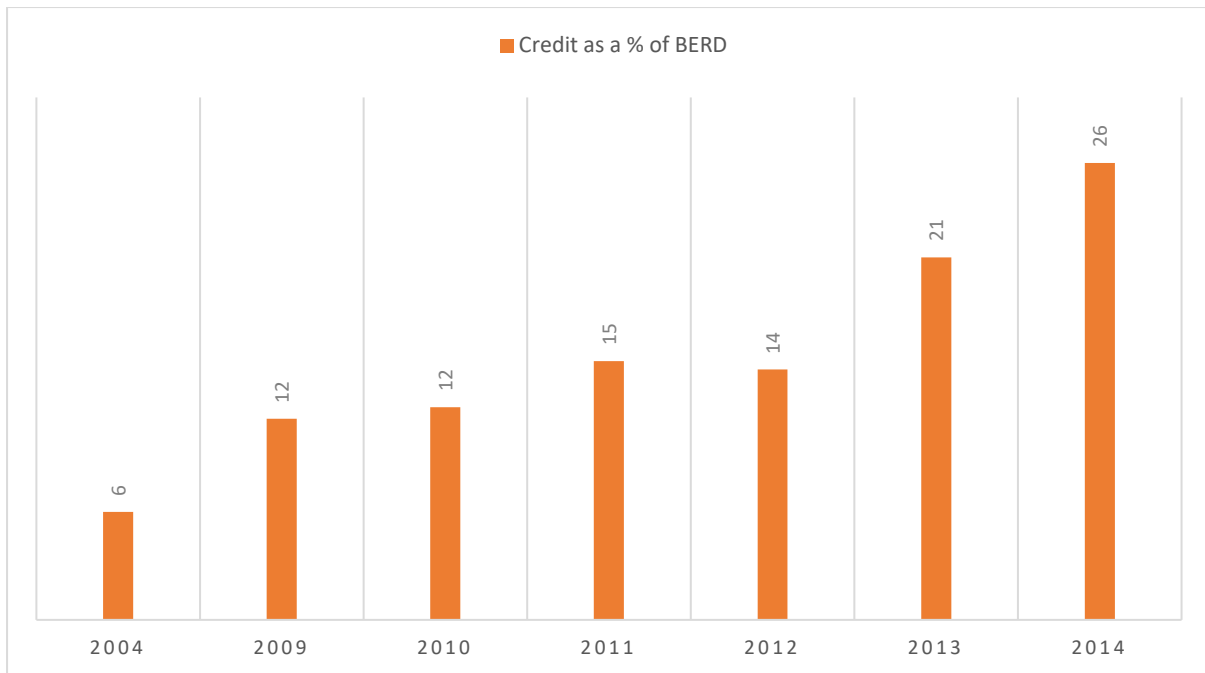


Figure 4.10 A graphical representation of the R&D Tax credit as a percentage of BERD in each year.

The trends also suggest that the level of claims by R&D active companies has started to plateau in 2012 (previously shown in Figure 4.9), whereby the number of companies claiming the credits has reached on average 1500. Considering this trend and from the information presented in Figure 4.11, a 30% increase was observed in claims between 2009 and 2010. As the claims increased in the subsequent years, the % difference each year diminished. In 2014 this value was negative (-0.4), however, as previously outlined the information relation to the claims for 2014 has not been updated by the CSO and it is expected that this value will be slightly positive, but not to the levels previously see in 2009-2010.

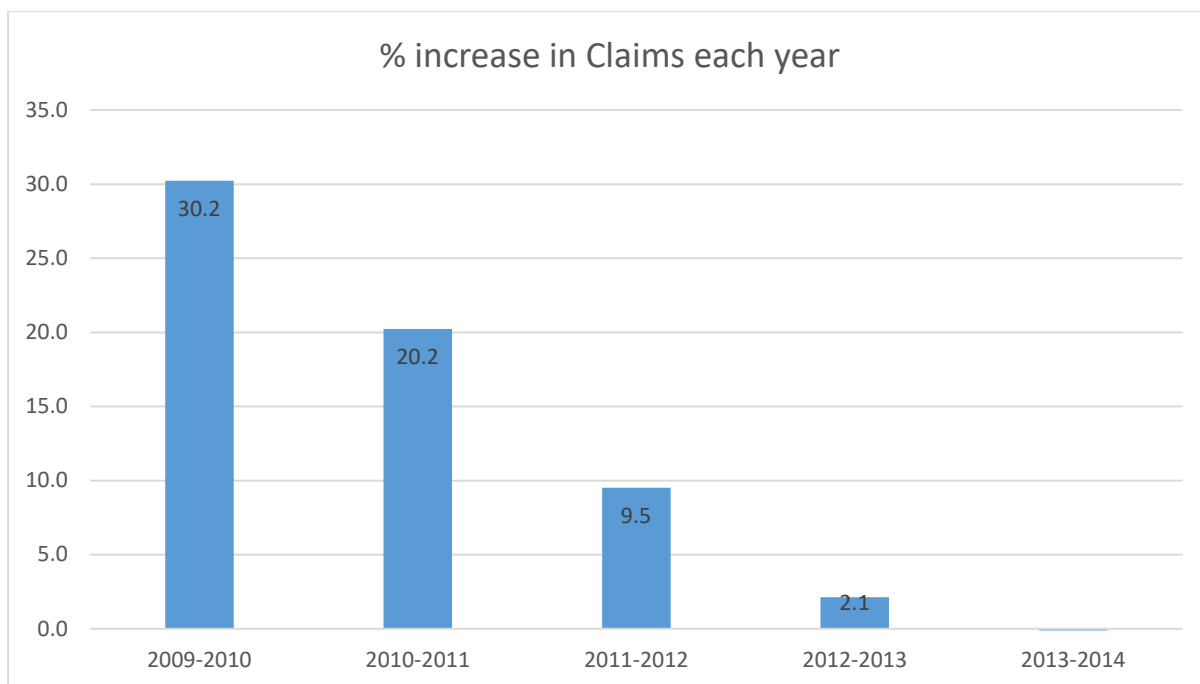


Figure 4.11 A percentage increase in claims between each subsequent year. The information in 2014 is negative (-0.4).

From the literature, IBEC have found from their survey that 16% of firms used the credit for only one year. Some 45% used it between 1 and 3 years, 25% used it between 4 and 6 years while 27% used it for 7 to 9 years (IBEC, 2014). In contrast, a report by the Department of Finance on tax expenditure in 2016⁴³, found that after monitoring first time R&D Tax credit claimant firms between 2009 and 2014 almost one third of these firms conduct R&D in every year after 2009 and over half conduct R&D in 4 or more years. However, 18% of the cohort only claimed in 2009; this is due to a combination of firm death and possible “gaming” of the repayable tax credit system, meaning taking advantage of the repayable credit during the economic downturn but not becoming a genuine or long-term R&D conducting firm.

This maybe the reason why the amount of companies claiming the credit has stabilised in the past 3 years, which can mean;

1. All the companies that can avail of the credit has done so.
2. There is a natural balance achieved whereby the amount of companies no longer availing of the credit (for reasons discussed later) is replaced by new companies claiming the credit.
3. Elements of both.

⁴³ http://www.budget.gov.ie/Budgets/2017/Documents/Tax_Expenditures_Report%202016_final.pdf

As presented in Figure 4.12, on average, 80% of the R&D active companies are claiming the credit, up from an initial 6% in 2004. This is interesting as it fits into the Pareto principle and means that there are at least 20% of R&D active companies either not claiming or not aware of the credit (discussed later). Based on a survey completed by IBEC in 2013 with 247 firms, they found that in 2004 the first year of the credit only 17% of companies used it. This figure had expanded to 44% by 2008 and risen to 79% by 2011. The trends found by IBEC are somewhat comparable with the analysis of the CSO data.

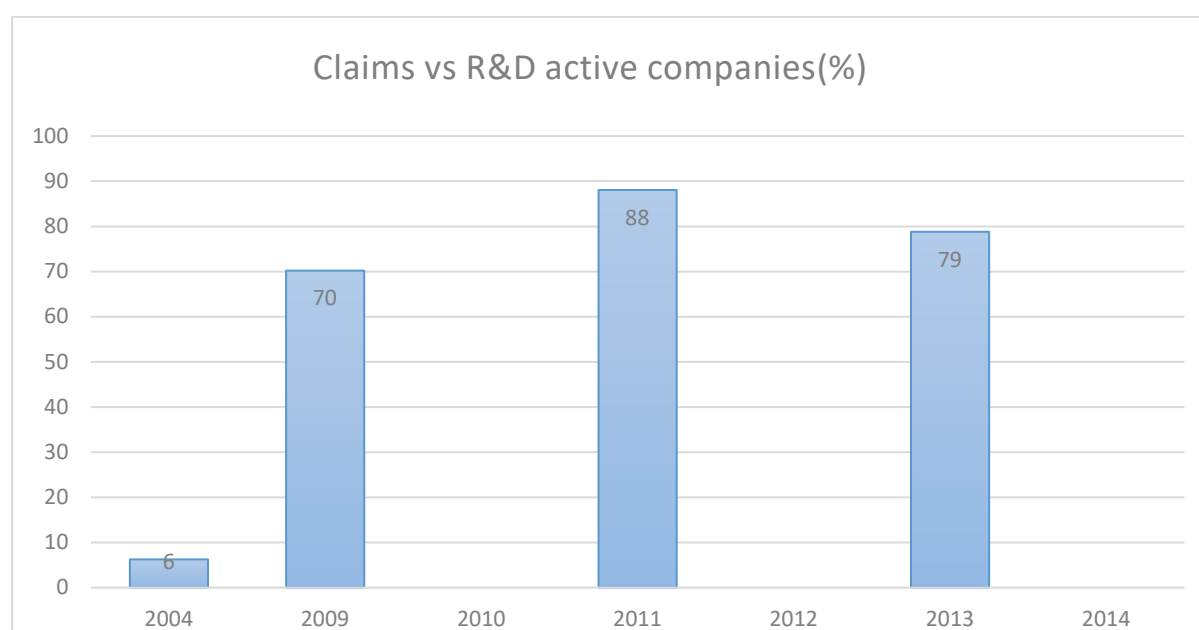


Figure 4.12 A graphical representation of the R&D Tax claims as a percentage of the R&D active companies in each year.

4.2.4 An assessment of the merits of the R&D Tax credit scheme

Ireland's tax incentives for R&D activity have improved considerably over the past decade but the offerings of our main competitors have also been enhanced (IBEC, 2014). In conjunction with the IBEC survey completed in 2013 by 247 firms and the information gathered by this survey (122 respondents/firms), a comprehensive understanding of companies views regarding the tax credit scheme has emerged from the data.

When asked if there was an awareness of the R&D Tax credit within their organisation, 95% of this survey response was Yes (Figure 4.13). This is an interesting finding, considering IBEC in 2013 found that almost one in three firms cited poor awareness of the credit as a reason for not using the credit (IBEC, 2014). Making an educated guess, it would suggest that there has been a growth in the awareness of the scheme which is an important indicator of the R&D

incentives available to the business community. However, if awareness is one of the factors in not using the credit, this may contribute to the plateau which has emerged from findings as previously presented in Figure 4.9.

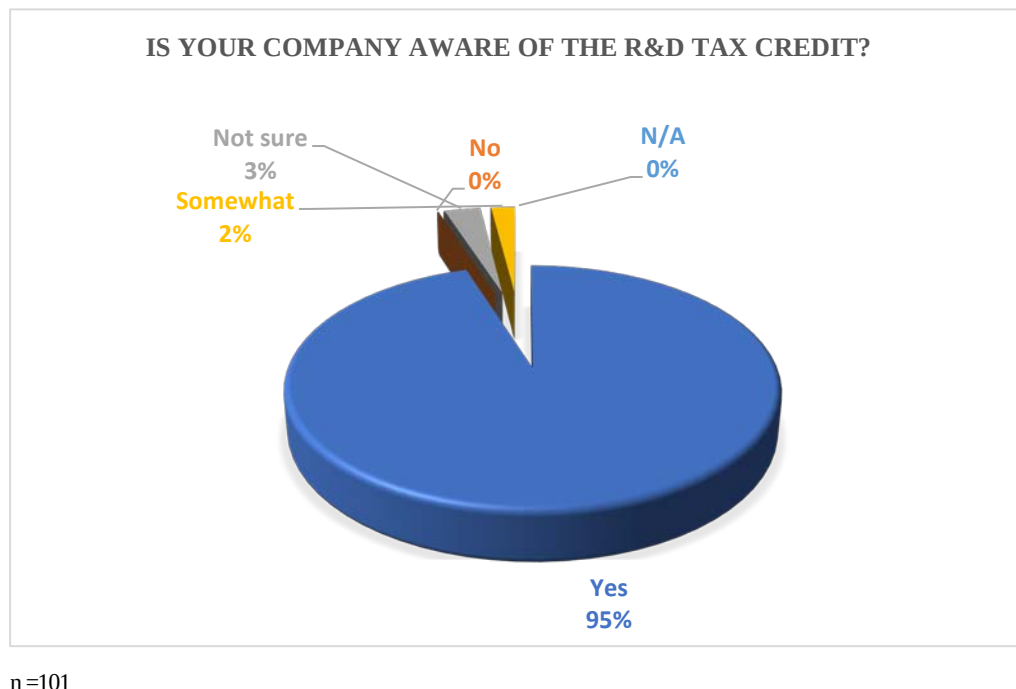


Figure 4.13 Awareness of the R&D Tax credit.

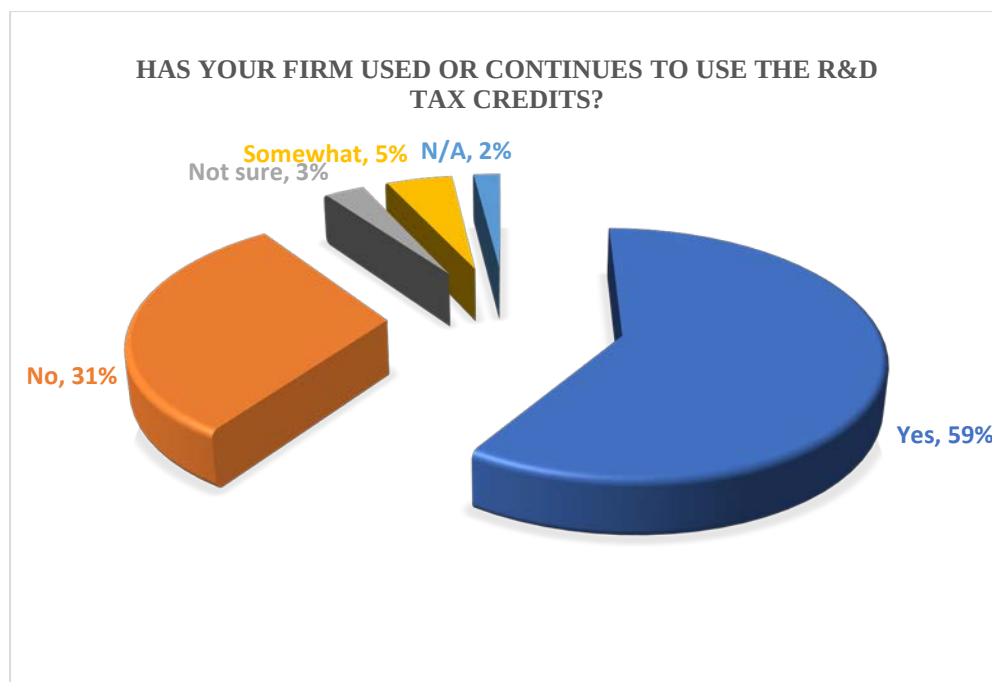
Expanding on this 95% response in relation to awareness, when asked if they felt if the R&D Tax credit was adequately promoted, 47% said yes and 32% said no. Even though such a high percentage are aware of the credit, one third said there is a lack of promotion. This may, in part, be due to internal company policies or lack of targeted marketing. However, from the Author's own personal perspective, the R&D Tax credits have been promoted by various government agencies as well can represented business groups. A breakdown of the company size response in presented in Table 4.4. It is of interest to note there is a relatively even split between the Yes and No views for the smaller sized companies and as the company size increases, the % value for Yes also increases [please note that the sample sizes are lower than that of the smaller companies].

Table 4.4 R&D Tax credit promotion

Do you think the R&D Tax credit has adequately been promoted?		
	Yes (%)	No (%)
Start-up [n=29]	34	31
Small enterprise (<50 employees) [n=34]	38	41
SME Foreign Owned (50 - 250 employees) [n=3]	33	33
SME Irish Owned (50 - 250 employees) [n=10]	50	30
Multinational Foreign Owned[n=19]	68	21
Multinational Irish Owned[n=4]	75	0

n = sample size

let's consider the breakdown of responses from Figure 4.14, when asked if the firm has used or continues to use the R&D Tax credits; one third (31%) has not used the credit (breakdown of company size is shown in Table 4.5). For the 59% of companies which said Yes, a large majority were from the SEM and Multinational sector. With a balanced mix of Yes and No from the start-up and small enterprise companies. However, the IBEC survey cites poor awareness as a reason but this is not the influencing factor regarding this survey. One probable solution is the increased awareness of the credit in recent years as well as the growth in the start-up sector. However, when asked if the R&D Tax scheme has been adequately promoted, only 47% said yes even though 95% of responders are aware of it. This is concerning factor and it introduces doubt into the process and reasons why companies are not availing of the credit will be discussed in section 4.2.4.



n=101

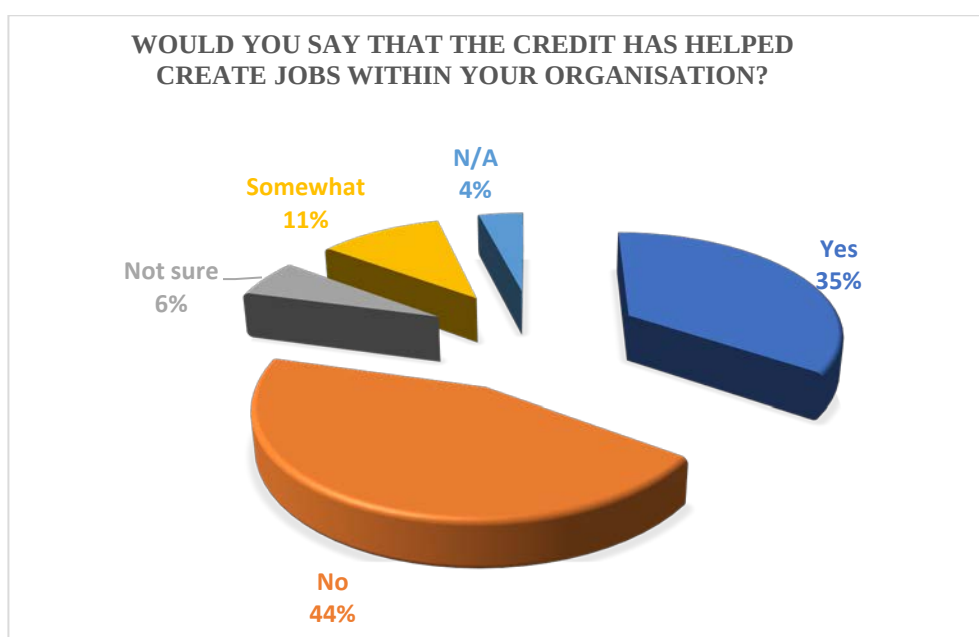
Figure 4.14 Usage and non-usage of the R&D Tax credit.

Table 4.5 Claiming the credit

Does your company claim the credit		
	Yes (%)	No (%)
Start-up [n=29]	7	76
Small enterprise (<50 employees) [n=34]	13	66
SME Foreign Owned (50 - 250 employees) [n=3]	33	0
SME Irish Owned (50 - 250 employees) [n=10]	10	80
Multinational Foreign Owned[n=19]	0	72
Multinational Irish Owned[n=4]	0	50

n = sample size

Considering the area of job creation, 35% of the of the people surveyed said that the R&D Tax credit has helped create jobs, with 11% saying somewhat equally 44% said it did not create jobs in the organisation (Figure 4.15). A breakdown of this finding in relation to company size is presented in Table 4.6. Looking at manufacturing based companies which responded to the survey [n=37], 41% of the responders said the credit has helped in the creation of jobs, were 35% have said No. And for R&D based companies [n= 60], 32% said Yes and 47% said No, which is almost an opposite view. What can be taken from the analysis is that there is a clear indication that companies acknowledge that the credit is a factor in job creation.



n =101

Figure 4.15 Job creation resulting from the R&D Tax credit.

Table 4.6 Job creation because of the credit within the organisation

Has the credit helped created jobs within the organisation?		
	Yes (%)	No (%)
Start-up [n=29]	17	69
Small enterprise (<50 employees) [n=34]	35	47
SME Foreign Owned (50 - 250 employees) [n=3]	0	67
SME Irish Owned (50 - 250 employees) [n=10]	50	10
Multinational Foreign Owned[n=19]	42	37
Multinational Irish Owned[n=4]	75	0

n = sample size

These are important indicators for the success of the scheme as job creation from new innovations is key driver in a Knowledge economy. Similar findings were also found by IBEC where they found that the R&D tax credit is important to employment growth in Ireland as 62% of firms say the credit is important to their firm creating new jobs, while a further 67% said it was important to the retention of jobs in the country, see Table 4.7 for the full breakdown.

Table 4.7 A snapshot of R&D related jobs (IBEC, 2014).

	2003	2007	2011
Total R&D jobs	355	1,129	2,990
Total R&D tax credit related jobs	279	894	2,523
Total number of employees allocating all/some of their time to R&D	375	1,270	3,016
Total number of employees	13,558	24,560	33,898
Average employment growth since previous year	8.5%	17.4%	10.7%

Table 4.4 shows that dedicated R&D employment in the firms increased during the period from 355 to 2,990, while total employees using some part of their time for R&D rose to 3,016. The difference between the two readings is likely because many companies perform R&D in cross-functional teams rather than having specific R&D positions, so there are usually more people in R&D-related jobs than dedicated R&D jobs. Total employment in the firms increased from 13,558 in 2003 to 33,898 in 2011.

4.2.5 Reasons for companies not claim the credit

It may be counterproductive to think why a company would not claim the R&D Tax credit (25% rebate back on qualifying expenditure) but there are genuine practicalities why this may be the case. The guidelines set out by revenue are very specific in their terminology but leaves certain interpretations to what can be deemed as qualifying. This puts the onus on the company to prove in an audit that qualifying activities took place; and the company must maintain these records for 4 years. Some reasons are presented from the IBEC survey below; where 25% of companies surveyed, which had not availed of the credit, provided explanations for this. The SMEs in the sample were less likely to use the credit, with 41% reporting that they had not done so (IBEC 2014):

- The major deterrent for R&D active companies to using the credit is its administrative burden. About 37% of companies cited this as a barrier to the credit.
- Almost one in three firms cited poor awareness of the credit as a reason for not using it.
- A further 26% of firms report that their lack of supporting documentation was a barrier to take-up.

Expanding on the above, the information collated from this work is presented in Table 4.8 and this gives more of an insight into the motives behind companies not claiming the credit. For clarity, the main reason given by companies from this survey was administration, which very much links to the IBEC survey as well as the Author's own personal experiences.

Table 4.8 Reasons why companies don't avail of the R&D Tax credit.

Administration-majority of responders gave this reason.
We claim R&D tax credit only for some projects. In reality, we should be able to claim it for more as the activity we are doing constitutes R&D in the typical meaning but not necessarily in the legislative definition currently or alternatively the burden of demonstration on this relative to the cost involved in doing so is great. The system needs to be simpler. We have a good R&D capability however the scheme is not really where it needs to be to be a real incentive. Currently it does not excite engineers etc.
Rule changes and complexity are very onerous on small start-ups.
We don't innovate because there's a tax credit - we do it because we must.
We need to refocus on claiming R&D tax credits. We appointed an Innovation Manager approximately 18 months ago but he was slow in formulating policy concerning R&D tax credits and subsequently left the company a few months ago.
Most companies are aware of the R&D credits.....although a fully compliant tax return is sometimes not that readily available.
You have to pay an accountant to claim it. Not user friendly for an SME. It triggered a revenue audit as the revenue don't like it.
R&D Tax Credits provide a cash bonus to the business in general and is accounted for outside of the R&D budget. All our R&D investments must make financial sense on their own, and the R&D tax credit is never a factor in decision making around project selection or the quantum of R&D undertaken. Therefore, the R&D tax credit provides a bonus to companies engaged in innovation but doesn't provide an incentive to increase the amount of R&D undertaken.
Some MNCs have done collaborative projects with us and have taken advantage of the R&D tax credit. It was likely to have been a consideration when the company decided to carry out the research in Ireland.
R&D tax credits are only useful for very large organisations that has the labour & financial resources to work on break through innovation. It is not suited to SME companies that largely have to work on incremental innovation & do not have designated team members on individual projects.
R&D Tax Credit has been critical to R&D in Ireland and to the manufacturing jobs that have resulted from that R&D.
Lack of clarity on eligibility, especially in the software development arena.
Cumbersome and slow process.
Revenue appear to be taking a different stance on R&D, don't provide good guidelines and then challenge claims fairly aggressively.
The continual re-appraisal of the rules and guidelines by Revenue-what is accepted today may not be accepted tomorrow.
There are no significant barriers except the definition of the type and quality of innovation which is to be used e.g. Incremental vs. Disruptive innovation etc.
Some people may consider the strict timesheet approach to tracking work undertaken in R&D to be too cumbersome.....especially if the gain is only marginal.
The "claw back" - if you inadvertently claim for something you were not entitled to, you have to pay it back promptly plus interest.
The level of work involved to prove the work is in depth research.

The cost of processing the claim by accountants.
Writing final reports and aligning with other projects.
Technical definition of what an innovation is far too high and is based upon laboratory study only & the administration for the scheme is too much.
Better clarity on what exactly is eligible. Accountancy firms try and complicate and cloud this in order to generate fees.
Start-ups struggle to get all the processes and software in place to track time spent in order to claim the tax back.
Audits.

Some interesting comments emerged from this study and it highlights the difficulties associated with the R&D Tax credit scheme. There is confusion regarding the process and companies rely for the most part on profession services such as accounting firms to assess and prepare the qualifying activities and financials. This has also created challenges and results in a lack of certainty in relation to the credit. For companies relying on the credit, especially start-ups, this can slow innovation due to financial reasons. Of interest, one responder made a very valid and important comment “*We don't innovate because there's a tax credit - we do it because we must*”. This opens an interesting debate, in that, if the credit did not exist would there still be innovation? A key motive of a company is to survive and grow, thus, would having no credit available make the company more efficient and less risk adverse? Or if a company can avail of the credit, the risky projects which may not have been considered for financial reasons maybe sanctioned on the bases that there are uncertainties associated with the work. This mindset to innovate very much feeds into the previous findings by the Department of Finance that roughly 40% of the R&D observed over the period would have occurred anyway, i.e. in the absence of the tax credit.

In acknowledgment to the barriers which are present, the Department of Finance (2016) in their R&D Tax credit evaluation have said “we did not find evidence that the tax credit scheme is effective in encouraging R&D in younger firms, which suggests other barriers to conducting R&D for this type of firm should be examined in greater detail, and public policy tailored appropriately. On the other hand, the scheme appears to be effective for older firms, so a possible policy response is simply to adopt a “wait and see” approach. If market forces allow a firm to grow to a sufficient stage of development, then the tax credit (as it stands) can assist that firm to perform additional R&D. It may give rise to further inefficiencies to try to target inexperienced firms via a tax credit policy that specifically differentiates firms with respect to age”.

Considering the above barriers in claiming the credit, 73% [n = 101] would recommend the Tax credit to a colleague. This figure is much higher when answered by foreign owned companies [92% n= 26], compared to 66% [n = 73] of Irish owned companies. A breakdown of the response based on company size is presented in Table 4.9.

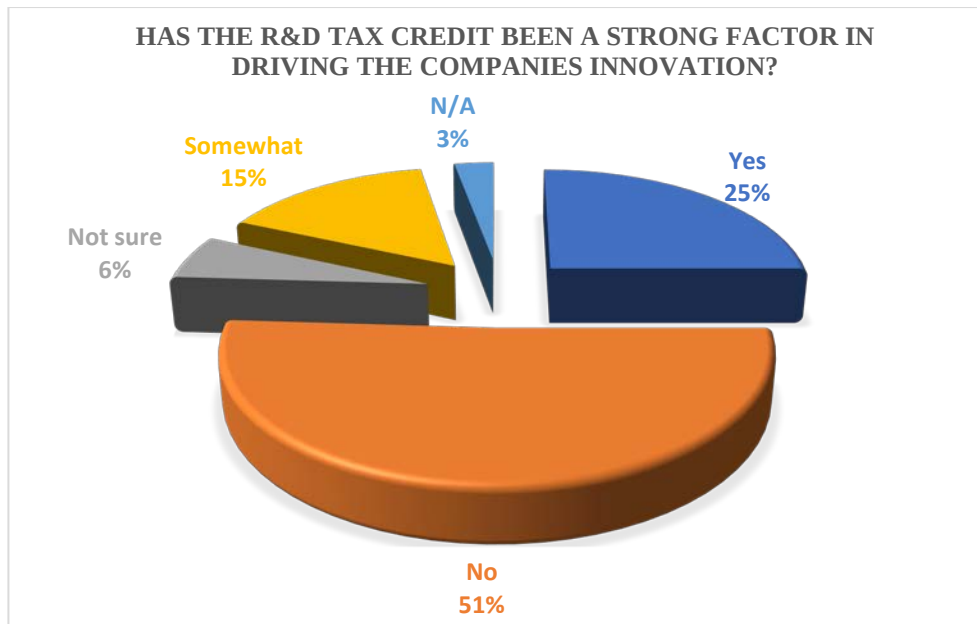
Table 4.9 R&D Tax credit recommendation per company size.

Recommend to a colleague		
	Yes (%)	No (%)
Start-up [n=29]	69	3
Small enterprise (<50 employees) [n=34]	59	12
SME Foreign Owned (50 - 250 employees) [n=3]	33	0
SME Irish Owned (50 - 250 employees) [n=10]	80	10
Multinational Foreign Owned[n=19]	95	0
Multinational Irish Owned[n=4]	50	0

n = sample size

4.2.6 R&D Tax credits as an innovation driver

To promote innovation, the credit is important to future investment in Ireland, particularly in terms of FDI. Almost 70% of firms from the IBEC study state that the credit is important in their decision to invest in R&D, while 65% said it is important to overall investment in Ireland. However, in contrary to the IBEC study, when asked if the R&D Tax credit has been a strong factor in driving the company's innovation, 51% said no with 25% saying it is an important factor (Figure 4.16).



n =101

Figure 4.16 R&D Tax credit as an innovation driver.

To gain more of an insight into a company's motives behind their use of the R&D Tax credits, a question was proposed if the R&D Tax credit has been a driver in the company's innovation, some interesting results emerged. The following are the responses;

For R&D and R&D based companies

- 20% said yes, while 58% said no (n=60)

For Manufacturing, based companies

- 38% said yes, while 36% said no (n=37)

As presented above, for R&D based companies 58% have said that the credit is not an innovation driver, while this is much more balanced for manufacturing based companies which tend to be more established. When the question was subdivided into company sizes the above responses would seem valid, see Table 4.10.

Table 4.10 R&D Tax credit as a driver of innovation.

R&D Tax credit as a driver of innovation		
	Yes (%)	No (%)
Start-up [n=29]	3	86
Small enterprise (<50 employees) [n=34]	24	53
SME Foreign Owned (50 - 250 employees) [n=3]	0	33
SME Irish Owned (50 - 250 employees) [n=10]	50	30
Multinational Foreign Owned[n=19]	42	32
Multinational Irish Owned[n=4]	50	0

n = sample size

4.2.7 Industry recommendation to improve the R&D Tax credit process

IBEC has found that most of companies are pleased with the administration of the scheme, however, a significant percentage of companies have experienced difficulties. With the increase in companies availing of the credit, revenue have become more active and most companies now receive (1) a revenue questionnaire to clarify some point regarding what they are claiming to justify the credit, (2) they may have to undergo a desk audit regarding their financials and (3) a full physical audit with a technical expert in their premises. This activity can be a deterrent to companies who wish to avail of the credit. IBEC have collected some of their findings as shown below:

- ❖ A number of start-up firms were unsure of the potential barriers they may face and experience capacity issues in undertaking R&D.
- ❖ Some firms which did participate in R&D activities felt their R&D activities fell outside the scope of the existing credit. This was particularly true of firms in the IT sector.
- ❖ A number of firms did not participate in R&D activities.
- ❖ A number of firms were investigating the implications of the credit for them and had yet to make a decision on its applicability.

As a key part of this work, the voice of industry was a requirement in addressing the Tax incentives available to them. There is a lot of promotion in relation to the R&D Tax credit but as previously outlined, there is a lot of work needed to avail of the credit and the uncertainty which surrounds each claim is a key risk. As revealed in Table 4.11, there are very strong

recommendations to revenue/government regarding the process and considering the burden of administration and professional costs the opportunity cost not to avail of the credit will affect the company's ability to utilise the KDB.

Table 4.11 Industry recommendation to improve the R&D Tax credit process.

Quick turnaround on decision from revenue.
Credits are paid back over a shorter period of time.
Make compliance easier for all companies. We are by definition a large company (currently 350 employees), however by comparison to other players globally we are small. We need to be mindful of competitiveness so the cost of compliance should be reduced.
Simple structure.
Get pre-approval from Revenue on suitability of R&D activities for receiving the tax credit.
Simplify application process, and speed up approval and payments.
Reduce records and admin.
More transparency, set guidelines and parameters to operate within and audit accordingly.
Simplification of requirements.
Streamline the process. Maybe an online portal to bring together all the required information for the application.
Need to get cost outlays rebated to cash starved start-up much faster - State putting in funds through EI then withholding funds through revenue.
Approach differently between SME and MNC.
Simplify the documentation.
Simpler application & submission of reports.
Provide a framework for recording employee eligible work time.
All time spent on new products should qualify for R&D.
Clearly specify cost categories that are claimable.
Would like to see it more streamlined and simplified, particularly for an Irish SME.
Revenue need to be more supportive. They are too difficult to deal with.
1. Extend the claim period.
2. Further promotion (e.g. through IRDG events as an example).
A template for calculation would be a huge help and should be 'auditable' by the Revenue if they wish to query any amounts included as 'qualifying expenditure'.
Very clear guidelines of what can and cannot be included (with specific examples).
Make it simpler. Revenue have a very narrow view as to what constitutes R&D.
A little more flexible.
Simplify claim approach and lessen burden on companies.
Broaden the scope of qualifying work.
Increase the rate and make it easier on the internal administration.
Better detail around what is considered as research and development. The majority of multinationals in Ireland are doing Redesign and Development and should not be considered for R&D Tax credits. This is the reason multinationals provide large reports to try and justify that the work is R&D.
Make it easier to understand.

An online application claim, direct to revenue - self assessment like ROS process.
Simplify process.
R&D tax credits are being given on activity that companies are going to engage in anyway. Change the incentive to reduce companies direct R&D costs at source - e.g. reduced salary costs to companies (e.g. PRSI, PAYE rebates) - that way the tax credit is seen directly within R&D budgets and not applied outside of it to overall business costs. When tax credit benefit is seen directly within R&D budgets then overall R&D activity is more likely to increase.
All essential elements of R&D activities to be claimable. Currently many R&D support activities are deemed ineligible. This creates grey areas and high admin and risk.
Streamline admin & get rid of timesheets. the proof required for an innovation should be based on Laboratory based study & incremental innovation
Clearer Revenue guidance.
Simplify and reduce the workload, especially for small companies.
Give very clear guidelines and outline examples case studies etc.
Time to process the credit should be accelerated for start-ups as the cash flow is critical for small companies.

From reading through the above comments, it is clear that a streamlined approach is needed and direct guidelines are required by revenue as well as more openness.

4.2.8 Summary

In summary, it is important to note, that after 13 years in existence there is still confusion regarding the Tax credits and this will have a major influence on the KDB. The R&D tax credit is available in relation to unsuccessful R&D whereas the KDB requires that the R&D activities have resulted in a qualifying asset which has been commercially exploited. In principle, the technical criteria for inclusion of expenditure under the R&D tax credit and the KDB are essentially linked as R&D must be undertaken to generate the qualifying asset. So, regardless if a company has or has not claimed the R&D tax credit for the activities resulting in the qualifying asset, they must provide evidence that these technical or scientific qualifying activities were undertaken. Some key findings from this section are:

- 95% of the responders are aware of the R&D Tax credit.
- 73% would recommend the R&D Tax credit to a colleague.
- 47% said the R&D Tax credit was adequately promoted and 32% said No.
- 35% of the of the people surveyed said that the R&D Tax credit has helped create jobs, with 11% saying somewhat equally 44% said it did not create jobs in the organisation.
- Administration was the main reason given by companies for not claiming the R&D Tax credit.

- 51% has said that R&D Tax credit has not been a strong factor in driving the company's innovation, with 25% saying it is an important factor.

The following section will investigate the interaction of the KDB with intellectual property as the mechanism to qualify as a qualifying asset.

4.3 Intellectual property

4.3.1 Introduction

According to the Evers (2014), Tax legislators increasingly struggle to tax income from intangible assets in a way that prevents IP income from being shifted abroad and the introduction of dedicated Tax policies to promote innovation is now widely perceived as the key driver for economic growth and productivity. Investing in innovation has meant that intellectual property rights (IPRs) have begun to take on a more significant role in Ireland's economy. There is some evidence of an increased awareness amongst Irish business that an ability to develop innovative ideas and to commercialise those ideas can contribute significantly to economic success. It is increasingly the case that many of Ireland's export led growth industries are those that are IP-rich and IP-intensive, such as new ICT related technologies, high-end design and media content (Patent Office, 2017).

As an intermediated before the crux of the KDB is assessed, it is important to get an understanding of the views of both industry and government in relation to IP and IP protection. The reason being, a company may qualify for KDB if it creates a usable qualifying asset from qualifying R&D activities that then proceeds to be commercialised to generate income. A qualifying asset is one that is created from R &D activities such as:

- an invention protected by a qualifying patent.
- a computer programme.
- IP for small companies which is certified by the Controller of Patents as patentable, but not patented, i.e. KDB Certificate of Invention.
- Certain other IP such as supplementary protection certificates (SPCs) and plant breeder's rights may also be qualifying assets. However, any marketing related IP such as trademarks, brands, image rights and other intellectual property used to market goods or services cannot be a qualifying asset. Short term patents are not qualifying assets⁴⁴.

⁴⁴ <https://www.patentsoffice.ie/en/About-Us/IP-for-Business/Knowledge-Development-Box/>

According to the guidelines issued by Revenue⁴⁵, patent systems can generally be split into registration systems (e.g. the Irish system) and systems which only grant patents following substantive examination for novelty and inventive step (e.g. the EPO system) i.e. a full search report. The location of the ownership of the IP is not a factor which impacts on the availability or otherwise of relief under the KDB. It is recognised that group companies may wish all legal ownership of IP to be centralised for IP protection purposes. Revenue expects that many claims under the KDB, in the long term, are expected to be in relation to income arising from inventions protected by patents granted following substantive examination for novelty and inventive step⁴⁶. However, how valid is this statement?

4.3.2 Methods of protection used by Industry

As previously outlined, a component of the KDB will be the requirement that a company needs to show income derived from a qualifying asset. When asked how IP is protected within their organisation, some interesting results emerged. From the 97 responders, 47% say they patent their technology, 52% keeps it as a trade secret and 1% copyrights. Some comments are presented in Table 4.12.

Table 4.12 Technology protection within their organisation.

Have patents as well.
Combination of patents / trade secrets.
Patent & Trade Secrets.
All of the above including trademarks.
Use both patents and Trade Secrets - product are patent protected, manufacturing processes are kept as trade secret.
Know how.
N/A - we generate patents and IP for clients.
Patent if practical, but treat as secret know how at all times.
A patent application is in process for an aspect of the product we are developing.
We do both Patent and Trade secret depending on technology.
Also patents in the past, Community Registered Design and registered trademarks.
We also use patent and copyright, but keeping the technology within the company is the most used method.

⁴⁵ <http://www.revenue.ie/en/tax-professionals/tdm/income-tax-capital-gains-tax-corporation-tax/part-29/29-03-01.pdf>

⁴⁶ <http://www.revenue.ie/en/tax-professionals/tdm/income-tax-capital-gains-tax-corporation-tax/part-29/29-03-01.pdf>

Both IP and trade secret.
Specific to project undertaken.
Copyright.
Trade secrets, branding.
Case and situation specific - 'blended'.
All three as appropriate.

From the above responses, it is difficult to ascertain if there has been an increase or decrease in the amount of companies patenting their technologies and how this will influence the KDB. But it is evident that companies are using more than one method of protection. There are reasons why a company would not patent and this is discussed later in the section. However, from the literature it would suggest that a decrease in patent applications is the most likely. Linking the data back to the literature, [section 2.9.1], Squicciarini & Denis (2013) found that in 2009, 1.6 % of all firms applied for patents in Ireland. Further investigation has shown that, approximately 0.2% of firms in Ireland account for 77% of applications between 1999-2013 (CSO, cited in DJEI (2015)). Please note that a small number of firms are responsible for many patent applications.

Putting this into perspective, the Patent Office has collated the national IP filing from 2008 to 2016 as presented in Figure 4.17. From the information presented, the number of national patent and trade mark filings has shown a modest increase from 2014 to 2015, whereas, national patent filings in 2016 fell back to 2014 levels. Only trade mark and design filings continued to increase at a very modest rate. It is very important to comment, that figures for national filings do not necessarily reflect the extent to which Irish based firms and inventors are engaged in innovative activity (Patent Office, 2017), for reasons to be discussed below.

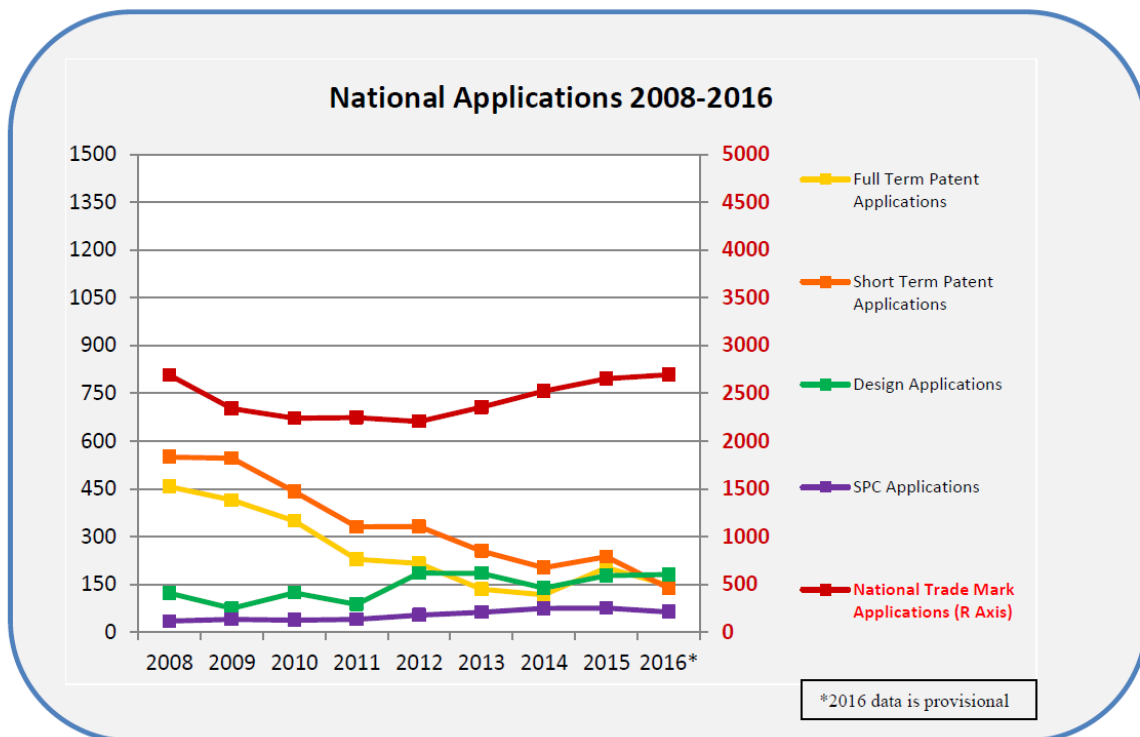


Figure 4.17 National Applications 2008-2016 (Patent Office, 2017).

The data shows a move away from patent filing in the Irish Patent Office, with the US and EU becoming the most- and second-most-dominant locations over the period respectively (DJEI, 2015). This reduction in the number of patents is a concern for the economy, before investigating the remainder of the findings from the survey, it's important to introduce a key report by the Department of Jobs Enterprise and Innovation (DJEI) entitled "Enhancing the intellectual property activities in the firm base in Ireland". Given the growing importance of IP in knowledge based economies, the DJEI felt that it was timely for Ireland to review the IP activities in the firm base in Ireland. The overall goal was to develop an understanding of the IP activity in Ireland and what role the State has in best supporting IP activity in the firm base into the future (DJEI, 2015).

Key finding from this important study are (DJEI, 2015):

- Ireland performs no better than 4th out of the six comparator nations across all forms of formal and registered IP, even when data is normalised for population size and GDP. Patenting is noticeably low compared to the innovation leaders, and more recently compared to Singapore, which has now overtaken Ireland in filing volume.
- Ireland demonstrates a decline in patent filing, driven largely by decreasing firm-level filing, which displays a year-on-year decline since it reached a peak in 2006. Meanwhile, the proportion of total patents that are assigned to the Higher Education

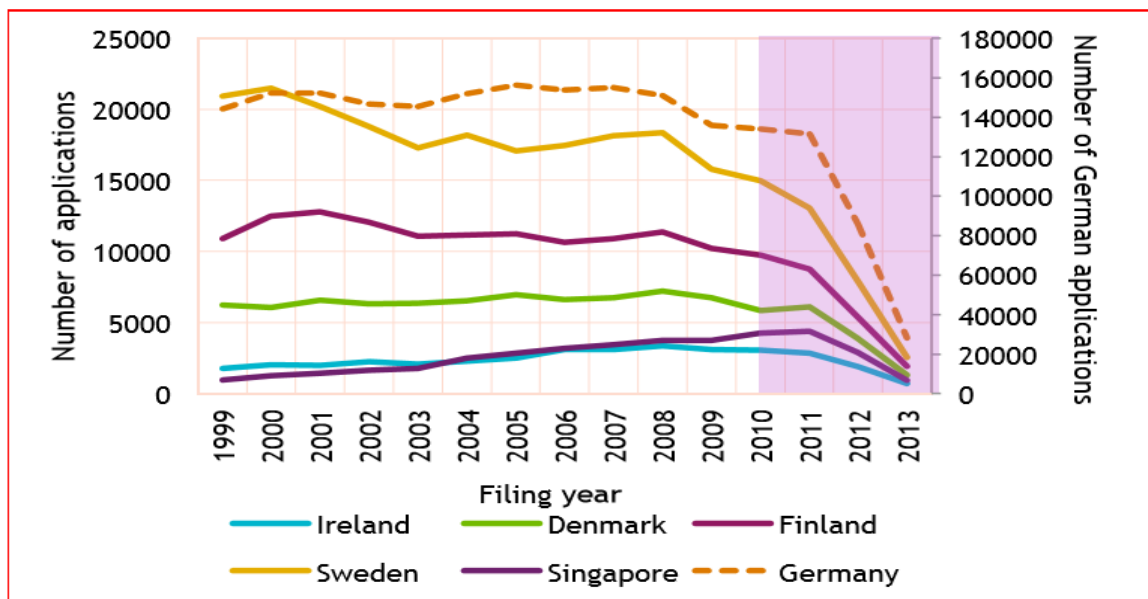
Institutions (HEIs) in Ireland is greater than in other countries. The proportion of patents assigned to HEIs continued to increase steadily until 2008.

- Data show that the patent filing trend of Irish inventors with foreign applicants (a proxy for foreign-owned multinational firms) has been in general decline since a peak in 2005. The trend is that of a steep decline from 2007 to 2010. Conversely, the filing of Irish inventors with Irish applicants (a proxy for indigenous firms) has demonstrated a positive trend, growing to 2008 and then steadily tapering away.
- Sectoral, patenting appears to be focused in pharmaceuticals, medical devices and ICT hardware, with some activity in the food and drink sector. Data suggests that the pharmaceuticals sector is a major contributor to the decline in patent filing, including the filing activity of foreign-owned multinationals in the sector.

{Please note that the response rate for this DJEI report by Technopolis covers 128 respondents from a total of 517 businesses giving a 25% response rate, this study had 122 respondents from 438 companies, which give a 28% response rate}

This low base in patent filings can initially be considered to some extent a reflection of the lower focus on RD&I in Ireland before the 2000s. Ireland experienced an economic shift from an agricultural economy to one focused on services and high-tech industries since the mid-1980s. Significant investments and focus in the Science, Technology and Innovation (STI) agenda were introduced in the early 2000s (DJEI, 2015). Resulting in the ramping up of patent activity with patent filing increased in Ireland up to 2008.

However, the subsequent rate of decline in patent filing after 2008 is lower for Ireland than observed in the selected comparators (apart from Singapore, which exhibited net volume growth over the period). The data indicates that filing decline in Ireland is driven by falling firm filing, which decreases from a peak in 2006 (DJEI, 2015). Looking at the graph presented in Figure 4.18, there is a clear and substantial reduction in the number of patents being filed per country so it's not unique to Ireland. To put this into numbers of patents by country of applicant, Ireland is 6th of 6 in terms of volume with 36,100 published applications between 1999-2013 (Germany 2m; Sweden 242,200; Finland 150,600; Demark 89,000; Singapore 39,000).



Source: CambridgeIP

Figure 4.18 Patent applications by applicant country 1999-2013 (DJEI, 2015).

At this point of the study the author has started to question the motives behind patent boxes/ KDB. To recap, income derived from intellectual property is generally subject to the ordinary corporate income tax rate. However, patent box regimes are an exception to this, as they provide a reduced tax rate for income from the exploitation of IP. Based on the trends as presented in Figure 4.18 something dramatically is happening globally. The exact reasons for the decrease in patent filing numbers are not readily defined, however, it would suggest that the global economic recession has contributed to the decline, as 2008 appears to be the turning point where the decline across sectors started to emerge. To coincide with the reduction in patent applications, the graph previously presented in Figure 3.7, shows an increase in Patent box regimes during this time.

The question which now emerges is that: can a small country like Ireland with the KDB in place act as a catalyst to increase the growth of patents from the 1.6% in 2009 to minimise their tax liabilities. Because, countries which have introduced the patent box scheme, probably have done so to address the reduction in patents applications. Recalling back to the work by Hassbring and Erdwall (2013), they found that active patent boxes found that patent boxes have a statistically positive effect on both foreign and domestic patent applications in Europe, indicating increases of 10% to 20%, and promoting commercialisation of R&D.

Regarding Ireland, its advantage can be attributed to the low CT tax rate, it is more attractive to the larger companies to move the IP to Ireland.

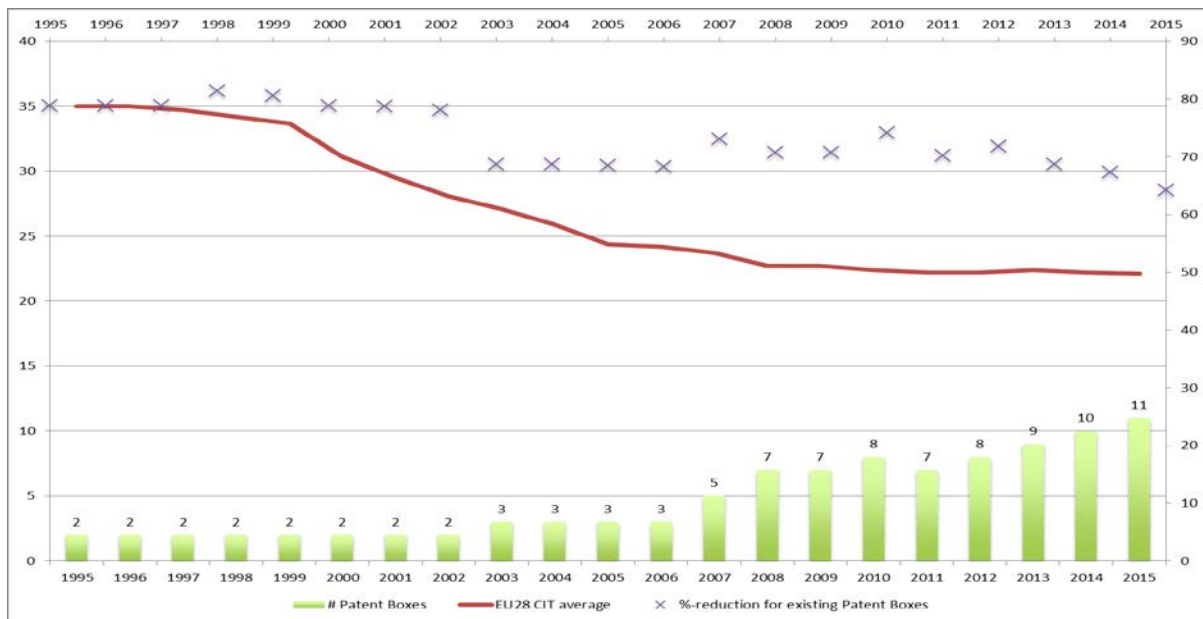


Figure 3.7 Average Corporate Tax Rate and Patent Boxes in the EU-28⁴⁷.

Adding to this, Siedschlag (2015) has said that the propensity of firms to use patents is in general concentrated in certain industries and types of firms. Where, large countries and a small number of large firms account for a large share of patent applications. Thus, IP intensive firms appear for the most part to be export led, FDI and multinational sectors. Considering the Government's strategy is to promote Ireland as a R&D focused, innovation-based, knowledge-intensive economy tied with low corporate taxes, the promotion of incentives is a deciding factor in Ireland's ability to attract continued investment. Moving on to the 2015 DJEI report, they noted that while it was difficult to statistically quantify from other sources, such as those used in the quantitative data study, research has shown that informal and unregistered forms of Intellectual Property Rights (IPR) are used by a wide range of sectors, firm sizes and firm age. They found that informal mechanisms such as trade secrets, complexity of design and lead time advantage were all regarded as important by many firms surveyed and are often used in combination with formal patent mechanisms, which coincides with the responses as previously presented in Table 4.12.

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http://iri.jrc.ec.europa.eu/documents/10180/608300/presentation_Alstadsaeter_Barrios_Nicodeme_Skonieczna_Vezzani.pdf.

Certain forms of IP protection are not suited to some sectors (for example, the software sector uses patenting sparingly). This mirrors the conclusions from this body of work, where it was found that 52% of the responders say they protect by trade secrets (74% are Irish owned and 26% are foreign owned [N= 50]) and the 47% of companies who patent 66% are Irish owned and 34% are foreign owned [N= 44]. Visually both methods of protection are presented in Figure 4.19. This give an indication to the protection methods used per sector. All though the numbers are statistically small, certain trends emerge such as the low % in patent protection in the pharma sector⁴⁸ which was traditionally know for patenting compared to the software sector which tends to keep trade secrets. However, the reasons behind the decisions are primarily to do with cost, regulations and first to market etc.

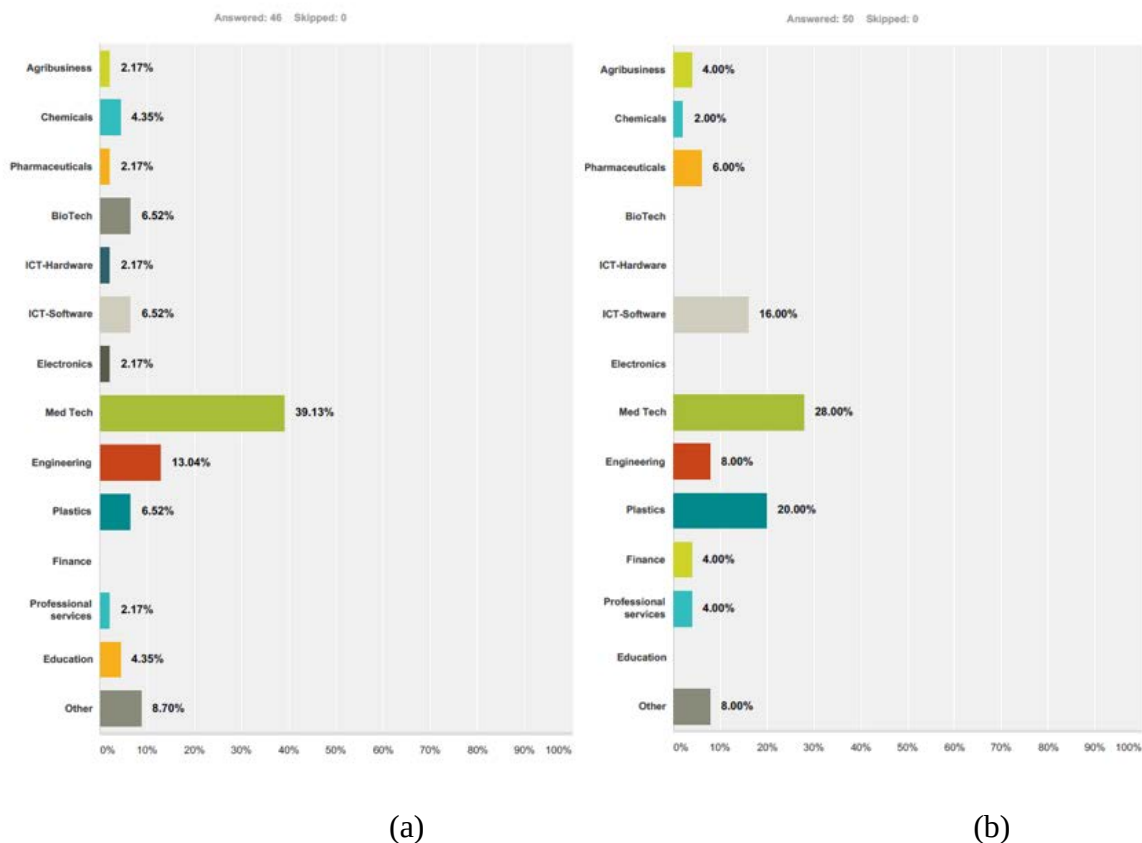


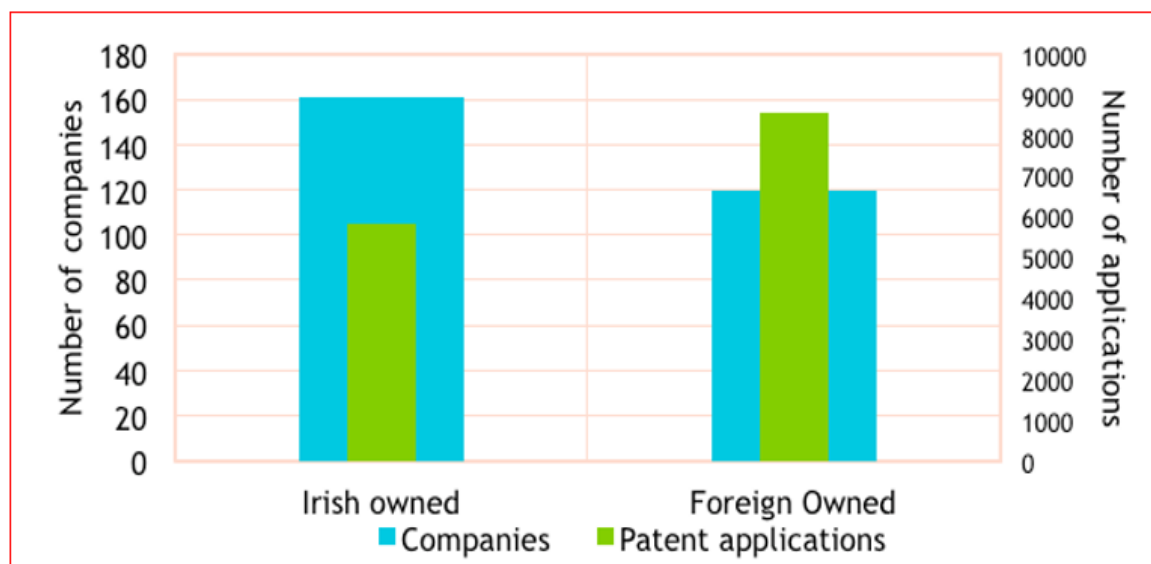
Figure 4.19 A breakdown of companies who protects by (a) Patent and (b) Trade secret.

Linking the data found in this study to the report by the DJEI regarding IP. It was found that patenting activity was concentrated in a small fraction of the total business population: of the 189,000 firms, just 358 companies had applied for 10 or more patents over the time frame

⁴⁸ It is worth noting that the pharmaceuticals sector has experienced a number of issues that may contribute to this over and above the global economic recession, including the 'Patent Cliff' (expiring protections on a number of patented drugs within a short space of time), and restructuring of the sector.

considered and this accounted for 77% of applications by companies where Ireland is the applicant country for the period 1999-2013, which equated to 0.2% of firms in Ireland (DJEI, 2015). Of which, ownership was assigned to 281 of the 358 applicant companies, and these 281 firms accounted for 65% of all applications by Ireland (as an applicant country) between 1999-2013. Based on these 281 firms, 57% were Irish owned, but foreign-owned companies account for 60% of the applications (DJEI, 2015). Figure 4.20 highlights this point, charting the ownership of patenting activity for firms who filed 10 or more Irish applications over the period.

Tables 4.13 to 4.15 are included to give the reader some perspective from this work regarding the breakdown of the companies per sector, location and discipline. Please note that the corresponding Tables have low samples numbers and they are only presented to give the reader an appreciation for the complexity associated with company types and their position regarding protection. This investigation into the reduction of the number of patents and the increase in the number of patent box scheme during the same period merits a much larger study, but the information received from this body of work does not have the depth to address the finding which has emerged as it was unexpected. This would make a very interesting read.



Source: CambridgeIP

Figure 4.20 Ownership of patenting activity, Irish applications by companies 1999-2013 for firms with 10 or more Irish applications (DJEI, 2015).

Table 4.13 Technology protection per sector.

Companies who patent [n=45]		Companies who keep trade secrets [n=50]	
	%		%
Start-up [n=14]	31	Start-up [n=14]	28
Small enterprise (<50 employees) [n=13]	29	Small enterprise (<50 employees) [n=15]	30
SME Foreign Owned (50 - 250 employees) [n=2]	4	SME Foreign Owned (50 - 250 employees) [n=1]	2
SME Irish Owned (50 - 250 employees) [n=3]	7	SME Irish Owned (50 - 250 employees) [n=7]	14
Multinational Foreign Owned[n=9]	20	Multinational Foreign Owned[n=12]	24
Multinational Irish Owned[n3]	7	Multinational Irish Owned [n = 1]	2
Other [n= 5]	11	Other [n= 1]	2

Table 4.14 Technology protection per location.

Company location for companies who patent [n=45]		Company location for companies who keep trade secrets[n=50]	
South-West Region (Kerry, Cork and Cork City)	7.0%	South-West Region (Kerry, Cork and Cork City)	2.0%
Border Region (Cavan, Donegal, Leitrim, Louth, Monaghan, Sligo)	2.0%	Border Region (Cavan, Donegal, Leitrim, Louth, Monaghan, Sligo)	14.0%
Mid-East Region (Kildare, Meath, Wicklow)	2.0%	Mid-East Region (Kildare, Meath, Wicklow)	4.0%
Mid-West Region (Clare, North Tipperary, Limerick City & County)	13.0%	Mid-West Region (Clare, North Tipperary, Limerick City & County)	6.0%
South-East Region (Carlow, Kilkenny, South Tipperary, Wexford, Waterford City & County)	11.0%	South-East Region (Carlow, Kilkenny, South Tipperary, Wexford, Waterford City & County)	12.0%
Midland Region (Laois, Longford, Offaly, Westmeath)	13.0%	Midland Region (Laois, Longford, Offaly, Westmeath)	20.0%
West Region (Mayo, Roscommon, Galway and Galway City)	29.0%	West Region (Mayo, Roscommon, Galway and Galway City)	12.0%
Dublin Region (Dún Laoghaire–Rathdown, Fingal, South Dublin and Dublin City)	27.0%	Dublin Region (Dún Laoghaire–Rathdown, Fingal, South Dublin and Dublin City)	32.0%

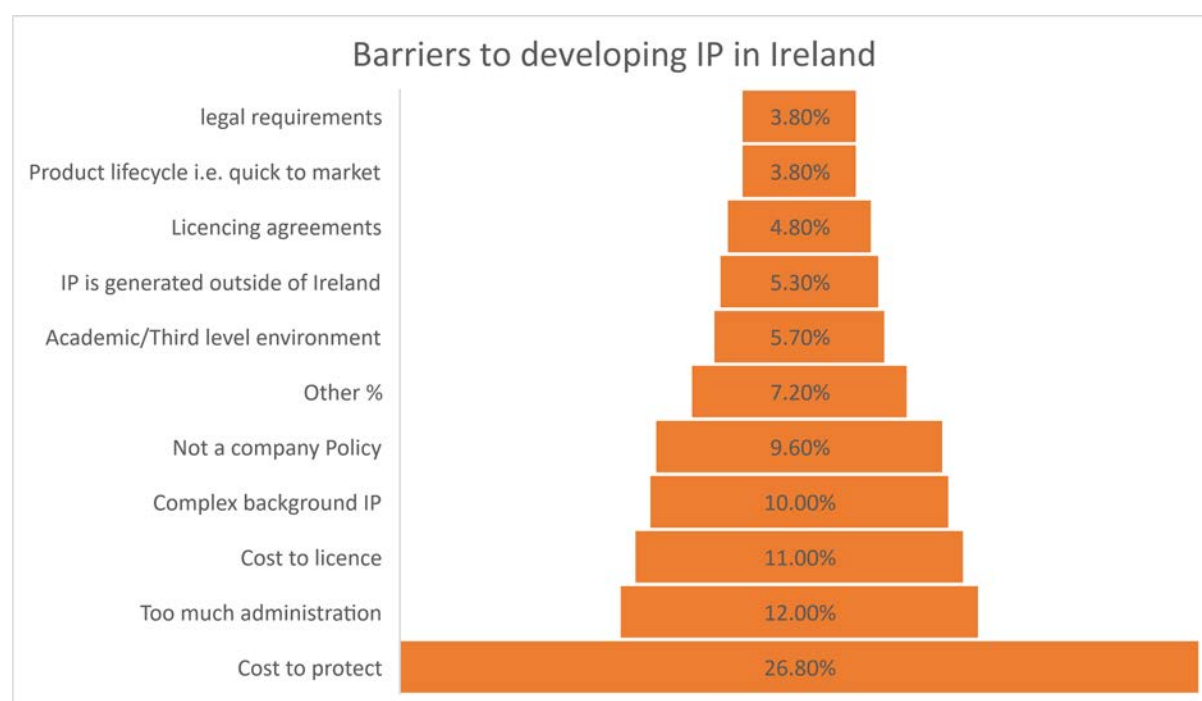
Table 4.15 Technology protection per company discipline.

Companies who patent [n=43]		Companies who keep trade secrets [n=48]	
The strategic R&D centre of the global company	19.0%	The strategic R&D centre of the global company	13.0%
The strategic R&D centre of the company	33.0%	The strategic R&D centre of the company	23.0%
A strategic R&D centre for a region, product or service	28.0%	A strategic R&D centre for a region, product or service	17.0%
Higher value support function	9.0%	Higher value support function	4.0%
Basic product or service	4.0%	Basic product or service	17.0%
Manufacturing	40.0%	Manufacturing	44.0%
Financial Services	7.0%	Financial Services	4.0%

Multiple answers were allowed

4.3.3 Barriers to developing IP in Ireland

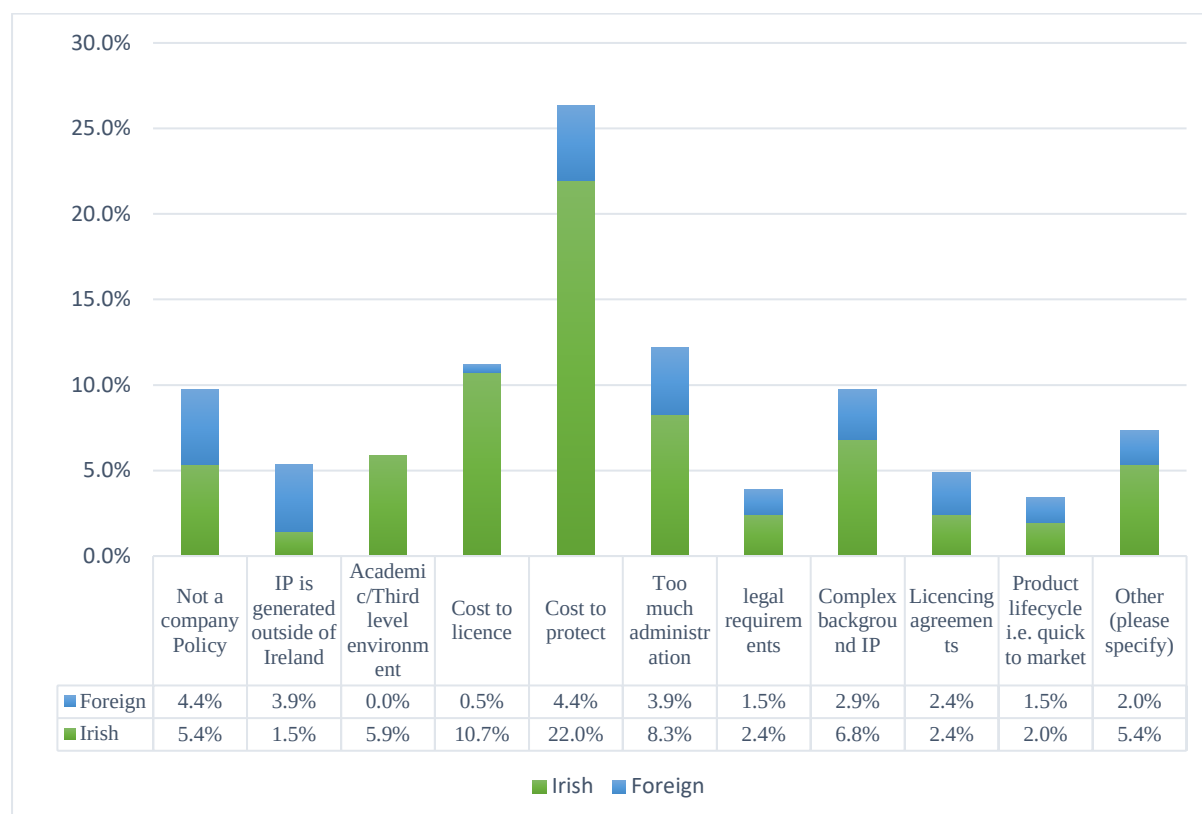
To address why there is such low % of companies which patent, a list of barriers is presented in Figure 4.21. However, the most frequent barriers were cost related where the cost to protect was by far the largest barrier followed by administration which can also be linked to the cost. In total, about 50% of the barriers as found by this survey are cost related. Similar results were found from the DJEI report in 2015 from Technopolis, where they found that 47.4% of the total respondents [n = 96] stated the costs were too high.



*209 responses from 104 responders

Figure 4.21 Barriers to developing IP in Ireland.

As presented in Figure 4.22, the barriers appear to be more dominant by Irish owned firms compared to foreign owned companies. Looking at the cost to protect, 22% of Irish owned firms say this is the main barrier compared to 4% of the foreign owned companies. This fits into the principle that much of companies who patent their technologies are foreign owned and this complements previous finding from this study. However, this trend is not unique to this work and similar finding were also found in the Technopolis report for the DJEL.



*205 responses [149 Irish, 56 foreign] from 102 responders

Figure 4.22 Barriers to developing IP in Ireland by ownership.

4.3.4 Advantages to patenting

To add balance to the study, a question was presented to the responders to evaluate their views regarding the advantages of patenting. In total, there were 182 replies from 85 responders. The author then assessed each and removed replies which were similar. After which, the comments {90 in total} were retrospectively categorised each into 6 sections as presented in Table 4.16. Considering the reduction in the number of patent applications the cost associated with patents outweighs the opportunity cost associated with protection. From all of the constructive comments within Table 4.16, it's difficult to find logic why a company

will not patent, but there is value in trade secrets especially in ICT companies. For the KDB to be successful, there needs to be awareness of the KDB certificate of invention which will allow companies to facilitate and benefit from the scheme, as IP play a significant part in stimulating innovation and creativity. Due to the level of firms keeping trade secrets, the KDB certificate mechanism is a desirable means for a company to pursue the KDB.

Table 4.16 Advantages to patenting.

Protection	Barriers to entry	Financial	Market	Asset	Other
Protect your technology against competitors.	Prevents competitors copying	Tax credit and KDB	Attract new customers	Improves the value of the company	Opportunity to become established as expert
Defensibility	Protecting the business from competitors	Licencing fees and improved value at exit	Exclusivity in the market	Protecting the company value	Protecting product lines
Only way to have a business if you are an inventor like me	Protecting your competitive advantage	Tax benefit of filing patents in Ireland	Protection in markets	Carve out technology space for the company	May make someone think twice before plagiarising
Protect from competitors	Prevention of competition	Revenue generation	Route to Market	Documented Ownership	Allow company to Internationalise.
Protect against cheap imitations	Prevent competitors from practicing similar technology	Perceived value if raising investment	Trade buyer would expect it	Increase the value of the business when selling to a third party	Protection can support funding applications
Protect the design	Prevent competitors from developing a similar technology	Investor confidence	Increase market exposure	Intangible asset for company valuation	Development of Innovative products /services to create higher margin profits
Legal protection	Stop others from using our IP	Leveraging IP for future revenues	Market share protection	Maintain intellectual property in the company	Demonstrates to investors that company has depth and ability to scale
Protect knowledge development in product	Makes life more difficult for competitors	Perceived value by partners / investors	Marketing - Demonstrating Technology in Product	Value added to Company worth on sale	Preserve product differentiation
Protect IP from external parties	Blocking competitors	Protecting Gross Margins	Sales potential	Added value for investors	Validating the process
Protect future development	Deterrent	Protects the revenue stream	Sales growth	Adding value to future net worth of business	Gives company credibility in International Markets

Prevent unauthorised copying of the invention	Keeping competitors out	leverages investment & prestige	Competitive advantage in the market place - outline technology applications	Added value to potential investors	Provides assurance to users of our product that the integrity of our claims has been assessed by external authoritative sources
Security	Prevention of competitor growth	Income from licensing	Ability to license technology in other markets, etc.	Potential licence opportunities	shows customer that company is progressive
Enable recourse if copied	Creates a barrier to entry for competitors	Protects the revenue stream	Competitive Advantage	Creates intangible assets	Creation of unique products/ services
Enhances licencing	Protecting product lines	Helps in negotiation of an acquisition valuation	Leverage against competitors	Creates an investible proposition	Prestige of filing patents and building an IP position
Requirement of corporate investors.	Valuable when working with multi nationals	Strategic Distributors prefer products with IP protection	Patent strategy helped formulate business strategy	Expanding product portfolio	Proves you are serious about R&D

4.3.5 Impact of IP within the organisation

Using economic return from innovation as a proxy for measuring IP exploitation, the latest CIS data show that Ireland's firms report 23% of enterprise turnover is because of new to market or new to firm product innovation. These data also show that foreign-owned firms perform better in this (27% of turnover from product innovation, compared to 17% in Irish-owned firms) (DJEI, 2015). When asked if IP was a factor in the strategy of the company, 70% of the responders said Yes, see Figure 4.23. This strengthens the argument that there is a growing emergence and awareness of the strength of IP protection, irrespective of how it is protected. A breakdown of the response is presented in Table 4.12.

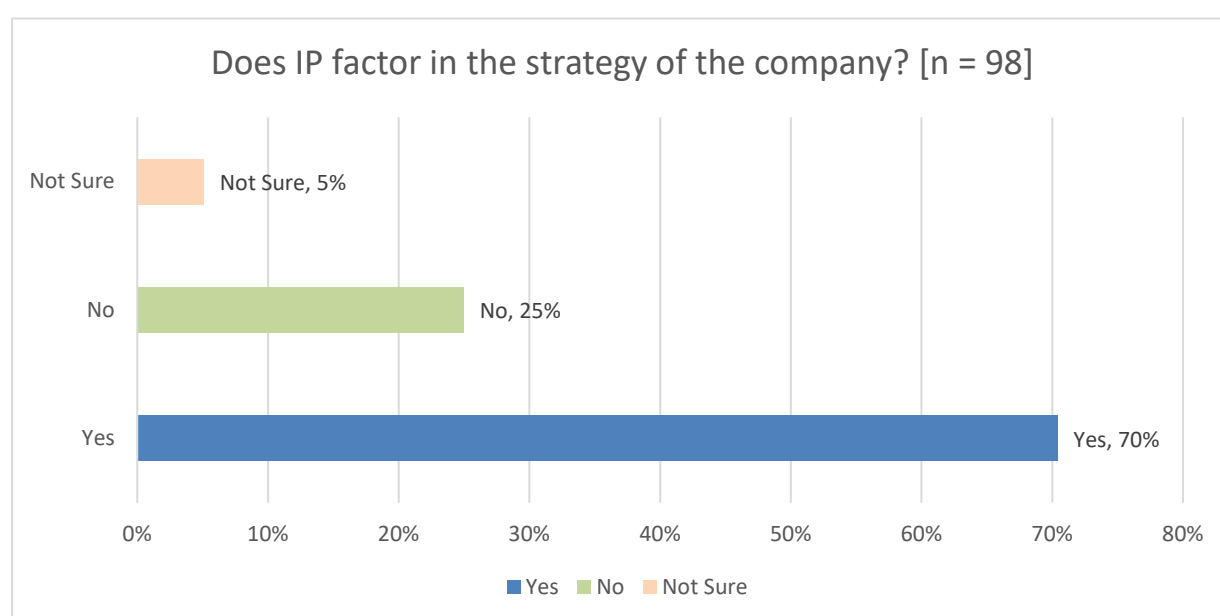


Figure 4.23 Impact of IP within the organisation.

Table 4.17 Evaluation of the Sector, Ownership and company size regarding companies who commented if IP has an impact on strategy.

Companies who said No [n = 24]						
Sector types	ICT-Software	Medtech	Plastics	Engineering	Agribusiness	Pharma
	17%	25%	21%	8%	8%	0%
Ownership	Irish			Foreign		
	63%			37%		
Company size	Start up	Small	SME-Irish	SME-Foreign	Multi-Irish	Multi-Foreign
	17%	33%	17%	0%	0%	38%

Companies who said Yes [n = 68]						
Sector types	ICT-Software	Medtech	Plastics	Engineering	Agribusiness	Pharma
	13%	33%	7%	10%	3%	6%
Ownership	Irish			Foreign		
	78%			22%		
Company size	Start up	Small	SME-Irish	SME-Foreign	Multi-Irish	Multi-Foreign
	38%	31%	6%	3%	6%	13%

4.3.6 KDB Certificate of invention

At this stage of the work, one begins to question the merits of the KDB considering the reduction in the number of patents. However, from the work by Bradley *et al.*, (2015), they noted that tax incentives subsidising investments in innovation increase the quantity but not the quality of R&D, while tax incentives subsidising the income stream from successful innovation increase both quantity and quality, i.e. Patent boxes/KDB.

Considering the KDB is intended to enhance Ireland's offering as an IP location alongside the 12.5 % corporate tax rate, the R&D tax credit and the IP amortisation regime. But it is important to remember that a company can apply for a Certificate of Invention and the location of the ownership of the IP is not an issue. Where, the KDB certificate may only be issued in respect of an invention which is novel, non-obvious and useful. The certificate may only be issued in respect of one invention except where the KDB certificate may be issued in respect of a group of inventions, if the inventions are so linked as to form a single general inventive concept. The certification enables smaller companies with income arising from intellectual property assets of less than €7,500,000 and a turnover of less than €50,000,000 within a twelve-month period. However, findings from this study found that 71% of the responders from this survey were not aware of the KDB certificate, which is a key component for companies who protect their IP by Trade secrets.

4.3.7 Summary

In summary, it is becoming clear that there is a global change emerging in relation to the way a company protect their intellectual property. To qualify for KDB, income derived from a usable qualifying asset from qualifying R&D activities is required. To avail of the KDB, Revenue expects that the majority of claims in the long term, are expected from income arising from inventions protected by patents granted following substantive examination for novelty and inventive step. However, the data presented from both the literature and this body of work

indicates that companies in Ireland file and register less than international comparators across the spectrum of formal IPR. When asked how IP is protected within their organisation, some interesting results emerged. From the 97 responders, 47% say they patent their technology, 52% keeps it as a trade secret and 1% copyrights. Some interesting findings emerged, some of which are presented below:

- About 50% of the barriers to protect IP as found by this survey are cost related.
- 71% of the responders from this survey were not aware of the KDB certificate.
- 70% of the responders said IP was a factor in the strategy of the company, with 25% saying No.

In practical terms, a technology may be protected by many integrated means which may come from external licence, patents, trade secrets and copyright i.e. a mobile phone. This makes the process of KDB more complex. Therefore, with the decrease in companies patenting their technology, there is an emergence of non-patented protection, such as the trade secrets. This will influence the uptake of the KDB, where companies may decide (a) not to use it, or (b) patent their technology or (c) apply for the KDB certificate of invention.

4.4 Knowledge Development Box

4.4.1 Introduction

Fundamentally, the R&D tax credit is available in relation to unsuccessful R&D, whereas the KDB requires that the R&D activities have resulted in a qualifying asset which has been commercially exploited. Thus, the KDB will be only granted where the qualifying assets are the result of qualifying R&D activities that have been carried out by the entity claiming the tax benefit. Therefore, the ethos of this work is to investigate the awareness of the KDB and assess its viability as a government tax incentive. Considering this incentive has come into effect since the first of January 2016, there is no data readily available which shows the extent of its usage throughout the various industry sectors in Ireland. To this extent, and to the best of the Author's knowledge the following findings are the first or one of the first studies which explore the views and operations of the KDB to date.

4.4.2 Awareness of the KDB

From a top-level approach, Irish or Irish-resident companies with qualifying R&D activities that results in the formation of qualifying assets can claim under the KDB. Thus, the broad objective of the KDB is to promote innovation and provide an incentive whereby profits

arising from qualifying assets can effectively be taxed at a reduced rate of 6.25%. Where, the relief ensures that the profits derived from the innovation are taxed at a lower rate than general corporate tax rate of 12.5%. The question now emerges, are companies aware of the KDB and its operations?

From the findings of this work, it is of interest to note that 67% of the responders are aware of the KDB which is an excellent response, considering 95% said they are aware of the R&D Tax credit which has been in existence since 2003. From the Author's interview with the DJEI, this was one of the finding that they were interested to know. A question was proposed within the survey which asked where they first heard about the KDB, several suggestions were made available. As presented in Figure 4.24, there was a varied response with media having the largest impact followed by Enterprise Ireland and conferences.

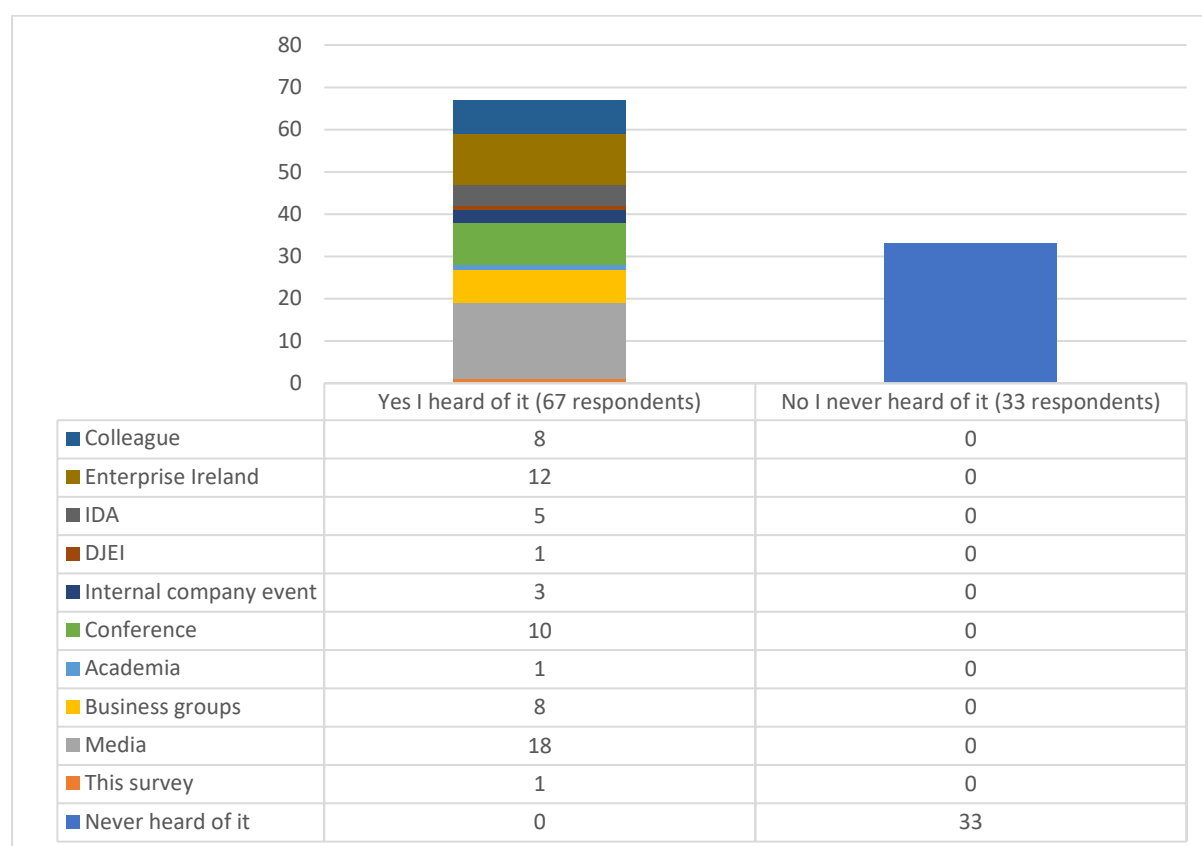
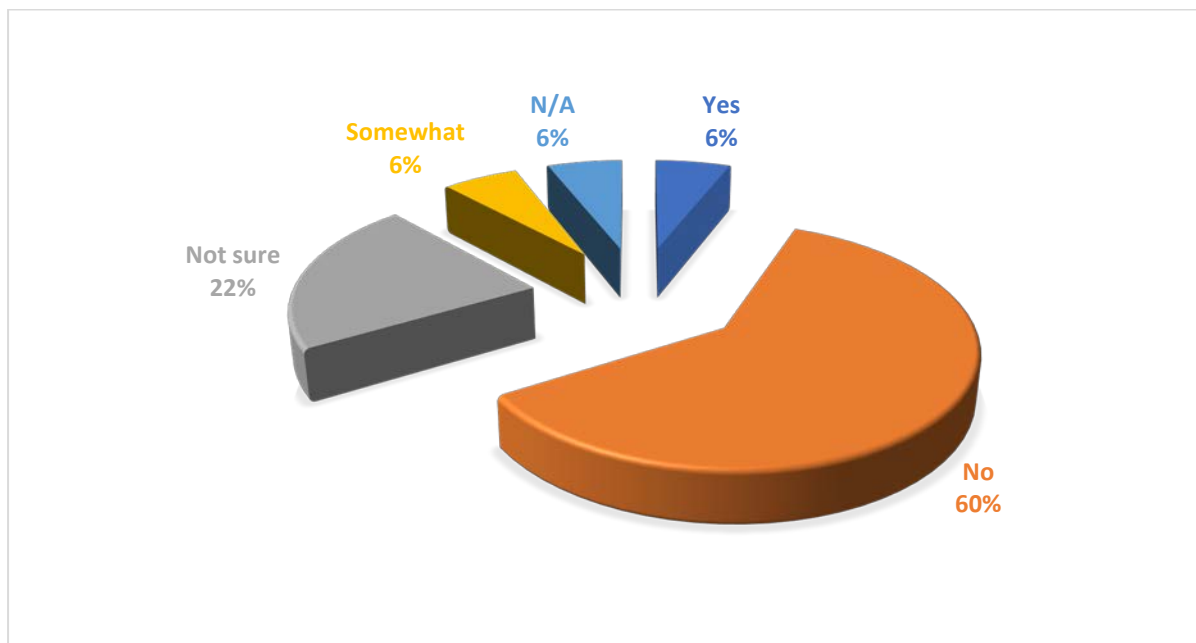


Figure 4.24 First time awareness of the KDB.

It is apparent that the level of promotion is diverse for such a new tax scheme, however, when asked by the responders if the KDB has been adequately promoted, 60% said No compared to 6% saying Yes (Figure 4.25). Once again it would seem that this is a conflicting result, but as is the case with the R&D Tax credit, there is confusion as being aware necessary

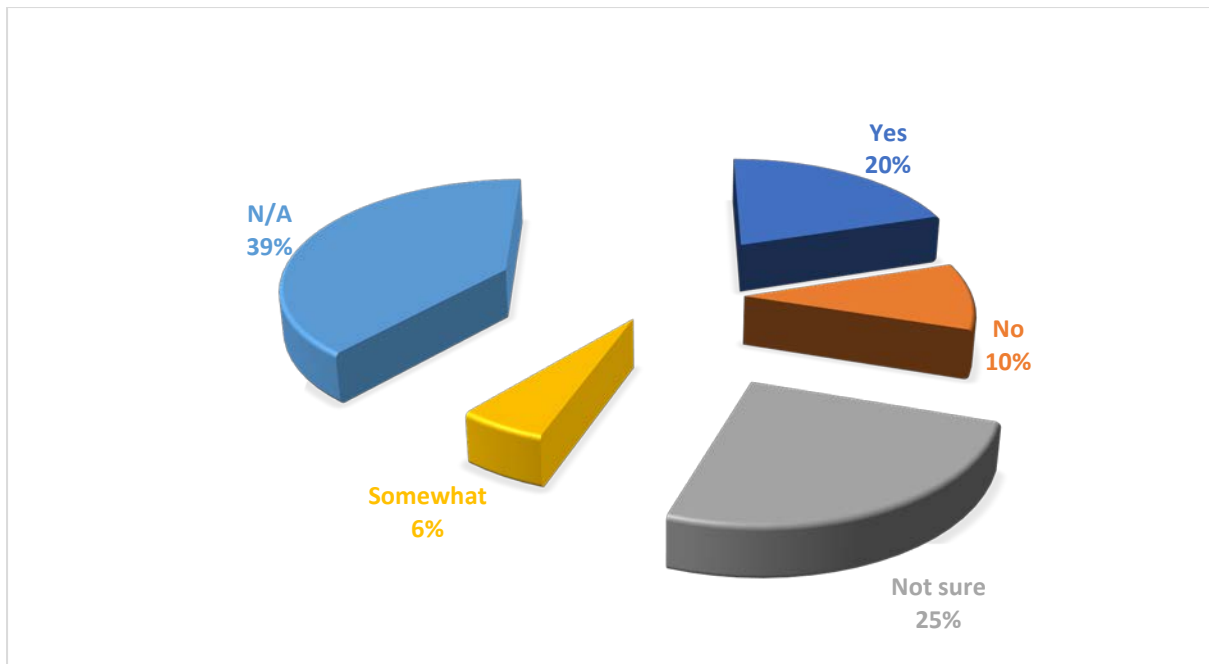
does not mean the KDB will be employed. When asked if the firm was not availing of the R&D Tax credit, would the attraction of the KDB make them reconsider applying for the R&D Tax credit, 20% said yes, 10% said No and 25% were not sure and 39% considered the question non-applicable (Figure 4.26).

This suggests that firms may not be aware of the full scope of the KDB and its links to R&D documentation. It is important to remember that a company does not need to claim the credit to avail of the KDB, but, if the company is going to do all the administration work it would make perfect sense to maximise the Tax incentives to receive the 25% rebate on qualifying expenditure for the R&D Tax credit. Therefore, claiming the KDB should be a natural extension for those companies already claiming the R&D tax credit on an annual basis.



n= 101 responses

Figure 4.25 Views of the responders when asked if the KDB was adequately promoted.



n= 101 responses

Figure 4.26 Views of the responders when asked if the attraction of the KDB would make them reconsider applying for the R&D Tax credit if they had not done so previously.

Of the 122 responders, when asked if they would promote the KDB to other colleagues, 38% say Yes with 9% saying No [32% not sure]. Word of mouth is considered by many as the most effective form of promotion, so time will tell if the take up of the KDB will incentivise companies for (a) their local R&D activities, (b) increasing their levels of IP protection, (c) commercialisation within the country, (d) retaining highly qualified professionals and (e) avoiding tax base erosion through intellectual property transfers to low tax jurisdictions.

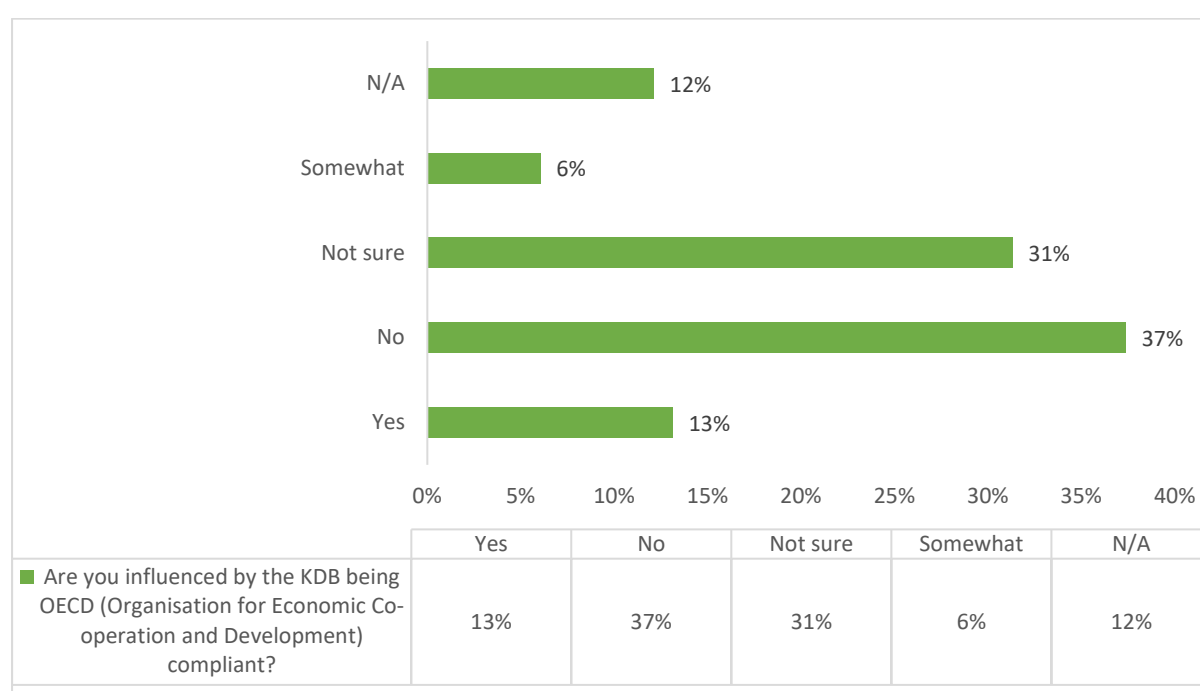
4.4.3 Influence of the OCED compliance in adopting the KDB

Recalling back to the Literature review, traditional Patent Box schemes have come under scrutiny which lead to the OECD [OECD Report on Action 3 on "Countering Harmful Tax Practices"] to review the entire process which in turn evolved into the modified nexus approach. The modified nexus approach seeks to align the taxation of profits with real substance. This approach will ensure that IP income will qualify for the preferential regime where the underlying R&D activities which generated the IP have predominantly taken place in Ireland⁴⁹. As Ireland was the first country to adopt this requirement, the KDB is drafted

⁴⁹ <https://www.williamfry.com/newsandinsights/news-article/2015/10/16/ireland-budget-2016-international-tax>

intentionally to satisfy OECD BEPS⁵⁰ objectives, thus making it the first OECD compliant patent box in the world.

From a government and global position this is a progressive and transparent Tax policy, which from a macro perspective is very positive. However, the Author was interested to see if this was a factor in a company's choice in using the KDB, see Figure 4.27. Of the 99 people who responded to this question, only 13% said Yes that they are influenced by the KDB being OECD compliant [9 responders were from Irish owned companies and the remain 4 were from foreign owned companies]. With 37% saying No and a further 31% saying Not sure, it can be reasonably deducted that for most companies this is not an issue.



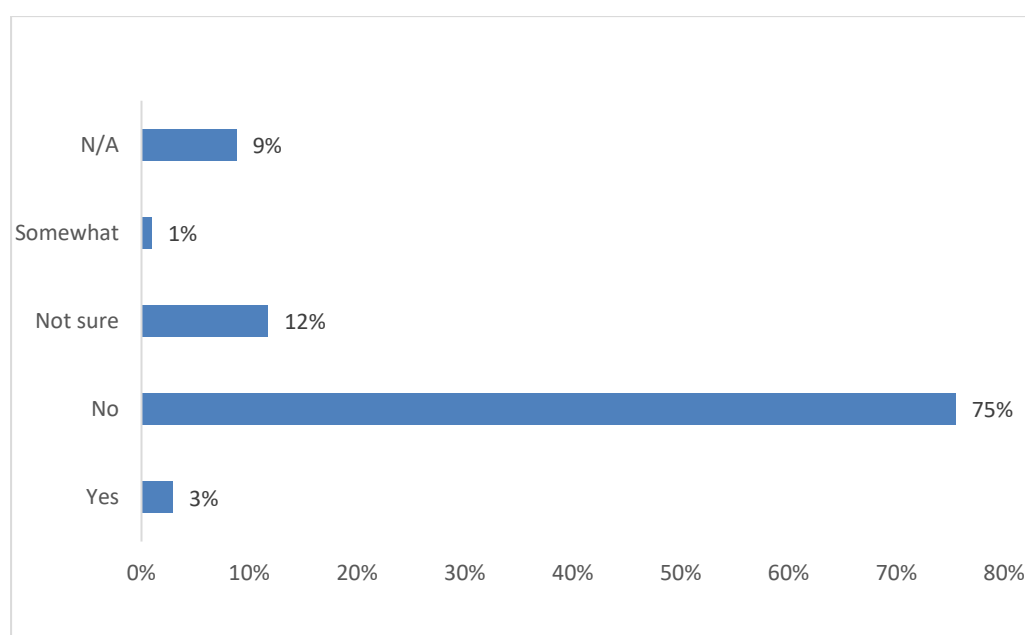
n= 99 responses

Figure 4.27 Views of the responders when asked if they are influence by the KDB being OECD compliant.

When asked if their company has used Patent box schemes in other countries, 3% of the responders replied with a Yes. Interestingly, this result was from Irish owned companies. But the overall results do indicate that patent Boxes have not been used and a reason may be

⁵⁰ Base erosion and profit shifting (BEPS) refers to tax avoidance strategies that exploit gaps and mismatches in tax rules to artificially shift profits to low or no-tax locations. Under the inclusive framework, over 100 countries and jurisdictions are collaborating to implement the BEPS measures and tackle BEPS. [OECD.org]

the complexity of the Tax systems prior to the OECD compliance, see Figure 4.28 for the findings.



n= 102 responses

Figure 4.28 Views of the responders when asked if their company has used Patent Box schemes in other countries.

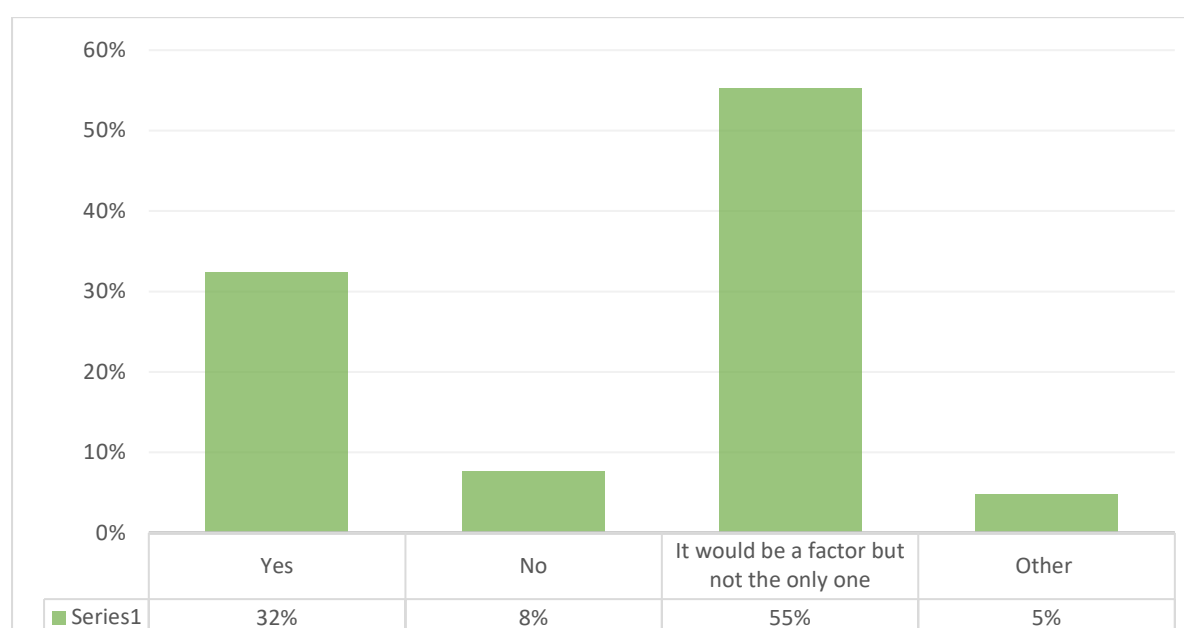
4.4.4 Corporation Tax incentives

To recall, Patent Boxes/KDB are government initiatives designed to attempt technology based companies from moving their company profits offshore to low tax jurisdictions. This is achieved by offering a lower rate of corporation tax to these companies from profits derived by their commercial exploitation of qualifying asset(s) from qualifying R&D activities. Ireland introduced the OECD-compliant Knowledge Development Box in January 2016 which resulted in a reduced corporation tax rate from 12.5 to 6.25% for eligible activity. This scheme was commonly seen as a move to promote inward investment after the decision to scrap the controversial “Double Irish” mechanism.

When asked if the if the reduction in the Corporation Tax (CT) would be the main deciding factor in utilising the KDB, 32% of the responders said Yes and 55% said it would be a factor but not the only one and 8% said No (Figure 4.29). Logic would dictate, that the reduction in the CT rate is the main factor in availing of the KDB, however, this is a complex process which requires a lot of work and resources, so it may only benefit a certain type of sector or company structure, such as, the multinationals. Linking this back to Siedschlag *et al.*

(2013) research, they found that corporate taxation rates are not significant in attracting R&D activity to a region, partially because multinational enterprises locate foreign subsidiaries in multiple regions and taxation is optimised on a global, rather than regional, basis. They conclude that policy initiatives to increase a region's knowledge are more likely to increase that region's attractiveness to foreign R&D investors.

However, as the complexity of compliance is a large undertaking, if one recalls back to the information collated from Table 4.8 regarding the R&D Tax credit, the main reason given by companies for not availing was administration. To satisfy the OECD Nexus formula detailed information regarding R&D cost, sales etc is required. Also, it is important to note that not all products will have a single intellectual property associated with the technology and this also adds complexity to the calculation. To give credit where it is due, Revenue have collating real life examples on how to address the complex structures of company protection and they are presented in the guidelines⁵¹. Barriers to using the KDB will be assessed in the next section.



n= 105 responses

Figure 4.29 Views of the responders when asked if the reduction in the Corporation Tax would be the main deciding factor in utilising the KDB.

⁵¹ <http://www.revenue.ie/en/tax-professionals/tdm/income-tax-capital-gains-tax-corporation-tax/part-29/29-03-01.pdf>

4.4.5 Perceived barriers to using the KDB by Industry

Due to the timing of this work, there is no information available to assess the uptake of the KDB from Irish or Irish based companies (contact was made to Revenue in August 2017). There are a lot of similarities with those associated with the R&D Tax credit (Table 4.8) such as complexity and administration. Thus, when asked what the responders felt were the perceived barriers to the KDB, some interesting comments emerged, as revealed in Table 4.18. Considering 67% of the responders are aware of the KDB, the comments from Table 4.18 give a detailed insight into the current thinking.

From the Author's personal experience from working with companies to avail of the R&D Tax credit, there is a real sense of uncertainty surrounding both the credit and the KDB. From the survey, one interesting comment emerged which sums up the feeling of Industry *"Certainty about the calculation of taxes is pretty critical as if there is a disagreement with Revenue it has serious implications. This needs to be addressed as it's like offering an incentive but it's like trying to reward someone with cheese, except that cheese is in a mousetrap which can have very serious consequences"*. Selected comments from the responders regarding the KDB are presented which give an appreciation for their concerns.

1. *Uncertainty - look at the audit rate for R&D tax credit... it's very subjective / generalised 'guidelines' leaves uncertainty in a company's accounts... a tax credit award can become a contingent liability in the future if audited by Revenue in future years. A separate arm of state that would provide '3rd party' 'spirit of compliance' could overcome this.*
2. *The lack of knowledge of our industry within Revenue-the lack of understanding regarding the reluctance to pursue patents, IP etc for fear of disclosing trade secrets.*
3. *International Corporate Tax regimes - business can get better Tax advantages in other countries i.e. Singapore.*
4. *Estimating expense relating to invention (subset of R&D Tax Credit project) and % of product profit relates to that invention*
5. *Many start-ups have accumulated losses so the KDB is only relevant until they reach breakeven/ profits which can take many years.*

In truth, there will be complexity which is by default inherent within the modified nexus formula which requires a demanding tracking and tracing requirement. This is because separate profitability streams will need to be calculated for each individual qualifying asset, in determining the extent of any tax benefit under the Irish KDB regime. This results in an administrative challenge that needs to be considered if pursuing the KDB.

Table 4.18 Reasons why companies may not avail of the KDB.

lack of knowledge about the scheme
Never heard of it
We don't know what it is?
Complexity of compliance.
Current lack of information and clarity on how to best implement KDB
Time & resources
IP not being held in Ireland
Resources
Knowledge
None really just establishing structure.
The lack of knowledge of our industry within Revenue-the lack of understanding regarding the reluctance to pursue patents, IP etc for fear of disclosing trade secrets.
Lack of Profits to offset it against - a cost rebate system is more useful for start-up companies
Uncertainty about implementation
Can be confusing
Not enough info available
Need to be profitable for it to be valuable
Not enough knowledge for a start and our particular market does not attract a lot of IP
Not familiar with it
No idea at moment
Vagueness of legislation
Lack of knowledge
Currently difficult to implement at the present time due to limited resources in our company though we need to review this from a strategic alternative to free up sufficient resources to implement and develop.
1. Lack of understanding
2. Complexity, a toolbox would be useful
International Corporate Tax regimes - business can get better Tax advantages in other countries i.e. Singapore
None, provided the technology qualifies for KDB assessment
We have a separate Germany holding company that controls our IP.
Not enough known about it at the moment. The intrinsic ins and out have not all been assessed at the moment.
Understanding and regulations/compliance
Administration
1. The organisations providing knowledge on KDB are not fully competent in the area - it's at very early stages.

2. The level of work involved.
3. The acceptance criteria
It is still complex and suited to larger companies. Yes, yes, I know EI etc. say it is suitable for smaller companies but wishing it so does not make it so.
Many start-ups have accumulated losses so the KDB is only relevant until they reach breakeven/ profits which can take many years
Time and effort required to put it all together when busy doing normal work function in manufacturing
Estimating expense relating to invention (subset of R&D Tax Credit project) and % of product profit relates to that invention
UK version better
Uncertainty - look at the audit rate for R&D tax credit... it's very subjective / generalised 'guidelines' leaves uncertainty in a company's accounts... a tax credit award can become a contingent liability in the future if audited by Revenue in future years. A separate arm of state that would provide '3rd party' 'spirit of compliance' could overcome this.
Complexity
Too complicated
Lack of knowledge about how it works
Understandings of KDB

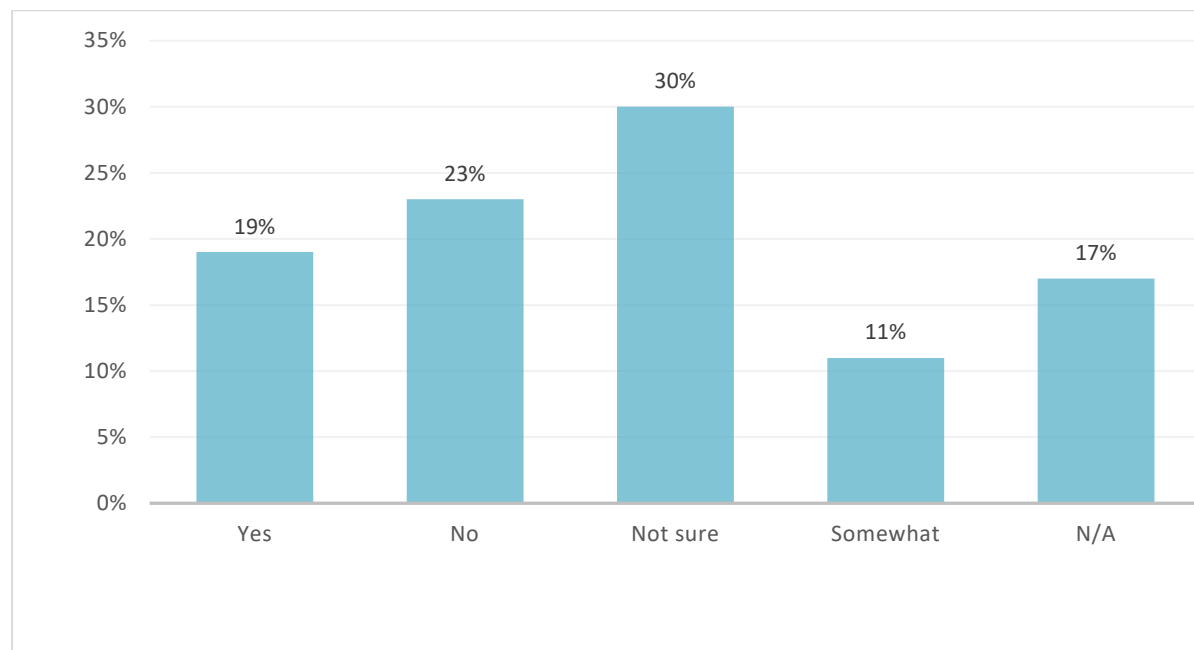
4.4.6 KDB as a strategic innovation driver

Moving on from the barriers, the definitions of “R&D” from a KDB perspective are the same as those under the R&D tax credit regime. Likewise, the definition of qualifying expenditure for the KDB is very similar to that for the R&D tax credit. It therefore makes sense for companies to start thinking of these two incentives under the same workflow whereby the R&D tax credit will directly feed into any KDB claim as this reduces the onerous tracking and tracing requirement. To get an understanding of the strategic importance of the KDB in relation to actual R&D, the Author proposed 3 questions;

1. Would the KDB be a reason to locate R&D activity in Ireland?
2. Has your company has placed the KDB in their R&D/company strategy?
3. Has the company new R&D projects in the pipe line, if so would the KDB be a factor in project selection?

In response to question 1, 23% said No with 19% saying Yes (Figure 4.30). Of the companies which said Yes, 12 were Irish and 6 were foreign owned. Considering this is a relatively new scheme, there is a lot of uncertainty associated with it. However, the finding is reassuring as there is potential movement in the 30% of responders who are no sure. A key component of the KDB is to encourage local R&D, so considering the barriers as previously

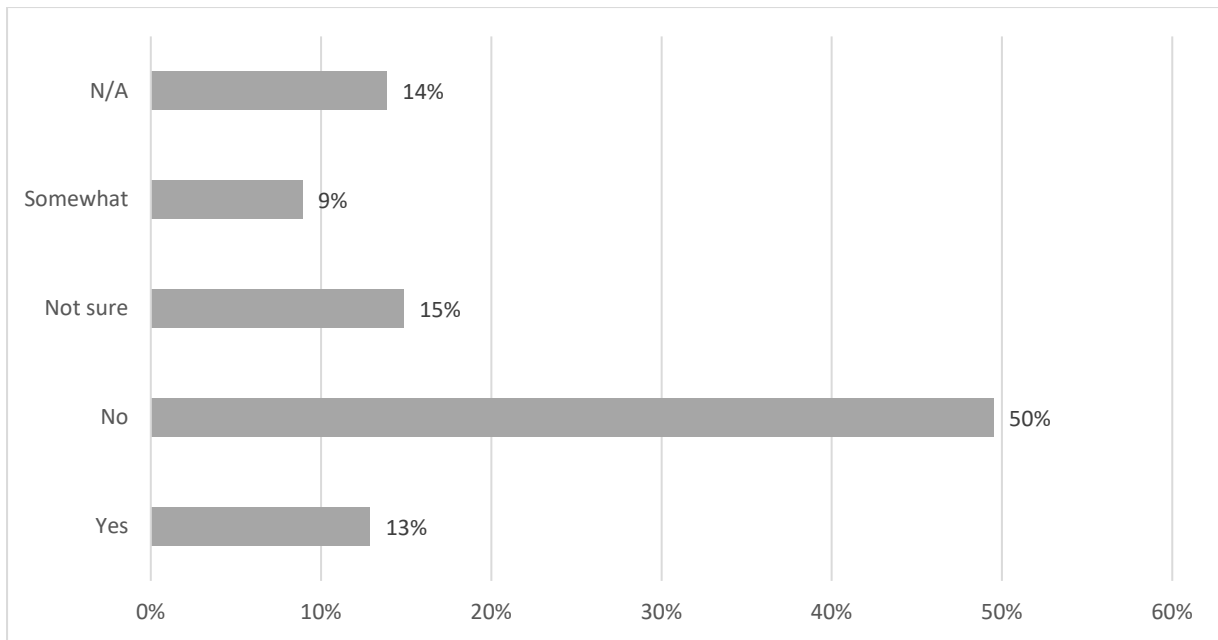
outlined, if/when companies start to avail of the KDB this will make the process more transparent while addressing apparent difficulties.



n= 100 responses

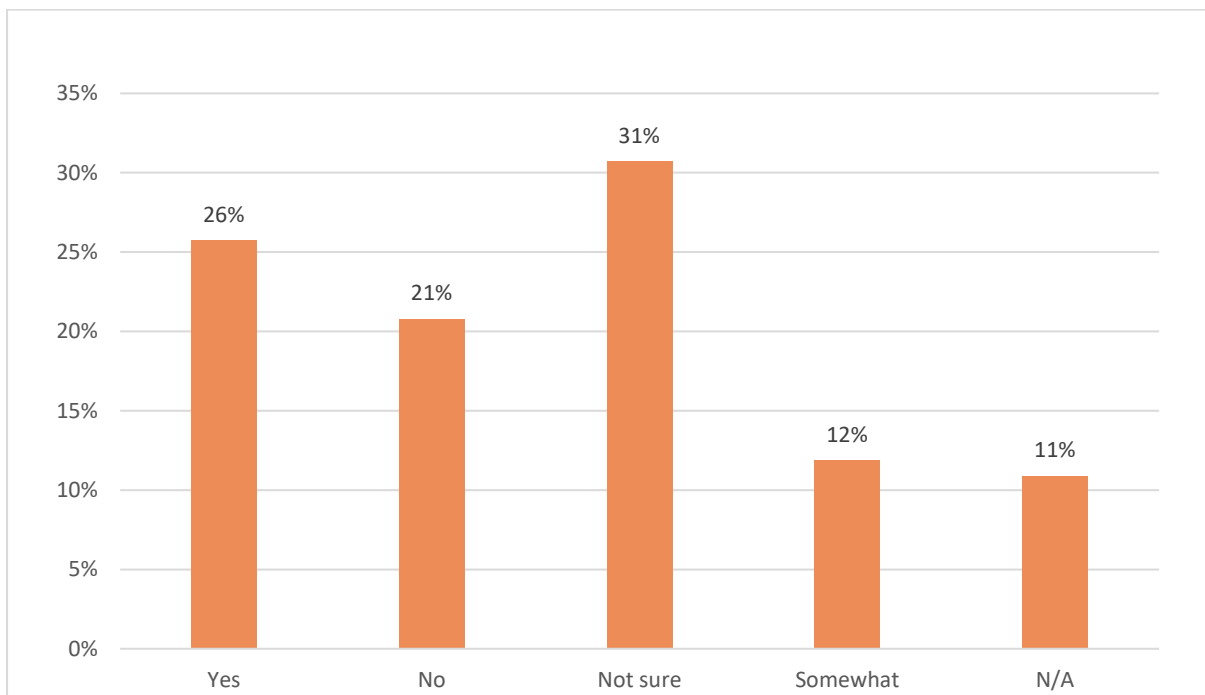
Figure 4.30 Views of the responders when asked if the KDB would be a reason to locate R&D activity in Ireland.

From question 2, there was a strong response for No [50%] when asked if the KDB was part of their company strategy, 13% said Yes, see Figure 4.31. Breaking this down, of the Irish owned companies 10 said Yes and 35 said No, for foreign owned companies 3 said Yes and 14 said No. Once again statistically these numbers may not be representative of the all sectors, however, what they do show is that there is real commitment to implementing the KDB as part of their strategic plan. To complement this, from question 3 as presented in Figure 4.32, 26% of responders have said that the KDB would be a factor in project selection for new R&D projects in the pipeline, 21% said No and 31% saying they are not sure. The key for the Government is to encourage more companies to avail of the KDB through processes which eliminates the perceived barriers and complexities.



n= 101 responses

Figure 4.31 Views of the responders when asked if their company has placed the KDB in their R&D/company strategy.

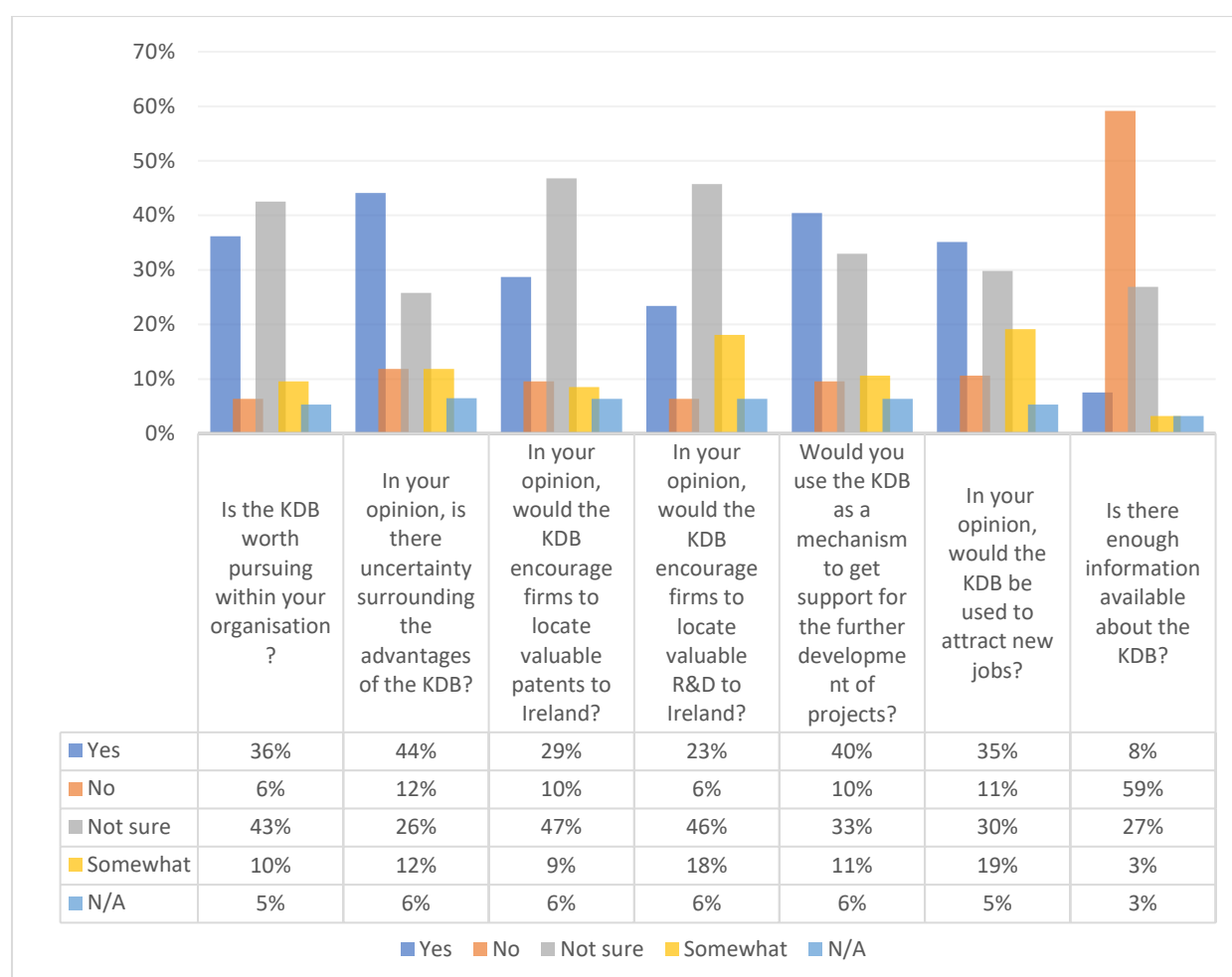


n= 101 responses

Figure 4.32 Views of the responders when asked if the KDB would be a factor in project selection for new R&D projects in the pipeline.

4.4.7 Industry views of the KDB from a macro perspective

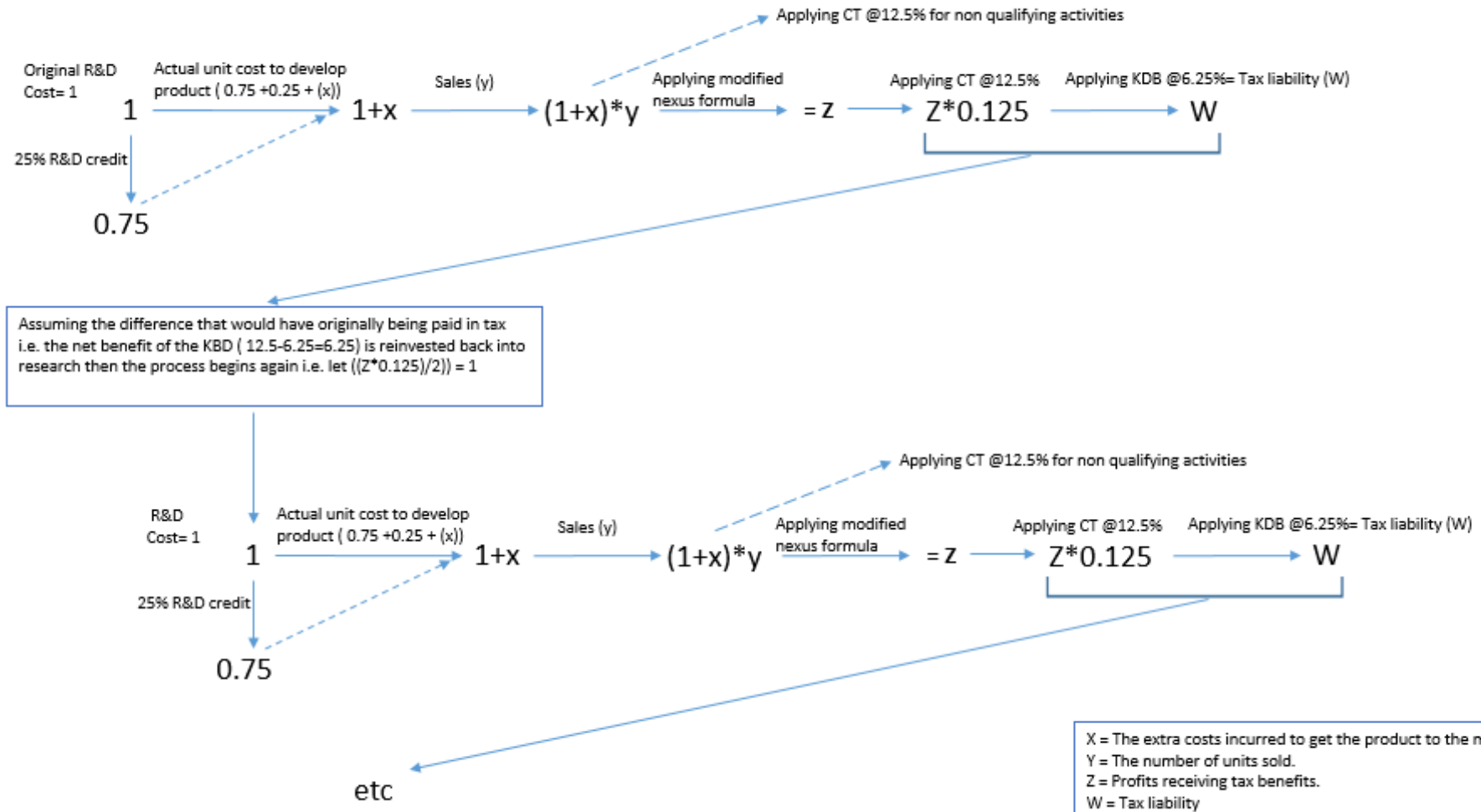
To best capture the macro views from Industry, the responders were asked to answer 7 questions. The findings are as presented in Figure 4.33, and they give a detailed snapshot of current thoughts. Fundamentally, what this shows is that R&D based Tax incentives are being considered in R&D selection and relating back to the Knowledge spill over principle, this can only be encouraging as the R&D Tax incentive mechanism proceeds, the full potential from basic research to income earning products can be truly assessed against the BERD and its associated “positive “effects on the economy. And pending the company is truly innovative, the potential savings on the CT from the R&D can be fed back into the R&D cycle. The Author has attempted to develop this model for the KDB, however, at this point in time there are no results from the economy to back it up, see equation 1. This would make an excellent study for the next generation or researchers (See Appendix 3 for the model used by the Department of Finance regarding R&D Tax credits).



n= 94 responses

Figure 4.33 Views of the responders regarding the KDB from a macro perspective.

Eq. 1 R&D Tax mechanism process assuming 1 iteration to generate an innovation spill over



4.4.8 Summary of the KDB

The overall ambition of the KDB is to be an innovation driver by providing an incentive to companies where profits arising from qualifying assets can effectively be taxed at a reduced rate of 6.25%. Considering the novelty of this work, in that, it's the first study which investigated the KDB from a company's perspective, some interesting findings emerged, some of which are presented below:

- 67% of the responders aware of the KDB after 1 year of its launch.
- 60% said No to the KDB been adequately promoted compared to 6% saying Yes.
- 20% said Yes to the attraction of the KDB make them reconsider applying for the R&D Tax credit, 10% said No and 25% were not sure.
- 38% would promote the KDB to other colleagues, with 9% saying No and 32% not sure.
- 13% of the responders said Yes that they are influenced by the KDB being OECD compliant whereas 37% saying No and a further 31% were not sure.
- 3% of the responders have used Patent box schemes in other countries.
- 32% of the responders said the reduction in the Corporation Tax (CT) would be the main deciding factor in utilising the KDB and 55% said it would be a factor but not the only one and 8% said No.
- 19% said the KDB would be a reason to locate R&D activity in Ireland, 23% said No and 30% of responders are no sure.
- 50% have said that the KDB was not part of their company strategy compared to 13% who said Yes that the KDB is in their R&D/company strategy?
- 26% of responders have said that the KDB would be a factor in project selection for new R&D projects in the pipeline, 21% said No and 31% saying they are not sure.

Chapter 5

5.0 Conclusions

Economists and social scientists have demonstrated that the R&D activities of private firms generate widespread benefits which are welcomed by consumers and society at large. Where, the overall economic value to society often exceeds the economic benefits by innovating firms because of their research efforts. This excess of the social rate of return over the private rate of return enjoyed by innovating firms is described as a positive externality or spill over. While the market is supposed to reward commercialisation after IP development, market failure may still exist because competitors may reap the benefits of innovation without incurring the development costs. Knowledge spill overs are more likely to result from basic research, but they are also produced by applied research and technology development. These spill overs are generally measured as the decline in costs or the increase in productivity of firms that occurs because of R & D undertaken by other firms.

To address this, economic theory provides a strong justification for government support for R&D, including subsidies and incentives for business research. Without such support, companies are likely to underinvest in research because the results of R&D cannot be fully appropriated by the investing firm. One of the crucial enablers to driving R&D is a well-designed, competitive and sustainable tax policy to support the activity. In recent years, the introduction of dedicated Tax policies to promote innovation is now widely perceived as the key driver for economic growth and productivity.

Tax incentives are a market-orientated means of delivering an increase in private R&D expenditures which also allows the support offered by the credit flexibility to respond to market demand. R&D tax incentives are one of the most popular innovation policy tools. Essentially, they reduce taxes for firms that have R&D expenditure (input-related R&D tax incentives) or for firms that have income from commercialising intellectual property rights (output-related R&D tax incentives). However, if the purpose of R&D tax incentives is to contribute to help drive innovation, it is not only relevant what type of expenditure is eligible, but whether R&D is primarily intended for true innovation or for learning from other firms (spill overs). Essentially, innovation is about bringing new concepts the market.

The main economic rationale for using R&D Tax incentives is that market failures reduce or may even deter private R&D investment due to knowledge spill overs. Although tax credits may provide a stimulus to overall R&D activity, some Author's have stressed that they

are less suitable than grants to address the sources of market failure. In addition, they are likely to encourage firms to undertake R&D activities resulting in short-term revenues, rather than projects with high rates of social return or long-term exploratory activities. Either way, it has been proved from a European perspective that R&D tax incentives motivate firms to start investing in R&D by allowing firms to offset against tax liability because the credits can help companies increase their cash flow and earnings per share, reduce their effective tax rate, hire more staff, develop new products, and finance other business objectives. However, while the flexibility of the R&D Tax incentive to respond to market demand is beneficial, it also creates an uncertain and unlimited demand on the exchequer.

Although there is substantial evidence that R&D tax incentives does increase the amount of R&D investment, estimates from literature vary considerably. In addition, R&D tax incentives may induce R&D investment to be shifted between different locations instead of increasing the overall level of local investment. R&D tax incentives have now become a popular innovation policy instrument and competition is growing between countries to attract investment. These incentives are important for a small and open economy like Ireland, as it maintains a balanced playing field for foreign direct investment inflows and facilitates knowledge transfer from innovative multinationals with a potential to create cluster spill overs. In this regard, multinational branches the knowledge distribution and encourages firms to incorporate investments in innovation because knowledge based capital is a key driver for competitiveness. But what is the true cost to the exchequer of multinationals competitiveness?

A large body of literature has identified that multinational firms engage in profit shifting activities to decrease their overall tax liabilities. Intangible assets, like patents, trademarks, copyrights and business methodologies play an important role, as their location of origin can be quite arbitrary. Findings from literature suggest that the location of R&D may be affected by tax-induced changes in the cost of R&D. To address this concern, Base Erosion and Profit-Shifting (BEPS) representatives have paid special attention to the intangible assets held by multinationals. As much of their profit-shifting can be realised via R&D tax incentives such as patent boxes, which relate to intellectual property and its accompanying income.

Intellectual Property is a topic of high global importance for fostering innovation, doing business and succeeding in markets and for creating jobs and growth. Considering the motivation behind a patent box is to benefit an economy by ensuring that economic activities through mechanisms of intellectual property will continue to be undertaken in that Country.

Income derived from intellectual property is generally subject to the ordinary corporate income tax rate. However, patent box regimes are an exception to this, as they provide a reduced tax rate for income from the exploitation of intellectual property from successful projects and not for the underlying research. However, once patented, an invention is protected from imitation, such that firms no longer have a disincentive to innovate. This lends itself to a contradiction, as it is not clear why innovations which have defined property rights and protection should receive a tax incentive; thus, patent boxes offer a broad scope for tax planning by firms. Fundamentally, this minimises the overall tax burden of a company or group without violating the law.

Based on the previous contradiction, why do Governments introduce patent box schemes? Essentially, they do so to attract investment by incentivising national and multinational firms to increase investment in innovative activities. This can also be achieved by attracting or retaining mobile investments that may be associated with high-skilled jobs and knowledge creation thus generating revenue more efficiently by differentiating tax rates on more mobile income streams. Several European countries now offer patent box schemes for income derived from patents and, in many cases, from other forms of IP such as software or trademarks. However, a key concern is the role that patent boxes may play in increased tax competition between European countries. Findings from literature have shown that Tax competition seems to have changed from a focus on statutory rates to one on tax bases, with Patent boxes being singled out as an important driver.

On assessment of the literature, patent box mechanisms (non-OECD compliant) have only promoted the location or relocation of IP to the specific country with the favourable tax regime and that the actual R&D has remained in the host country. This suggests that the decisions on patent registration by firms may have little to do with developing research and innovation but a lot to do with tax planning. However, as is the case with this topic studies have also shown that R&D tax incentives are found to have a positive effect on patenting while a statutory corporate income tax rate has a negative impact on patenting. In reality, global tax competition is a major reason behind the implementation of patent boxes. By encouraging companies to hold patents locally, governments will establish and retain high value knowledge, manufacturing, and jobs. Despite the OECD taking a dim view of patent box regimes, they have remained popular with countries looking to increase foreign direct investment.

The OECD has identified patent boxes as a harmful tax practice, since they allowed many companies (notably the multinationals) to take advantage of extremely low effective tax rates, without supporting their IP with economic substance. Patent boxes can result in large decreases in tax revenue for all governments, including those engaging in such a policy. In this scenario, it is unclear how the spill over benefits from R&D are distributed between economies. It is now recognised that if a company is availing of R&D Tax incentives there is a need to align taxation with substantial research activity being developed by the company. BEPS has helped to regularise certain R&D tax policies. This may be an advantage to domestic firms as they will not be disadvantaged due to their limitations in accessing the benefits of tax-planning via multiple jurisdictions which would limit their ability to compete and grow in the global market. Overall the aim of patent boxes is to encourage firms to innovate. An agreement between the OECD and the EU resulted in the establishment of a nexus between the income deriving from IP and the expenditure incurred to develop this asset, for the income to qualify for the patent box preferential regime. Despite general concerns that IP Box regimes might not be very effective in incentivising R&D, the modified nexus approach allows the design of the regimes to strengthen the link between the tax benefit and real activity, by linking the patent box to IP created through domestic R&D activity.

The introduction of the Knowledge Development Box was designed to increase Ireland's attractiveness as an innovation hub by complementing the R&D tax credit regime through targeting the different stages of a company's intellectual property development. This new mechanism can be linked to knowledge spill overs associated with the underlying R&D activities as specific R&D expenditure must be accounted for. It's also important to note that the impact of a tax incentive on innovation will depend strongly on the strictness of its novelty requirement. Without elements of novelty, a tax incentive could stimulate imitation, rather than innovation. As this is the first study to investigate the KDB from an Irish perspective, there was no data available to compare findings and as such this work is the foundation for future studies. Conversations took place with Revenue, IBEC and the DJEI and from these meetings a detailed survey emerged and of the 122 responders, 38% of the response were from the CEO's, this gives validation to the relevance of this work and its timing. The analysis with regards to the findings from this survey as well as comparable published secondary data is utilised to give an overview of the companies and the sectors they represent.

As part of this study, it was deemed important to evaluate when companies were established or were set up in Ireland. Much of response to this survey was from Irish owned

firms which equated to 72% (86 out of 122 companies). This number closely matches the 79% of all Irish owned enterprises engaged in R&D activities in 2015 as found by the CSO. Of the remaining 28% from this study, 34 were foreign owned companies. Predominantly from the 90's, there was a steady increase in the growth in companies and sector activity. Considering the very nature of those companies rely on strong R&D pipelines and patent protection. It is important to note that earlier foreign companies which set up Ireland were mainly focused on manufacturing.

Of the 45 manufacturing firms represented within the survey 58% were Irish owned and 42% were foreign owned. In relation to the manufacturing sector, 31% were established between 1981-1990, 18% between 1991 and 2000, 16% between 2001 and 2010 and 18% between 2011 and 2016. Of the 68-research based or research performing firms, 73% were Irish owned and 27% were foreign owned. 10% were established between 1981-1990, 15% between 1991 and 2000, 22% between 2001 and 2010 and 40% between 2011 and 2016. From the information gathered from this study as well as the data provided by the CSO, the increase in growth of high value companies through the economic crash, can be attributed to many factors, such as tax incentives, young educated work force, competitiveness, open approach to innovation and business, and the strategic direction of the government to transform the Irish economy to that of a Knowledge economy.

Regarding Ireland's economy, there were 1900 registered R&D active firm in 2015, 694 or 37% of R&D active firms had R&D spend of under €100,000 which was the most popular spend category for manufacturing firms. Therefore, with strong reputations build up in the manufacturing sector as well as the formation of clusters, the emergence of strong multidisciplinary approached has lend itself to unrepresented growth in innovation within the economy. This is great indication of the importance of R&D, which lends itself to manufacturing and further innovations, thus, at a macro level this is a real indicator of an innovation lead economy.

Looking at the Government R&D Tax supports which are used to promote innovation, the Department of Finance have calculated that for each euro in foregone revenue, an additional €2.40 is generated in R&D. This suggests that the policy is achieving its aim of increasing R&D, but with considerable deadweight. Fundamentally the calculations have shown that roughly 40% of the R&D observed over the period would have occurred anyway, i.e. in the absence of the tax credit, while 60% of the R&D observed was due to the tax credit. From an

IBEC study which comprised of 247 firms, comments on the impact of the scheme were almost wholly positive and most firms to be a key element in their decision to invest in Ireland. But the scheme is not without its challenges. However, it is very important to note that not all companies avail of the R&D Tax credit and as such the Author suggests that the real indicator is the increase in BERD.

BERD showed that more than €2.2bn was spent on R&D activities by enterprises in Ireland in 2015, with €2.3bn estimated for 2016. However, when compared to the 2013-2014 figures there was a reduction from 2000 enterprises engaged in R&D activities in 2013, to 1900 in 2015. The Author is not sure if this is a trend and until the 2016 figures are collected, this reduction may be a once off. Looking back at previous years, the collected analysis found that the level of claims by R&D active companies has started to plateau in 2012 whereby the number of companies claiming the credits has reached on average 1500. This maybe the reason why the amount of companies claiming the credit has stabilised, which can mean;

1. All the companies that can avail of the credit has done so.
2. There is a natural balance achieved whereby the amount of companies no longer availing of the credit is replaced by new companies claiming the credit.
3. Elements of both.

On average, 80% of the R&D active companies are claiming the credit, up from an initial 6% in 2004. When asked if there was an awareness of the R&D Tax credit within their organisation, 95% of the survey response was Yes. This is an interesting finding, considering IBEC in 2013 found that almost one in three firms cited poor awareness of the credit as a reason for not using the credit. However, if awareness is one of the factors in not using the credit, this may contribute to the plateau which has emerged.

When asked if the firm has used or continues to use the R&D Tax credits; one third (31%) has not used the credit. For the 59% of companies which said Yes, a large majority were from the SEM and Multinational sector. Considering, the IBEC survey cites poor awareness as a reason but this is not the influencing factor regarding this survey. One probable solution is the increased awareness of the credit in recent years as well as the growth in the start-up sector. However, when asked if the R&D Tax scheme has been adequately promoted, only 47% said Yes even though 95% of responders are aware of it. This is concerning factor and it introduces doubt into the process and reasons why companies are not availing of the credit.

One important area, is that of job creation, 35% of the of the people surveyed said that the R&D Tax credit has helped create jobs, with 11% saying somewhat, equally 44% said it did not create jobs in the organisation. Looking at manufacturing based companies which responded to the survey, 41% of the responders said the credit has helped in the creation of jobs. And for R&D based companies, 32% said Yes to the credit helping to create jobs. What can be taken from this is that there is a clear indication that companies acknowledge that the credit is a factor in job creation. These are important indicators for the success of the scheme as job creation from new innovations is key driver in a Knowledge economy.

To promote innovation, the credit is important to future investment in Ireland, particularly in terms of FDI. Almost 70% of firms from the IBEC study state that the credit is important in their decision to invest in R&D, while 65% said it is important to overall investment in Ireland. However, in contrary to the IBEC study, when asked if the R&D Tax credit has been a strong factor in driving the company's innovation, 51% said no with 25% saying it is an important factor. Breaking this down, for R&D based companies 58% have said that the credit is not an innovation driver, while this is much more balanced for manufacturing based companies which tend to be more established.

Bringing the analysis together in relation to the R&D Tax credit, after 13 years in existence there is still confusion regarding the Tax credits. Administration was the main reason given by companies for not claiming the R&D Tax credit. The R&D tax credit is available in relation to unsuccessful R&D whereas the KDB requires that the R&D activities have resulted in a qualifying asset which has been commercially exploited. So, regardless if a company has or has not claimed the R&D tax credit for the activities resulting in the qualifying asset, they must provide evidence that these technical or scientific qualifying activities were undertaken.

A component of the KDB will be the requirement that a company needs to show income derived from a qualifying asset. There is some evidence of an increased awareness amongst Irish business that an ability to develop innovative ideas and to commercialise those ideas can contribute significantly to economic success. When asked how IP is protected within their organisation, some interesting results emerged. From the 97 responders, 47% say they patent their technology, 52% keeps it as a trade secret and 1% copyrights. Considering, Revenue expects that many claims under the KDB, in the long term, are expected to be in relation to income arising from inventions protected by patents granted. It is difficult to ascertain if there has been an increase or decrease in the amount of companies patenting their technologies and

how this will influence the KDB. But it is evident that companies are using more than one method of protection. The exact reasons for the decrease in patent filing numbers are not readily defined, however, it would suggest that the global economic recession has contributed to the decline, as 2008 appears to be the turning point where the decline across sectors started to emerge.

Certain forms of IP protection are not suited to some sectors this mirrors the conclusions from this body of work, where it was found that 52% of the responders say they protect by trade secrets (74% are Irish owned and 26% are foreign owned) and the 47% of companies who patent 66% are Irish owned and 34% are foreign owned. When asked if IP was a factor in the strategy of the company, 70% of the responders said Yes. This strengthens the argument that there is a growing emergence and awareness of the strength of IP protection, irrespective of how it is protected. With the decrease in companies patenting their technology, there is an emergence of non-patented protection, such as the trade secrets. This will influence the uptake of the KDB, where companies may decide (a) not to use it, or (b) patent their technology or (c) apply for the KDB certificate of invention.

Fundamentally, the R&D tax credit is available in relation to unsuccessful R&D, whereas the KDB requires that the R&D activities have resulted in a qualifying asset which has been commercially exploited. The ethos of this work is to investigate the awareness of the KDB and assess its viability as a government tax incentive. From the findings of this work, it is of interest to note that 67% of the responders are aware of the KDB which is an excellent response, considering 95% said they are aware of the R&D Tax credit which has been in existence since 2003. Of the 122 responders, when asked if they would promote the KDB to other colleagues, 38% say Yes. From a government position, this is a positive.

Recalling back to the rationale behind the OECD scrutiny of traditional Patent Box schemes, of the 99 responders from this study only 13% said Yes that they are influenced by the KDB being OECD compliant. With 37% saying No and a further 31% saying Not sure, it can be reasonably deducted that for most companies this is not an issue. When asked if their company has used Patent box schemes in other countries, 3% of the responders replied with a Yes. Interestingly, this result was from Irish owned companies. But the overall results do indicate that patent Boxes have not been used and a reason may be the complexity of the Tax systems prior to the OECD compliance.

To recall, Patent Boxes/KDB are government initiatives designed to attempt technology based companies from moving their company profits offshore to low tax jurisdictions. This is achieved by offering a lower rate of corporation tax to these companies from profits derived by their commercial exploitation. When asked if the if the reduction in the Corporation Tax would be the main deciding factor in utilising the KDB, 32% of the responders said Yes and 55% said it would be a factor but not the only one and 8% said No. In truth, there will be complexity which is by default inherent within the modified nexus formula which requires a demanding tracking and tracing requirement. This is because separate profitability streams will need to be calculated for each individual qualifying asset, in determining the extent of any tax benefit under the Irish KDB regime. This results in an administrative challenge that needs to be considered if pursuing the KDB.

A key component of the KDB is to encourage local R&D, when asked about the strategic importance of the KDB in relation to actual R&D, 19% of the responders said the KDB be a reason to locate R&D activity in Ireland. Of the 30% of responders who are no sure there is potential for them to follow earlier adopters and this will make the process more transparent while addressing apparent difficulties. There was a 50% response for No when asked if the KDB was part of their company strategy, compared to the 13% who said Yes. However, 26% of responders have said that the KDB would be a factor in project selection for new R&D projects in the pipeline, 21% said No and 31% saying they are not sure. Therefore, it is necessary for the Government is to encourage more companies to avail of the KDB through processes which eliminates the perceived barriers and complexities.

In summary, the overall ambition of the KDB is to be an innovation driver by providing an incentive to companies where profits arising from qualifying assets can effectively be taxed at a reduced rate of 6.25%. However, the complexity in allocating income and expenditure to each qualifying asset may limit the uptake of the scheme. Companies will need to ensure that their internal practices are aligned in such a way that the required information can be collated in a reliable and efficient manner. Equally, it is questionable whether patent box mechanisms will have an impact in stimulating domestic R&D activity, as companies may easily benefit from the regimes without carrying out R&D activity in the country the patent box is being claimed. From the viewpoint of the Government and the KBD, at a time of increasing global competitiveness it is important that Ireland remains competitive in an FDI context as other countries begin to amend their IP box regimes to become OECD compliant.

Recommendations

6.0 Recommendations for further study

1. Looking at the 14 indigenous ICT-Software companies within this study, 11 were formed between 2011 and 2016 and this reflects the strong start up culture within this sector. Considering 900 software companies occupy this space (a large majority are based in Dublin), it would lend itself to a very interesting study regarding influencing factors of growth for R&D Tax incentives for this sector.
2. An evaluation of the foreign owned companies in Ireland with regards to their usage of R&D tax incentives.
3. An assessment of the performed of R&D versus R&D Tax credits, preferably to conclude on whether the tax credit, with 40% deadweight, promotes research within a company.
4. Assess what are the key elements of firms in their decision to invest in Ireland from an R&D perspective.
5. An assessment of the drivers of BERD and the associated impacts of innovation.
6. An evaluation to BERD growth in Ireland to assess why there has been a decline in patenting (2006 onwards).
7. To develop an understanding of the views of both industry and government in relation to IP and IP protection.
8. Assess the impact of the KDB certificate of Invention against the reduction of patents within the country.
9. Assess the uptake of the KDB. Considering this incentive has come into effect since the first of January 2016, there is no data readily available which shows the extent of its usage throughout the various industry sectors in Ireland. This data for this study will be available in 2019.
10. To evaluate the complexity which is by default is inherent within the modified nexus formula which requires a demanding tracking and tracing requirement. This is because separate profitability streams will need to be calculated for each individual qualifying asset, in determining the extent of any tax benefit under the Irish KDB regime

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Appendix 1



The University of Dublin

Business R&D incentives in Ireland

Sector Information

Hi..... You are probably looking at max 10 minutes to complete (25 questions, mainly multiple choice). The questions within this survey (apart from the company name), will be used to gauge the views of each sector and company size. Thanks once again for you time and help, its greatly appreciated.....James

1. What is the name of your Company (Please note this information will only be used for filtering purposes and will not be part of the results)

2. In what sector is your Organisation/Company primarily engaged

- ☐ Agribusiness
- ☐ Chemicals
- ☐ Pharmaceuticals
- ☐ BioTech
- ☐ ICT-Hardware
- ☐ ICT-Software
- ☐ Electronics
- ☐ Med Tech
- ☐ Engineering
- ☐ Plastics
- ☐ Finance
- ☐ Professional services
- ☐ Education
- ☐ Other

3. Is your operation Irish owned or foreign owned?

- ☐ Irish Owned
- ☐ Foreign Owned

If Foreign Owned (please specify the country)

4. What category best describes your business?

- ☐ Start up
- ☐ Small enterprise (<50 employees)
- ☐ SME Irish Owned (50 - 250 employees)
- ☐ SME Foreign Owned (50 - 250 employees)
- ☐ Multinational Irish Owned
- ☐ Multinational Foreign Owned
- ☐ Other

5. How many employees directly work within your Irish operation(s)?

- ☐ 1-10
- ☐ 10-29
- ☐ 30-49
- ☐ 50-99
- ☐ 100-249
- ☐ 250-499
- ☐ 500-1000
- ☐ 1000
- ☐ 1000-2000
- ☐ 2000+

6. What is your role (best match) within the Organisation (this will be used to gauge functional views i.e does the CEO in a start up have the same concerns as a CFO in a multinational...etc)

- ☐ CEO
- ☐ COO
- ☐ CFO
- ☐ CTO
- ☐ CIO
- ☐ VP of Strategy
- ☐ General Manager
- ☐ Managing Director
- ☐ Director of Finance
- ☐ Director of Engineering/Science/Technology
- ☐ R&D Manager
- ☐ Tax Manager
- ☐ Software Development Manager
- ☐ Team Manager
- ☐ Product Development Manager
- ☐ Project leader/Module Leader
- ☐ Engineer/Scientist/Developer

Other (please specify)

7. Where is your company located? (If located in a number of regions, multiple choice is available)

- ☐ **Border Region** (Cavan, Donegal, Leitrim, Louth, Monaghan, Sligo)
- ☐ **West Region** (Mayo, Roscommon, Galway and Galway City)
- ☐ **Midland Region** (Laois, Longford, Offaly, Westmeath)
- ☐ **Mid-East Region** (Kildare, Meath, Wicklow)
- ☐ **Dublin Region** (Dún Laoghaire–Rathdown, Fingal, South Dublin and Dublin City)
- ☐ **South-East Region** (Carlow, Kilkenny, South Tipperary, Wexford, Waterford City & County)
- ☐ **South-West Region** (Kerry, Cork and Cork City)
- ☐ **Mid-West Region** (Clare, North Tipperary, Limerick City & County)

8. How long has your company/organisation been established in Ireland?

- ☐ <1950
- ☐ 1951-1980
- ☐ 1981-1990
- ☐ 1991-2000
- ☐ 2001-2010
- ☐ 2011-2016
- ☐ 2017+

9. How would you characterise your Irish operation?

- ☐ The strategic R&D centre of the global company
- ☐ The strategic R&D centre of the company
- ☐ A strategic R&D centre for a region, product or service
- ☐ Higher value support function
- ☐ Basic product or service
- ☐ Manufacturing
- ☐ Financial Services

Other (please specify)



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Knowledge Development Box (KDB)

This next set of questions will be used to get an insight into the awareness of the Knowledge Development Box (KDB). Basically, a company which qualifies for the KDB will be entitled to a deduction equal to 50% of its qualifying profits in computing the profits of its specified trade. In effect, the profits arising from patents, copyrighted software or IP equivalent to a patentable invention are taxed at 6.25% rather than at 12.5%.

10. How do you protect your Technology?

Patent	Keep it as a Trade secret	Copyright
☐	☐	☐

Other (please specify)

11. What in your opinion are the obstacles in developing intellectual property (IP) in Ireland?

- ☐ Not a company Policy
- ☐ IP is generated outside of Ireland
- ☐ Academic/Third level environment
- ☐ Cost to licence
- ☐ Cost to protect
- ☐ Too much administration
- ☐ legal requirements
- ☐ Complex background IP
- ☐ Licencing agreements
- ☐ Product lifecycle i.e. quick to market
- ☐ Other (please specify)

12. What in your opinion are the advantages of patenting your technology?

1.
2.
3.

13. If possible can you answer the following.

	Yes	No	Not sure
In relation to the technology, has the R&D been solely carried out in Ireland?	☐	☐	☐
In relation to the technology, has the R&D occurred outside of Ireland?	☐	☐	☐
In relation to the technology, has the R&D occurred in more than 2 countries i.e. the R in country x and the D in Ireland etc....	☐	☐	☐
Does IP factor in the strategy of the company?	☐	☐	☐

Any comments?

14. Have you heard about the KDB?, if so can you recall where you first heard of it.

	Colleague	Enterprise Ireland	IDA	DJEI	Internal company event	Conference	Academia	Business groups	Media	This survey	Never heard of it
Yes I heard of it	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
No I never heard of it	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Somewhat	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Not relevant	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Other (please specify)

15. If possible can you answer the following questions

	Yes	No	Not sure	Somewhat	N/A
Has your company used Patent Box schemes in other countries?	☐	☐	☐	☐	☐
In your view would the KDB be a new reason to locate R&D Activity in Ireland?	☐	☐	☐	☐	☐
Has the company placed the KDB in their R&D/company strategy?	☐	☐	☐	☐	☐
Have you heard about the KDB certificate of invention?	☐	☐	☐	☐	☐
Has the company new R&D projects in the pipe line, if so would the KDB be a factor in project selection?	☐	☐	☐	☐	☐
Are you influenced by the KDB being OECD (Organisation for Economic Co-operation and Development) compliant?	☐	☐	☐	☐	☐
Do you think the KDB has adequately been promoted ?	☐	☐	☐	☐	☐
Would you promote the KDB to other colleagues?	☐	☐	☐	☐	☐

16. Would the reduction in your Corporation Tax be the main deciding factor in utilising the KDB (12.5 to 6.25%)?

- ☐ Yes
- ☐ No
- ☐ It would be a factor but not the only one
- ☐ Other (please specify)

17. Are their plans in your organisation to use the KDB?

- ☐ Already using it
- ☐ Going to implement it next year
- ☐ No foreseeable plans to use it
- ☐ Will consider it in the future
- ☐ Not applicable to the business
- ☐ Other (please specify)

18. In your opinion, what are the barriers to using the KDB?



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R&D Tax Credits

19. If possible can you answer the following questions

	Yes	No	Not sure	Somewhat	N/A
Is your company aware of the R&D Tax credit?	☐	☐	☐	☐	☐
Has your firm used or continues to use the R&D Tax credits?	☐	☐	☐	☐	☐
Has the R&D tax credit been a strong factor in driving the companies innovation?	☐	☐	☐	☐	☐
Would you say that the credit has helped create jobs within your organisation?	☐	☐	☐	☐	☐
If your organisation is not currently using the R&D Tax credits, would the attraction of the KDB make you reconsider applying for the R&D Tax credit?	☐	☐	☐	☐	☐
Do you think the R&D Tax credits has adequately been promoted ?	☐	☐	☐	☐	☐
Have you an R&D or Innovation tab/link on your webpage	☐	☐	☐	☐	☐
Have you made a choice not to claim the R&D Tax credit?	☐	☐	☐	☐	☐
Would you recommend the R&D Tax credit to a colleague?	☐	☐	☐	☐	☐

Any comments?

20. In your opinion, what are the barriers to using the R&D Tax credits?

21. What improvement would you make to the R&D Tax credit scheme?



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Your views

22. If possible can you answer the following questions

	Yes	No	Not sure	Somewhat	N/A
Is the KDB worth pursuing within your organisation?	☐	☐	☐	☐	☐
In your opinion, is there uncertainty surrounding the advantages of the KDB?	☐	☐	☐	☐	☐
In your opinion, would the KDB encourage firms to locate valuable patents to Ireland?	☐	☐	☐	☐	☐
In your opinion, would the KDB encourage firms to locate valuable R&D to Ireland?	☐	☐	☐	☐	☐
Would you use the KDB as a mechanism to get support for the further development of projects?	☐	☐	☐	☐	☐
In your opinion, would the KDB be used to attract new jobs?	☐	☐	☐	☐	☐
Is there enough information available about the KDB?	☐	☐	☐	☐	☐

Any comments?

23. A stronger R&D environment is crucial to winning future FDI and mobile R&D investment projects-
Would you see the R&D Tax credit and KDB being part of this?

24. Have you thought about alternative ways the KDB can be used to help your organisation?

25. Finally, would you like to make any further comments or observations?

Appendix 2

Dear Colleague,

First, I would like to thank you for taking the time to read this mail. My name is James and I would like to invite you to participate in a survey, entitled "Business R&D incentives in Ireland." The study is being conducted by myself, under the guidance of Professor Frank Barry, Chair-International Business & Development, Business & Administrative Studies within the School of Business, Trinity College Dublin. This survey is part of my MSc thesis into R&D financial incentives for Industry.

The survey is generically designed to be answered by either financial, legal or technical personnel within an organisation. To be honest, the word Tax is used and I appreciated how this will turn people away from this study (my own background is engineering), but please don't be discouraged, I want to get a broad spectrum of views from all stakeholders within an organisation and detailed knowledge of Tax systems are not required.

The purpose of the overall study is to investigate if government based R&D Tax incentives such as the R&D Tax credit and Knowledge Development Box (KDB) have a real impact on actual R&D by Irish based companies and how this might incentivise the creation of future innovations.

There is no compensation for responding nor is there any known risk. To ensure that all information will remain confidential, neither your name or gender is included in the questionnaire. For filtering purposes only, your company name will only be used to eliminate multiple responses from the same company, and I promise it will not be included in any results. In this study, you will be asked to complete an electronic survey. Your participation in this study is voluntary and you are free to withdraw your participation from this study at any time. The survey should take no more than 10 minutes to complete and the questions are predominately multiple choice.

While you will not experience any direct benefits from participation, the total information collected in this study will be used to get a real understanding of views of the business community in relation to R&D, Intellectual Property, R&D Tax credits and the Knowledge Development Box. It is envisioned that the findings will be published and presented to the Department of Jobs, Enterprise and Innovation (DJEI) and any other relevant industry related bodies. I would be most grateful if you could pass on the mail with the survey link to fellow colleagues if you feel it would be relevant to them. Or if you are part of a third level research centre, industry group or incubation space would you be so kind to pass on this mail to your client companies (Thank you).

Thanks once again for you time and help, its greatly appreciated.

James

Dr James Kennedy

Survey Link

<https://www.surveymonkey.com/r/HC33387>

Appendix 3

Before presenting the ratio related to the regression result, it is worth remembering that for a firm who would not have undertaken any R&D at all without the existence of the tax credit scheme, the BFTB is 4 (1 / 0.25), given that the credit has been issued at 25% since 2009. For firms who would have undertaken R&D in full without the tax credit the BFTB is 0. This means that any BFTB less than 4 implies “deadweight” i.e. R&D that would have been conducted anyway by the private sector. Turning to the regression results, recall that the model used to obtain our result is as follows:

$$\ln(R\&D)_{it} = \alpha + \mu_i + \sum_{t=1}^{t=T} \delta_t D^{year\ t} + \theta D^{year\ post-treatment} \cdot D^{treatment} + \gamma \ln(employees)_{it} + \varepsilon_{it}$$

Our value for θ is 0.912. Its interpretation is the change in log R&D induced by a firm receiving a financial incentive to conduct R&D – all else equal. This implies that the expected value of the counterfactual R&D in the absence of the tax credit scheme for such a firm is:

$$\begin{aligned} \ln(R\&D)^{without\ tax\ credit} &= \ln(R\&D)^{with\ tax\ credit} - \theta \\ R\&D^{without\ tax\ credit} &= \frac{R\&D^{with\ tax\ credit}}{\exp(\theta)} \end{aligned}$$

We note that firms face an incentive to over-report their R&D expenditure in the Revenue data. To reduce the administrative burden, firms only must prove their R&D claims if Revenue audits them, and while Revenue operates an effective compliance programme to police claims, it remains the case that not every firm will be subject to official scrutiny. R&D expenditure on the corporation tax form is also supposed to be reported net of grant financing but not all firms may do this (accidentally or otherwise). We note, on this basis, that our estimate for BFTB may be biased upward.

Coefficient for average treatment effect	0.912
Exponent for coefficient	2.49
Observed R&D conducted in the post treatment period (2009-2014), in the presence of the tax credit	€10.4 billion
Counterfactual R&D: the R&D that would be conducted in absence of the credit	€4.2 billion
The additional R&D caused by the presence of the tax incentive: the difference between the observed and counterfactual R&D	€6.2 billion
Cost of the scheme (foregone revenue + repayable credit)	€2.6 billion
Bang for buck (BFTB)	€2.40

Note: the figures for nominal R&D assume that the behavioural response to the R&D tax credit, i.e. the coefficient for the average treatment effect, can apply in any time period.

Appendix 4

Business Expenditure on Research and Development	
2013-2014	2015-2016
➤ Enterprises that employ 250 persons or more had the greatest share of R&D expenditure in 2013 with just under 50% of all actual expenditure	➤ Enterprises that employ 250 persons or more had the greatest share of R&D expenditure in 2015 with just under 55% of all actual expenditure.
➤ Medium sized enterprises employing between 50 and 249 persons spent €576m in the same period which represents over 28% of total spend.	➤ Medium sized enterprises employing between 50 and 249 persons spent €503 m in the same period which represents over 23% of total spend.
➤ Small enterprises with less than 50 persons engaged spent almost €445m on R&D in 2013 which accounted for 22% of the spend.	➤ Small enterprises with less than 50 persons engaged spent almost €502m on R&D in 2015 which accounted for 22% of the spend.
➤ Over €1.2bn was spent on labour costs, which accounted for 61% of all R&D expenditure.	➤ Over €1.3bn was spent on labour costs, which accounted for 61% of all R&D expenditure.
➤ Current costs, which include materials, supplies, equipment and overheads associated with R&D, had an associated cost of nearly €636m which accounted for 31% of total expenditure.	➤ Current costs, which include materials, supplies, equipment and overheads associated with R&D, had an associated cost of nearly €726m which accounted for 33% of total expenditure.
➤ The remaining expenditure of €147m was accounted for by capital expenditure with just over 50% of capital expenditure being spent on Instruments and Equipment wholly acquired for R&D purposes.	➤ The remaining expenditure of €157m was accounted for by capital expenditure with just over 53% of capital expenditure being spent on Instruments and Equipment wholly acquired for R&D purposes.
➤ R&D spending was highest in the services sector which accounted for 57% of all expenditure. Spending in this sector was just under €1.2bn in 2013 while the manufacturing sector spent over €864m on R&D.	➤ R&D spending was highest in the services sector which accounted for 61% of all expenditure. Spending in this sector was just under €1.4bn in 2015 while the manufacturing sector spent over €876m on R&D.
➤ 90% of all R&D expenditure was funded by enterprises' own company/internal funds, while 6% of expenditure was funded from public funds. Small enterprises were more likely to use public funds, with 9% of funding for these enterprises attributed to public funding.	➤ 88% of all R&D expenditure was funded by enterprises' own company/internal funds, while 6% of expenditure was funded from public funds. Small enterprises were more likely to use public funds, with 7% of funding for these enterprises attributed to public funding.

➤ There were nearly 2,000 enterprises engaged in R&D activities in Ireland in 2013. More than 74% of all enterprises spent less than €500,000 on R&D activities. Just over one sixth spent between €500,000 and €2m, while only 10% of enterprises spent €2m or more on R&D activities.	➤ There were nearly 1,900 enterprises engaged in R&D activities in Ireland in 2015. More than 73% of all enterprises spent less than €500,000 on R&D activities. Just over one sixth spent between €500,000 and €2m, while only 10% of enterprises spent €2m or more on R&D activities.
➤ In 2013, nearly 1,500 small enterprises were engaged in R&D. They accounted for 73% of all R&D active enterprises compared with 378 medium enterprises which accounted for 19% of R&D active enterprises and 143 large enterprises which accounted for 7% of all R&D active enterprises	➤ In 2015, nearly 1,300 small enterprises were engaged in R&D. They accounted for 71% of all R&D active enterprises compared with 386 medium enterprises which accounted for 21% of R&D active enterprises and 166 large enterprises which accounted for 9% of all R&D active enterprises