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# The Relationship between Tax Payments and MNE's Patenting Activities and Implications for Real Economic Activity
Evidence from the Netherlands

Mark Vancauteren, Michael Polder,
and Marcel van den Berg

## 7.1 Introduction

It is well known that in a globalized economy, intellectual property (IP), such as patents, trademarks, and copyrights, is a key driver of international competitive success. Many governments worldwide have indeed put innovation as a stimulus to growth at the forefront of their industrial policy agenda providing fiscal incentives, such as R&D tax credits and patent boxes, to firms investing in R&D.

A sizable literature on the effectiveness of innovation-related tax incentives exists. However, the use of such tax incentives raises the concern of policy makers about yet another tax device that can be employed by firms for tax structuring purposes in the sense that IP-related profits of multinational enterprises (MNEs) can be segregated from ordinary profits across borders. These concerns have been a driver of discussions in the context of the OECD Base Erosion and Profit Shifting (BEPS) and of the EU code of conduct on business taxation with the aim to align taxation with substantial research activity. Because of the opportunity of tax structuring, one should be cautious when interpreting the evidence of the effectiveness of innovation-related tax incentives, as this may be driven by a shift in inno-

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vation efforts from one country to the other rather than an increase in net investment in innovation.

The chapter's focus on the Netherlands provides an interesting case for several reasons. First, MNEs are important in the Netherlands. We define an MNE either as a firm with a foreign mother firm or a Dutch firm with daughter firms abroad. A recent report issued by Statistics Netherlands (CBS 2018) finds, among other issues, that turnover of MNEs amounts to one-quarter of the total turnover and has increased by more than 37 percent between 2010 and 2016. On the other hand, the employment share of MNEs is much lower and amounted to 11 percent in 2016. In addition, it has also been found that MNEs do more R&D and innovate more in comparison to non-MNEs. Second, Netherlands has put several tax instruments in place to lower taxes on R&D and IP-related innovation activities. Under the so-called Dutch innovation box (originally introduced as patent box), income derived from innovations is subject to lower effective tax rates. This benefit can be utilized by any MNEs, that is, foreign companies with operations in the Netherlands as well as by Dutch firms with income derived from various types of intangible assets abroad. This accentuates the globalization issue as well as the key concern that a particular tax scheme must be tied to real economic activity.

The focus of our chapter is to empirically investigate the relationship between tax payments and firms' innovation activities. In particular, we are interested in finding out to what extent innovative firms pay lower taxes and whether they take advantage of tax credits in their real economic activity and how this differs between domestic firms and MNEs. The key methodological challenge in this relationship is to separate the tax structuring motive from the technological motive, which concerns real economic activity rather than fiscal activity. To investigate the existence of a direct channel between innovation efforts and tax payment, we employ different measures of R&D efforts. We consider firm-level patent count applications, R&D expenditures (investments and labor input), as well as R&D-related tax reductions, taking also into account other determinants of firm-level taxation. A major advantage of using patent applications is that the time of filing or applying for a patent coincides very closely with the time that innovative activities take place within a firm (Nagaoka, Motohashi, and Goto 2010).

Our empirical results show that firm-level patenting activities lead to lower tax payments. Indeed, this may be an indication that MNEs shift their IP and R&D related assets, usually at relatively low costs, to countries with a beneficial innovation tax regime. This finding is in line with (the small body of) existing evidence. However, several factors may weaken the relationship between tax payments and innovation efforts. For instance, MNEs usually arrange protection of intellectual property rights in all countries in which they are active. In addition, tax schemes not specifically targeting R&D

and innovation may also affect the decision to locate activities in a certain country. Therefore, we also investigate to what extent R&D investments per employee induce lower tax payments, putting the hypothesis of real economic activities to the test. Our evidence confirms the existence of a positive relationship between R&D success (measured by R&D investments per employee and the number of patents) and reduced tax payments. When we consider several subsamples, our results show that the negative relationship between firm-level patenting activities can only be ascertained by domestic firms and not by the part of MNEs that have foreign headquarters. This all leads us to infer that the Dutch tax regime provides a stimulus to a conducive environment for innovation.

In the next part of the chapter, we zoom in on a specific tax measure to stimulate innovation, which is the innovation box, and study whether firms that take advantage of the innovation box regime also increase their real economic activities. The benefits of the innovation box regime are tied to a minimum requirement of R&D personnel that are subject to pay taxes in the Netherlands. We hypothesize that the labor productivity of firms that utilize the innovation box and R&D related tax credits is higher than the productivity of firms that are not engaged in any of these tax policies. Using a decomposition analysis, we find evidence supporting our hypothesis: firms utilizing the innovation box regime have a higher labor productivity than firms that do not. Furthermore, we find that while the productivity premiums vary across industries, it does not vary systematically between the services sector and manufacturing. We augment our hypothesis by linking labor productivity to profits. Therefore, we also consider a firm's profit as a share of wages, which relates more directly to employment. Our results show that firms that receive an innovation box also report higher profit-wage ratios in comparison to all other firms within a particular sector; however we do not find any convincing evidence across sectors of a situation of high profit-wage ratios and low labor productivity premiums.

Our data consist of an unbalanced panel of patenting firms. The firms in our sample are enterprise groups (the highest national aggregate of the firm) located in the Netherlands, but not necessarily the ultimate parent firm, since foreign control is possible (and controlled for in the analyses). The statistical unit "enterprise group" is essential in the construction of data sets concerning patent data, because firms may register patents (and R&D) under different firm names. Generally speaking, the ownership of a patent applies at the level of the enterprise, and it is practically impossible to link ownership to affiliate or plant level.

We consider two data sets. First, when looking at the relationship between innovation activities and tax payments using regression analysis, we consider a panel covering the period 2000–2010. We work with data including financial information, R&D expenditures, patent application counts, forward citations of these counts, and the utilization of the innovation box regime. A second data set covers the period 2011–2015, which matches population data on the innovation box and the R&D tax credit regime, enabling us to verify to what extent R&D- related tax deductions are related to productivity in conjunction with profits and hence real economic activity.

Profit shifting across borders has implications for the measurement of economic activity in the national accounts, the conceptual scope of which is by definition confined by national borders. Such profit shifting can be the result of differences in tax rates and policies between countries. Distortions in the measurement of national aggregates arise when income from abroad is shifted to a lower tax jurisdiction, without a contribution to actual economic activity. For example, an innovation can be developed outside the Netherlands, but its intellectual property can be allocated here to profit from the tax benefits. This leads to additional income in the Netherlands, without any actual economic activity, and vice versa leads to lower income in the country where the development has taken place. Our analysis sheds light on whether, and to what extent, national tax incentives around innovation lead to a distortion in the national accounts of the Netherlands.

The remainder of the chapter is organized as follows. Section 7.2 presents a review of literature dealing with the relationship between innovation, tax payment, and real economic activity. Section 7.3 outlines our hypotheses. Section 7.4 describes the data. Section 7.5 presents the empirical model. In section 7.6 we present the estimation results of the model. Section 7.7 looks at real economic implications, while section 7.8 discusses implications for the national accounts and concludes.

## 7.2 Background and Related Literature

A compelling body of empirical literature shows that MNEs tend to shift income across borders (see Hines and Rice 1994, and Desai and Dharmapala 2009, among others, for an overview of the literature). The consensus is that MNEs face a significantly lower tax burden compared to domestic firms which do not have access to international tax strategies. For instance, Egger, Eggert, and Winner (2010) estimate that foreign ownership reduces the tax burden by about 56 percent. Firms can shift income across borders in two ways. First, they can locate the economic activities that generate income in the most beneficial location. For instance, a firm can choose to locate its R&D center in a country that provides the most stimulating environment or the most R&D friendly tax regime. This offers firms the opportunity to minimize tax payments on the income generated from these activities. The OECD (2008) provides some evidence on the estimated impact of tax rate differences on location choice and note that on average a reduction of the effective tax rate of 1 percentage point in one country leads to an investment increase of 3.7 percent in that specific country. Second, firms can also strategically price intra-firm transactions of goods and services (transfer pricing) to minimize the total tax burden by directing profit margins to the most tax-optimal location.[1]

In order to minimize tax payments, firms need to decide strategically where to locate tangible investments, human capital, and IP investments. De Simone, Mills, and Stomberg (2019), using IRS data on cross-border intra-firm transactions of US firms, show that the likelihood of US firms shifting income out of the country is positively related to subsidiaries in tax havens, high-tech operations, income tax incentives, R&D investment and foreign profitability, and negatively related to foreign sales, gross profits, and capital expenditures.[2] Grubert (2003) estimates that about 50 percent of US MNEs' shifting of income to low tax countries can be accounted for by income from intangibles linked to R&D and IP activities. Intangible assets create opportunities for income shifting because it is less costly for intangible assets–intensive firms to relocate their assets in comparison to capital-intensive firms (De Simone, Mills, and Stomberg 2019). One of the attractive features of IP is that ownership can be separated from the innovative activity, implying that firms can strategically claim ownership in favorable locations in term of taxation. This leads to a tax strategy in which firms shift income by locating their patent activities in a country with a favorable tax rate and selling the right to use the patent (licensing) to affiliates in high tax countries.

### 7.2.1 Innovation Box Regimes

Innovation is considered to be an important determinant of firm growth (Hall and Sena 2017). Therefore, many governments provide incentives for firms to innovate and to attract and retain MNEs by, for instance, providing tax credits on R&D or IP. Over the last decade, so-called patent boxes were introduced, referring to the introduction of reduced tax rates on revenues derived from IP and patent royalties. Comparing across countries, these patent boxes are very heterogeneous in their design. For instance, in the Netherlands, the patent box applies to intangible assets that are self-developed and also covers intangible assets resulting from the efforts of

1. Note that intra-firm transactions are required to be settled against market prices according to the Dutch corporate tax law. However, as noted by OECD (2015), "there is room to manoeuvre, especially in the case [. . .] of knowledge content and/or brand reputation, or in [other cases where] products [. . .] are not marketable [and therefore] it is not possible to apply a true market-equivalent price," (op. cit. p. 492).

2. De Simone, Mills, and Stomberg (2019) use several proxies for intangible intensity. These include R&D, advertising (AD), "intangible assets" from the balance sheet, and selling, general & administrative costs (SG&A). AD expenses are a proxy to capture the investments such as self-created IP and brand value that are not capitalized; SG&A is a proxy for intangible assets so to capture investments related to administrative support, such as legal costs associated with patent and trademark expenses.

R&D labor. Alternatively, under the Belgian patent box regime, the patent must have been developed by the firm in an R&D center that qualifies as a branch of activity.[3]

A relevant strand of literature focuses on the way innovation is affected after an innovation box is implemented using patent data. For instance, Karkinsky and Riedel (2012), using data for European MNEs during the period 1995–2003, find a negative relationship between the difference in the relevant corporate tax rate imposed on an affiliate and other firms in the multinational enterprise group and the number of patent applications filed by the MNE affiliate. In particular, the authors find that a 1 percentage point increase in the corporate tax rate reduces patent applications filed in that location by around 3.5 percent. Alstadsaeter et al. (2015) employ a rich firm-level data set concerning the top 2,000 corporate R&D investors worldwide covering the period 2000–2011. The authors show that offering a patent box regime is positively and significantly associated with attracting patents. Interestingly, a similar conclusion can be drawn for high-quality patents, which the authors consider as proxy for innovation with high earning potential. Related studies investigating to what extent innovation box regimes affect the location of firms' IP assets (Ernst and Spengel 2011; Bradley, Dauchy, and Robinson 2015; Gao, Yang, and Zhang 2016; Hassbring and Edwall 2013; and Koethenbuerger, Liberini, and Stimmelmayr 2016) come to similar conclusions.[4]

### 7.2.2 Implications for the Real Economy

The empirical evidence discussed so far does suggest that, generally speaking, tax rate reductions have strong effects on attracting patents. However, firms' patenting strategies may be heterogeneous when linked to the geographical dimension. Patent applications are affected not only by corporate tax rates in the host country but also by factors such as market size, competition intensity, the quality of the regulatory system, protection of IP rights, as well as firm internal characteristics (quality of R&D personnel). For example, in an online survey asking why firms remain in the Netherlands, den Hertog et al. (2015) report the following location determinants in order of importance: availability of qualified personnel, geographic location, personal preference, availability of knowledge centers, R&D know-how, and policy related innovation incentives.

For several reasons, the link between location, tax payments, and the innovation remains an empirical question which provides the central tenet of this

3. Patent box regimes were initially designed as an incentive to boost European R&D activity. Currently, there are seventeen countries in the world that have adopted innovation box regimes. Patent boxes have larger scopes than just patents and may additionally include trademarks, model designs, copyrights, domain names, trade secrets (see Alstadsaeter et al. 2015).

4. The empirical setups for analyzing how tax deductions may impact patent activities are different in some of these papers.

chapter. First, as pointed out by Chen et al. (2016), firms generally file for patent protection in all countries in which they are operatively active. Therefore, the association between IP related tax reductions and income shifting in a particular jurisdiction is unclear ex ante. Second, there is the threat of a crowding out effect. For instance, Evers, Miller, and Spengel (2014) note, in the context of patent box regimes, that firms may already take advantage of alternative tax incentives available to them, watering down the importance of patent box related tax advantages. In addition, firms may relocate their IP income related activities but not their real economic activities. Third, the effective tax payments resulting from the patent box are also influenced by the design of the tax facility. In some countries, like the Netherlands, tax deductions are on the basis of net incomes after R&D cost deductions, to ensure that at least some real activity is associated with the patent box tax credit. In addition, the so-called nexus approach, recently introduced by the OECD and the G20, is also a tax policy design aimed at ensuring that firms establish a clear link between real costs and benefits before taking advantage of relief tax facility. Consequently, the difference in effective tax payments between patenting firms that do not qualify for this type of tax policy and non-patenting firms may disappear.

A primary reason firms invest in, for instance R&D, is to increase their ability to innovate, which in turn provides opportunities for differentiation, organizational renewal, growth, and profitability. Indeed, one of the primary intents of introducing lower tax rates tied up to IP profits is also to encourage domestic innovation, which in return may lead to IP related spillovers that are beneficial to growth, and hence the real economy.[5] In some countries, including the Netherlands since 2008, the patent box regime modified its scope and also covers provisions specifying the link with the underlying research activity, in addition, small and medium sized firms are now also included in the eligibility process.[6]

There is some interesting empirical evidence on the economic effects of R&D related tax credits. For example, Alstadsaeter et al. (2015) look at cross-country mobility of inventors. They investigate whether patent applications lead to an increase in the number of inventors located in the country of patent registration and whether this occurs at the expense of the number

5. For instance, to ensure such aims is the discussion in the context of the OECD Base Erosion and Profit Shifting (BEPS) and at the EU code of conduct on business taxation with the aim to align taxation with substantial research activity. This in turn enforces high tax countries' policy to restrict the outflow of patents and other intangible assets from the host county to low tax economies. Policy measures to circumvent such practices are for instance, tightened legislation which makes foreign income taxable at the parent location. Another instrument was introduced in Germany in 2008, which allowed German tax authorities to tax a fraction of the future income generated from patents and other (intangible) assets developed in Germany even after the relocation to a foreign income.

6. See Evers, Miller, and Spengel (2014) for a detailed overview on innovation boxes in an international perspective. In the appendix we provide a short discussion on the patent box initiatives in the Netherlands.

of inventors located at the parent company.[7] The results show that locational shift of patents due to the existence of patent box regimes does not induce a corresponding shift in the base of inventors. Chen et al. (2016), using data of US and EU multinationals' subsidiaries from 2006 to 2014, find evidence that the introduction of innovation box regimes is associated with labor increases but do not result in significant increases in fixed asset investments. Using US located firm-level data for the period 1987–2010, Gao, Yang, and Zhang (2016) regress multiple measures of firm-level tax payments on the number of patents as well as variables intended to capture patent counts and R&D success measured by patent application and citation counts per R&D dollar, with the premise that R&D investments lead to higher productivity of the innovation process.[8] They find robust evidence that patenting activities are strongly related to lower levels of taxation and this relationship is more pronounced for innovative firms located in states that have R&D tax credits. However, R&D success (i.e., filing of a patent) is not related to lower levels of taxation. Hence, these results suggest that firms are not inclined to allocate part of their income savings in higher R&D investments. Koethenbuerger, Liberini, and Stimmelmayr (2016), using data of European subsidiaries for the period 2007–2013, find that firms directly or indirectly owning patents (within the enterprise group) before patent box regimes were introduced, report on average 2.5–3.9 percent higher pre-tax profits compared to firms not owning patents. However, if the patent box regime only applies to newly created patents requiring a certain amount of R&D activity, the difference in profits between the two groups disappears. The results indicate that the nexus approach seems to be an effective instrument to prevent profit shifting and to encourage real R&D activity.

## 7.3 Hypotheses

Empirically, the focus of the chapter is to investigate the relationship between various measures of tax payment and firms' innovation activities. The central premise of this chapter is that innovating firms pay less taxes. Among other countries, the Netherlands has implemented the innovation box regime, which, by design, creates a tax-wise favorable environment regarding income generated from intangible activities (patents, R&D). We use historical data on patents, as well as R&D efforts and financial performance measures, as extra controls to isolate the impact of innovation efforts on tax payments. Taking heterogeneity in patent citations into account

7. CEC (2014) points out that for EPO patent applications, the country of the inventor is not a reliable source, as applications are not legally required to inform the EPO about the addresses of the inventors.

8. R&D investments are usually regarded as the input side of innovation generating innovation output in the form of patents, new products, and/or processes, and hence, is therefore an important control for explaining patents (see Vancauteren et al. 2017).

enables us to separate the quantity and the quality component of patenting. That is, whereas a simple unweighted yearly sum of a firm's total patent counts is indicative of its volume, using information on the forward citations of these patents, we are capturing the quality effect of these patents. Higher patent quality implies a higher value of the innovation. According to the literature, important determinants of patent quality are firm efficiency (Nagaoka, Motohashi, and Goto 2010), the willingness to take risks and accept uncertainty (Harhoff et al. 1999), and the investment in seeking network technological externalities (Capaldo and Petruzzelli 2011).

In order to separate purely tax motivated patenting activities from patenting activity derived from real economic activity stemming from local R&D efforts, we also investigate the role of (local) R&D investments. A primary reason for firms to engage in R&D is to increase their ability to innovate, which in turn provides opportunities for productivity growth. However, R&D investments are risky, since firms must incur (considerable) costs in the present period with uncertain gains in the future (Roberts and Van Anh 2013).[9] These anticipated gains and the necessity to invest in R&D in order to spur firm growth are more likely to be realized if they are evaluated over a longer time period. This indicates that R&D activities may be perceived as a way to achieve long-term goals, suggesting that not only patent activities but also R&D investments are an important driver of firm growth. Specifically, if the Dutch taxation climate is actually conducive to the knowledge economy as a driver of economic growth in the sense that it stimulates firms to invest in R&D locally, we should not find a significant difference between R&D efforts (input) and innovative output (i.e., patents) in the relationship with taxation.

These considerations can be operationalized into the following first set of hypotheses:

H1: The number of patents filed by firms is positively associated with lower tax payments.

H2: Innovation success measured by the number of patents and R&D investment per employee is positively associated with lower tax payments.

The proposed analysis should yield an empirical answer to the question of how tax credits relate to innovation among patenting firms. By incorporating R&D investments, we also put (to some degree) the hypothesis of real economic effects to the test. Further, if firms locate their innovation activities (both R&D and patenting activities) in a particular country merely to take advantage of tax benefits, this would have real economic implications. We dig into this issue by investigating to what extent innovation translates

9. The paper of de Haan and Haynes (2018) discusses dynamic R&D externalities and how this impacts national accounting measurement.

into higher productivity in terms of a more efficient allocation of resources, even though empirical evidence shows that tax incentives simultaneously provoke misallocation of resources.[10] To sort this out we use a standard (productivity) decomposition approach to discern productivity differentials across sectors between firms that utilize these tax policies and firms that do not. In line with hypothesis 1 and 2, the third hypothesis states:

H3: The productivity contribution of firms utilizing innovation related tax credits is higher than the employment-weighted productivity of firms that are not engaged in this type of tax scheme.

We augment our hypothesis by linking labor productivity to profits. Therefore, we also consider a firm's profit as a share of wages, which relates more directly to employment.

## 7.4 Data

We compile a panel data set derived from various data sources for our analyses. First, we employ a data set that consists of an unbalanced panel of over 2,700 firms situated in the Netherlands, representing the entire population of firms that has applied for at least one patent during the years 2000–2010. The level of analysis is the enterprise group (the highest national aggregate of the firm) located in the Netherlands. We match the patent data to financial information using the general business register (GBR, the backbone of the firm-level statistics process in the Netherlands) and the database for nonfinancial enterprises in order to be able to connect tax payments and patent related activities. Second, we utilize a data set consisting of an unbalanced panel of 343,025 enterprise groups, which we match with the firm-level population data on the utilization of two tax instruments for the stimulation of innovation: the innovation box and the WBSO covering the period 2011–2015. WBSO is a Dutch acronym for Promotion of Research and Development Act.[11] Earlier data on the innovation box and the WBSO are not available.

### 7.4.1 Patents and Firm-Level Data

To collect information about the firms that applied for at least one patent, we used the database of the total population of filed patents in Europe (of the European Patent Office, EPO). The patent data give us information about the application number, the patent owner (name of the firm), patent title, name of the inventor, year of publication, and location. Since firms may register patents under different firm names, we retrieve information regarding the firms' complete ownership structure to match the names of

10. Pioneered in Restuccia and Rogerson (2008), the literature has looked at factors in explaining misallocation. These include among others labor and capital tax exemptions, but also institutional differences as well as input and output market imperfections.

11. In Dutch: Wet Bevordering Speur- en Ontwikkelingswerk.

patents with the direct ownership of the enterprise group of all their subsidiaries, holding units, and their shareholders. This yields a data set with patents matched to enterprise groups from the GBR.[12] With this database, of all the EPO patent applications, 98 percent were matched with a firm (enterprise groups) from the GBR. The matching procedure linking firms to patent applicant is based upon name and address matching, which for some few cases resulted in name inconsistencies. Applicants that involved private persons were not taken into account.

We match consolidated financial information and foreign ownership information of MNEs located in the Netherlands to our entirely patent firm-level data set. These full population data cover the years 2000–2010 to arrive at a sample of 14,981 firm-year observations of 2,704 firms. These firms are in turn matched to a subsample of firms reporting R&D activities. We extract R&D data from the Community Innovation Surveys (CIS waves) and R&D surveys that are collected by Statistics Netherlands. The R&D surveys report R&D expenditures in the odd years while each of the CIS waves measures R&D expenditures in the even years of our sample period 2000–2010. R&D responding firms that are included in either the R&D and CIS waves are representative of the total firm population in the Netherlands (GBR population defined in December of each year). Firms are stratified according to their economic activity (two-digit NACE) and size class of the firm.

We retain 3,598 firm-year observations distributed over 1,053 firms. To get an idea of their relevance, we note that a total of 36,000 patents applications are retained in the sample, while around 50,000 patents were filed in the total population of the patenting firms before the R&D match was made. This amounts to 75 percent of the total number of patent applications. Possible bias in our estimation due to sample selection, that is, only considering firms that are both engaged in R&D and patenting activities, is examined in our analysis.

Summary statistics of our key variables (transformed to fit our analysis) are shown in table 7A.1. The statistics are based on the sample of firms concerning the period 2000–2010. The unweighted average firm in our sample applies for approximately 1.6 patent counts a year and spends on average 4.8 thousands of euros of R&D per employee. The average annual tax payment as a percentage of pre-tax financial income is equal to 24.3, which is very close to the Dutch corporate tax rate of 25 percent.[13] We also note that the distribution of the patent variables is quite skewed, while the other vari-

12. We refer to Vancauteren et al. (2017) for a more detailed description of the data. The paper applies a firm-level analysis using EPO patents for the period 2000–2006. For the purpose of this paper, we extended the database to the most recent year (2010) that can be retrieved from the PATSTAT database within Statistics Netherlands.

13. During our sample period, the taxation rate was much higher. For instance, till 2003 the highest possible rate was 35 percent; this can be reconciled with the overall distribution of our sample taxation rate.

ables are generally more evenly spread. In the specification of the regression equations we account for multiple number of firm financial and innovation characteristics. Along with their conclusions, they might potentially generate multicollinearity problems. The correlation matrix of the variables is presented in table 7B.2. Generally, we observe low correlation coefficients for most of the variables. Low correlation coefficients indicate that multicollinearity is not a problem.

### 7.4.2 WBSO Tax Credit and Innovation Box

Firms have to supply information on the number of hours of labor invested in R&D and the associated wage costs on an annual basis to be eligible for the WBSO. The WBSO only considers a credit for real R&D activities; R&D management is not taken into consideration. The match between the WBSO data (registered on the Chamber of Commerce number of the firm) with the GBR is set at the consolidated enterprise group level. The WBSO data are available for the period 2011–2015.

The innovation box data are registered at the level of fiscal units, which are the legal entities used by the Dutch tax authority. These units can be matched to the enterprise groups of the GBR. It is important to note that the innovation box concerns profits that are derived not only from patents but also from other intangible assets. Under certain circumstances, the patent is the intangible asset itself or the patent constitutes some part of the intangible asset. The innovation box data are available for the period 2011–2015. The data include information on the profits derived from the intangible assets, given they exceed a threshold value, and costs that are associated with it.[14]

## 7.5 Empirical Implementation

The following section presents our estimation strategy when examining the impact of patenting activities on tax payments. This analysis is based on our panel data set covering the period 2000–2010, which enables us to investigate whether tax payments are correlated with patenting activities and patent quality. Our data also allow us to investigate to what extent the introduction of the innovation box has accentuated this relationship for 2010, the initial period for which we have innovation box data.

We start by estimating the following equation to examine the effects of innovation activity (patenting) on tax payments:

14. We refer to a recent report by Statistics Netherlands (CBS 2017) on its collection of R&D, the innovation box and other dimensions of innovation. See also table 7B.3, which gives an overview of the number of firms that applied for the innovation box and that have applied for a WBSO tax credit during the period 2011–2015. The table indicates that there is complementarity between R&D input and innovation output: out of the 5,343 innovation box users, 3,312 firms have also applied for the WBSO. Notice that there are also still a significant number of firms that are granted a WBSO tax credit but that do not apply for the innovation box. Or in other terms, a considerable number of firms reports R&D input, but no innovation output.

$$(1) \quad TAX\,PAY_{it} = \beta_0 + \beta_1 PAT_{it-k} + \beta_2 \mathbf{X}_{it} + Year\ \&\ Industry\ Effects + \varepsilon_{it}$$

where we let a firm be indicated by the subindex $i$ and time by the subindex $t$ and $TAX\,PAY_{it}$ is the firm's effective tax rate. $TAX\,PAY_{it}$ equals the ratio of taxes paid divided by financial income (i.e., profit before taxes). Based on empirical models used in the corporate tax payment literature (Dyreng, Hanlon, and Maydew 2008, 2010; Mills, Nutter, and Schwab 2013; Gao, Yang, and Zhang 2016), a firm's effective tax payment, $TAX\,PAY_{it}$, is a widely used measure not only for evaluating a firm's ability to minimize income tax but also for evaluating a firm's strategy to defer tax payments to later periods (Erickson, Hanlon, and Maydew 2004).

The variable of interest is $PAT_{it-k}$ which expresses a measure that captures a firm's patenting activities[15] (#patents and patent counts per unit R&D), all expressed in logs. We allow for several $k$ time lags as patenting activities and tax payments may not coincide contemporaneously. The vector of independent variables $\mathbf{X}_{it}$ represents firm's characteristics, and $\varepsilon_{it}$ is a random error with specific clustering at the firm level. We also include year and industry effects to capture additional unobserved heterogeneity.

We include the following independent variables in the vector $\mathbf{X}_{it}$ to explain the firm's effective tax rate: total assets ("Assets") measured in logs, the return on assets ("ROA"), the ratio of long-term debt to assets ("Leverage"), the ratio of tangible capital to total assets ("Tangible"), the ratio of intangible income to total assets ("Intangible"), the ratio of inventory to total assets ("Inventory"), R&D investment per employee[16] measured in logs, and a dummy ("Ownership") that takes the value 1 if the firm is foreign owned. The choice of these variables is based on previous studies with respect to explaining firm-level tax payments (see, e.g., Gao, Yang, and Zhang 2016; Dyreng, Hanlon, and Maydew 2008, for a recent review).

The variable Assets, a proxy for the size of a firm, is expected to be negatively correlated with tax payments because it is argued that larger firms are able to work the tax system better than do smaller firms (Mills 1998; Dyreng, Hanlon, and Maydew 2008) and have greater resources to engage in tax planning to reap the benefits from tax shelters (Gao, Yang, and Zhang 2016). We also include firms' profits, ROA, and hypothesize that profits and tax payments are positively correlated (Gupta and Newberry 1997; Mills, Nutter, and Schwab 2013). On the other hand, more profitable firms have a larger incentive to engage in tax structuring due to their greater potential of cost savings (Manzon and Plesko 2002; McGuire, Omer, and Wang 2012). The variables a firm's leverage, its fixed tangible and non-tangible capital capture firm characteristics that may also affect a firm's income tax liability.

15. We refer to the data section for further details on these measures. Table 7B.1 in the appendix lists all the variables and its definitions that are considered for this paper.

16. To avoid firms with reported zero investment to drop out of the sample, we use 1+R&D per employee.

Firms with a higher leverage (Leverage) have been found to pay lower taxes (Desai and Dharmapala 2009) and, regarding MNEs, have a greater incentive to locate their leverage in high tax jurisdictions (Gupta and Newberry 1997). Generally, these studies posit a negative relationship between leverage and tax payments. We also control for the ratio of tangible capital to total assets (Tangible) and non-tangible capital to total assets (Intangible), which is expected to be negatively related to tax payments. This is because capital intensive firms have lower tax burdens as a result of legislated tax shields (Gupta and Newberry 1997). Moreover, intangible assets may provide more profit shifting opportunities. In addition, countries often offer tax policies aimed at the promotion of investments, which provides tax planning opportunities (Mills, Nutter, and Schwab 2013). According to Evers, Miller, and Spengel (2014), firms with a greater inventory intensity (Inventory) are restricted in their tax planning activities. Accordingly, we expect a positive relationship between inventory and tax payments. As a final control, we also take into account former ownership to proxy for income shifting opportunities of MNEs (e.g., Mills, Nutter, and Schwab 2013).

## 7.6 Results

In this section we present our estimation results for the first part of our analysis regarding various specifications of the empirical model, and robustness checks are presented.

### 7.6.1 Innovation and Tax Payments

We first focus on the regression results explaining tax payments, see table 7A.2. The model is estimated using OLS, and results reported use robust standard errors clustered at the firm level. In the first column (I), we present the results without sector and year dummy effects, using patent counts. Column II shows the results with sector and year dummy effects. First, we notice that the coefficients of the patent count variables are negative and significant ranging between –0.012 (standard error 0.003) and –0.015 (standard error 0.004), after controlling for additional firm characteristics.[17] The magnitude of the results are in line with Gao, Yang, and Zhang (2016). These results indicate that the more patents a firm produces, the lower its effective tax rate, a result that validates hypothesis H1. Second, a robust finding from our regression is that a firm's engagement in R&D activities is consistently and significantly negatively correlated with its effective tax

17. Since we express the # of patents (and citations) as in logs, the interpretation of its corresponding coefficient can be interpreted as follows: a 1 percent change in the # patents is associated with a change in the tax payment ratio of 0.01*(–0.012). Is this estimate large or small? From table 7A.1, we may infer that 200 percent increase in patent counts, which moves an average firm from the 25th percentile to the 75th percentile, leads to a tax payment ratio that is 2.4 percentage points lower, which amounts to 10 percent lower tax payment of an average firm.

rate. This suggests that firms pay lower taxes as they increase their R&D expenditures per employee. Indeed, this result can be partially explained by R&D tax incentives that are available to firms, as far as these concern benefits in terms of profit tax. An important result is that the effect of both patenting (innovation output) and R&D activities (innovation input) enter the relationship with tax payments significantly, supporting hypothesis H2 and hence providing some evidence that the Dutch taxation regime is conducive to stimulating innovation.

The additional control variables show that tax payments are positively related to the size of the firm (measured by its total assets), its profit (measured by the return on assets), and its tangible and intangible asset ratios. The leverage of the firm is negatively associated with tax payments. These results partially align with earlier findings. More specifically, based on the literature review in section 7.5.1, we expected that larger and more asset intensive firms would on average pay less taxes. Also important is that we find a positive and significant coefficient on foreign firm dummy (Ownership), which indicates that foreign firms pay on average more taxes.

Columns (III) in table 7A.2 consider again the role of multinational headquarters. We now subgroup our sample where we define a subsample of firms with Dutch headquarters and a subsample of firms that have a foreign parent. We note that a majority of Dutch headquartered firms also fulfill the definition of MNE since they also have foreign subsidiaries. We find that the coefficient of patents is significant for the Dutch firms while the coefficient related to the patent activities of foreign firms is not significant. For R&D, our results show that domestic firms that do more R&D enjoy higher tax benefits while this is not significant for foreign firms. These results indicate heterogeneous behavior between foreign MNEs and firms located in the Netherlands, namely that for those firms that do shift some of their activities to the Netherlands, there is no significant relationship between patenting and tax payments. We also note that only for domestic firms, the result implies that the tax benefit has a positive and significant effect on the real economy, as only actual R&D activities performed locally lower the tax burden.

## 7.6.2 Some Robustness Checks and Additional Results

### *7.6.2.1 Sample Selection*

In table 7A.3 we present some robustness checks to investigate the sensitivity of our results to various data issues. First, we tackle the issue of selectivity in R&D expenditures. As discussed in detail in section 7.4, the patent population includes all firms that have applied for at least one EPO patent during our sample period while R&D reported figures are extracted from annual survey data. The results so far have been obtained based on a subsample of firms that have reported R&D which may also include true zeros. This gives rise to sample selection. However, firms with missing R&D expenditures, because it is not reported, may also be engaged in patenting activities. The reporting of R&D investment itself may concern a strategic firm decision (Nagaoka, Motohashi, and Goto 2010) or can be due simply to nonresponse. For example, to get an idea on the importance of "missing" R&D, Koh and Reeb (2015) show that firms not reporting R&D have patents that are on average 27 percent more influential (that is, approved and cited) than R&D reporting firms.

Therefore, we run the regression for all firms, that is, R&D reporting and non-R&D reporting firms. From the panel B column of table 7A.3, excluding R&D as a control variable, we can infer that our result concerning the negative effect of patent counts on tax payments becomes even stronger (patent coefficient is -0.022, standard error 0.003). In column panel C, we set the R&D expenditures of firms with missing values to zero. The results are only slightly affected. This implies that the importance of R&D expenditures as an extra control variable does not seem to affect the negative relationship between patent activities and tax payments.

A second robustness check involves adding a control group of non-patenting firms in our sample to the regressions. We match a control group of non-patenting firms with a firm size (in terms of sales revenue) closest to the patenting firm within the same industry (by two-digit SIC classification). We then add an additional dummy variable for non-patenting firms. If the coefficient estimate of the dummy variable has the expected negative sign and is significant, we can conclude that patenting activities do indeed have an effect in terms of tax payments (Gao, Yang, and Zhang 2016). The coefficient on patent counts is –0.021 (standard error 0.003), slightly lower than before. In addition, as expected, the coefficient of the Zero Patent dummy variable is positive and significant (coefficient is 0.012, standard error 0.003). These results thus confirm that patenting firms face a lower effective tax rate relative to non-patenting firms. Thus, besides through the intensive margin, patents are also associated with lower tax payments through the extensive margin.

#### *7.6.2.2 Patents and R&D Success*

Table 7A.3, panel E, presents the results regarding an alternative measure of the quality of innovations by looking at patent counts per unit R&D investment. This measure captures the relation between R&D input and innovation success. Because it may take several years to reap the benefits of R&D projects, we try using patent counts with a three-year lag. The results show that the coefficient on the count of lagged patents per R&D is marginally rejected at the 10 percent significance level.

Our results confirm hypotheses 1 and 2 (H1 and H2), confirming to a certain extent that the Dutch taxation regime provides a stimulus to the innovation-based economy. Indeed, on the one hand, patent-active firms are less tax liable, which can be indicative for a favorite tax regime. On the other hand, we also find that the extent of actual innovative activities as measured by R&D investments is also associated with less tax payments.

#### *7.6.2.3 Innovation Box*

To get an idea of the effect of the innovation box on the stimulation of innovation, we consider the interaction between the Dutch innovation box and both R&D and patenting activities. We use the Dutch innovation box for the year 2010. This tax device allows firms to enjoy a tax credit of 5 percentage points on profits derived from intangible assets (not only patents) that have resulted from local R&D investments (i.e., R&D personnel) by the firm. As of 2010, firms need to provide proof that the qualified intangible assets derive from the deployment of the firm's own R&D staff. We define the innovation box (IB) as a dummy variable with value 1 if the firm has successfully applied for the IB.

The results, based on the specification of the models reported in table 7A.2, are presented in table 7A.4, columns panels E-F. Fitting the model with data for 2010, we fail to find a significant relationship between patenting and tax payments. The coefficient on the interaction term with patent counts is not significant in addition to the coefficient on the lagged patent measures. Similar results are obtained when we use the aggregated patent counts of year $t$, $t - 1$ and $t - 2$ or the lagged aggregate ($t - 1$, $t - 2$ and $t - 3$) as an additional robustness test instead, or alternatively, when we express patent counts in four- or five-year averages.[18] We do note that the sample size is now substantially smaller than the sample sizes of the previous regressions, implying that coefficients are less precisely estimated, which may have contributed to a lack of a significant relationship between patenting and tax payments.

## 7.7 Implications for Local Economy

As already highlighted in section 7.6 of the chapter, our empirical results show that firm-level innovation output is positively related to a lower effective tax rate. In addition, local R&D activities are associated with a lower tax burden. These can be seen as indications that there is no valid reason to justify concerns related to cross-border tax planning concerning innovation tax credits, since patenting firms reaping the benefits of their inventions in terms of lower tax payments also seem to be major R&D players.

A natural question that remains regarding hypothesis H3 is to what extent

18. Dynamics are important as we work with patent applications. The European patent grant procedure takes about three to five years from the date your application is filed. It is made up of two main stages. The first comprises a formalities examination, the preparation of the search report and the preliminary opinion on whether the claimed invention and the application meet the requirements of the EPC. The second involves substantive examination.

innovating firms are actually engaged in real economic activity. As a first measure, we consider labor productivity. Labor productivity is decomposed into the contribution of firms that receive tax credits from the innovation box and the WBSO and the contribution of firms that did not. The analysis is conducted at the sector level for the years 2011–2015.

The productivity contribution of firms belonging to category $k$ in a sector $j$ at period t is given by:

$$P_{jt}^{K_j} = \frac{1}{L_{jt}^{K_j}} \sum_{i \in K_j} L_{ijt} P_{ijt} \tag{1}$$

where $L_{ijt}$ is the employment of firm $i$ in sector $j$ at time $t$ and $P_{ijt}$ is its labor productivity, measured by value added per employee, $K_j$ designates the category type per sector $j$ and $L_{jt}^{K_j}$ measures the total employment at firms in category $K_j$. We consider two categories. First, we compare a category of firms that utilized the innovation box regardless of whether or not they also received a WBSO tax credit. Second, we define a category of firms that both utilized the innovation box and received WBSO tax credit.

To understand how these firms differ by category from the rest of the sector we compute the weighted average labor productivity in sector $j$:

$$\overline{P}_{jt} = \frac{1}{L_{jt}} \sum_{i} L_{ijt} P_{ijt}. \tag{2}$$

The ratio $P_{jt}^{K_j} / \overline{P}_{jt}$ captures the extent to which productivity in these categories differs.

The ratios expressed in two-digit NACE averages are reported in table 7A.5 with standard deviations (StDev) in parentheses. The first column reports the number of firms that utilized the innovation box, column 2 lists the labor productivity ratio of this subset of firms to that of the total number of firms in the sector, column 3 reports the number of firms that utilized both the innovation box and the WBSO, column 4 reports the ratio of this subset of firms vis-à-vis the total number of firms within the respective sector. We also report the average labor productivity as well as the average employment by sector. Looking at the differences between the two categories, we see that the majority of firms that utilized the innovation box also applied for a WBSO tax credit. For instance, in the IT and IT related service sector (62-63) we see, throughout the period 2011–2015, 1,784 firm-year observations that were granted an innovation box tax credit, of which 1,541 firm-year observations are linked to the WBSO tax credit. This also makes sense because these tax instruments are complementary in nature, one focusing on innovation input, the other on innovation output. A labor productivity ratio larger than one indicates that firms that take advantage of the innovation box are more productive compared to the average weighted labor productivity within a particular sector. We see that for the majority of sectors, this is indeed the case. Sectors with relatively large labor productivity premiums include machinery and equipment (28), textiles and clothing

(13-15), furniture and n.e.c. (31-33). Sectors with a negative productivity premium for firms engaging in R&D and innovation specific tax policies are transportation and storage (49-53) and distribution of natural resources (35-39). Furthermore, we find that these premiums vary by industry, but not systematically between services and manufacturing. In conclusion, the evidence supports the hypothesis that innovation tax credit policies are in general positively associated with higher levels of labor productivity.

To test the existence of possible patent shifting, i.e., where the inventor is located in a different country than the MNE applying for a patent, we also have information on the foreign ownership status of firms that were granted an innovation box tax credit as well as information on whether domestic located firms have affiliates in foreign countries. Table 7A.6 reports the results for selected industries for which we have sufficient observations for doing the analysis. By restricting the above analysis to a sample of either foreign firms or domestic firms with no foreign affiliates, the results are essentially the same, suggesting that firms (whether foreign or domestic with or without foreign affiliates) that utilize the innovation box are more productive compared to their counterparts within a particular sector. In comparison to the other firms within the retail and wholesale sector, we also note a positive labor productivity premium of foreign innovation box firms.

Instead of using labor productivity as a measure of performance, we also consider a firm's profit as a share of wages, which relates more directly to employment and hence is also connected to the domestic economy. For instance, to what extent these firms are willing to be engaged in so-called rent sharing, whereby realized profits, as a result of higher productivity, flow back in the local economy through labor compensation. Results are reported in table 7A.7. We follow the same structure as in table 7A.6 in order to make an interesting comparison. We conjecture that innovation box firms are involved with tax planning activities, and hence participate to a minimum in local economic activities if their income to the Netherlands is high relative to their employment level. This may lead to artificial high labor productivity levels and high profit-wage ratios. On the other hand, if high labor productivity corroborates with a low profit-wage ratio, this may indicate that firms are willing to participate to the local economy (due to, for instance, higher investments, higher wage payments).

Table 7A.7 shows that on average, in comparison to all firms within a particular sector, firms that receive an innovation box report profit-wage premium ratios. For the sector Basic, fabricated metals (24-25) and the food sector (10-12), a profit-wage discount is found for both domestic and foreign firms. By putting our conjecture forward, we do not see any strong evidence of possible profit shifting. Overall, our results show, in comparison with table 7A.6, that firms making use of innovation box incentives have higher labor productivity, but also higher profit-wage ratios. This suggests that any additional income due to increased productivity is not proportionally shared with employees through increased wages. The remaining profit can be used for investment or income for the owner(s). The result is true regardless of ownership, but foreign firms have the highest productivity differential, combined with the highest profit-wage differential. One notable exception is Retail & wholesale (45-47), as it is shown to be the case for domestic firms whereby high profit-wage ratios are associated with low labor productivity. We can infer that these are especially firms that have affiliates abroad. We also note negative profit ratios for the case of foreign firms that belong to IT & related services sector (62-63). This negative profit ratio is due to an unusual low profit-wage ratio of one firm in this relative small subcategory, which makes possible inferences more difficult to make.

## 7.8 Implications for National Accounts and Concluding Remarks

In July 2016 the Statistical Office of Ireland revised its GDP figure according to the accounting standard framework set by the ESA 2010. The revision implied that the Irish economy had grown by 26.3 percent over 2015. The revision triggered a trail of comments from economists, statisticians, and the media, the bottom line of which was that growth figures of this order of magnitude were hard to take seriously. Paul Krugman referred to the issue as "Leprechaun economics." Referring to James Joyce and Flann O'Brien, *The Financial Times* drew a comparison to the Irish merits regarding works of fiction (*The Financial Times*, July 12, 2016).

For a large part, the growth of Irish GDP was the consequence of inversions related to firms moving assets, intellectual property, or domicile. Being a small open economy, Ireland largely depends on foreign direct investment, and with an attractive corporate tax climate, the country proves to be attractive for big multinational companies.

In response to its publication, Eurostat responded that "[t]his revision can be seen as an effect of increasing globalization. It is primarily due to the relocation to Ireland of a limited number of big economic operators. Based on the preliminary information provided by the CSO, including data, the revision is plausible" (Eurostat 2016). In addition, the pertinent communication warns that this could happen again "if huge multinationals move their business around Europe or the globe."

It is important to reemphasize that the 2015 Irish growth figure was not the product of some evil statistician but the result of applying internationally agreed accounting rules. However, clearly, this example shows the cautions one must be aware of when interpreting GDP figures, as the relation to real economy activity may be tenuous in cases where globalization issues play a big role. In general, the activities of multinational companies may raise concerns for the compilation of national accounts (OECD, 2015). In particular, although there are other considerations to be taken into account, lower tax countries are evidently attractive for businesses to locate. This in itself is not directly a problem, but, as recognized by, for example, the OECD-led initiative against base erosion and profit shifting (BEPS), in practice the locus of production and the location where taxes are paid may get separated, undermining the fairness of tax systems, and indirectly affecting the quality of measuring national economies.

In addition, cross-border intra-firm flows are hard to measure, as a consequence of so-called transfer pricing: firms may strategically price their (intra-firm) exports so as to allocate profits to the location with the most attractive tax regime. Therefore it becomes harder to assess where the actual economic activity is taking place, which affects not only GDP but also the balance of payments. In this context, measurement of intellectual property and flows of R&D are particularly prone to such measurement problems, as market prices are absent and there is no physical flow of products. Because R&D and IP investment have to be capitalized under the SNA 2008 guidelines, this impacts directly upon GDP. The empirical results in this chapter show that in general firms located in the Netherlands that innovate benefit from a relatively lower tax burden. With respect to R&D, this means that the tax incentive seems to stimulate innovative efforts, creating employment for knowledge workers. For patenting activities, especially high-quality patents seem to decrease the tax burden, so that it can be argued that the tax incentive stimulates high-quality innovation.

Our empirical analyses present us with contrasting messages about the consequences for the national accounts. On the one hand, our regression based results suggest that (i) foreign firms do not pay less taxes than other firms, and (ii) tax payments by foreign firms are not significantly correlated with R&D and patenting activity.

Comparing the productivity and profit-wage ratio of firms making use of tax incentives for innovation to those that do not provides some contrasting evidence. Overall, we find that firms making use of these incentives have higher labor productivity, but also higher profit-wage ratios. This suggests that any additional income due to increased productivity is not proportionally shared with employees through increased wages. The remaining profit can be used for investment or income for the owner(s). The result is true regardless of ownership, but foreign firms have the highest productivity differential, combined with the highest profit-wage differential. Unless the excess profits are invested locally, this suggests that the contribution to the local economy of foreign firms with tax benefits from innovation is in fact lower than what one would expect from their relative productivity.

Therefore, in all, we conclude that firms do not seem to use innovation tax incentives to shift profit to the Netherlands, but it does seem that foreign firms making use of these incentives are able to generate relatively large profits, which are not associated with higher wages of local employees.

# Appendix

## *Results*

**Table 7A.1 Sample means and standard deviations, 2000–2010**

| Variable | Mean | Std. Dev. | Q1 | Median | Q3 |
|---|---|---|---|---|---|
| Log of patent counts | 0.491 | 0.946 | 0 | 0 | 0.691 |
| Tax payments (ratio) | 0.243 | 0.230 | 0.054 | 0.238 | 0.328 |
| Assets (in thousands) | 11.280 | 2.350 | 9.651 | 11.231 | 12.945 |
| Leverage (ratio) | 0.203 | 0.226 | 0.001 | 0.142 | 0.320 |
| Return on assets (ROA, ratio) | 0.099 | 0.144 | 0.016 | 0.066 | 0.120 |
| Inventory (ratio) | 0.136 | 0.165 | 0.032 | 0.107 | 0.211 |
| Tangibles (ratio) | 0.249 | 0.207 | 0.085 | 0.194 | 0.367 |
| Intangibles (ratio) | 0.050 | 0.114 | 0 | 0.002 | 0.040 |
| Log R&D per employee | 1.564 | 1.290 | 0.439 | 1.232 | 2.251 |
| Origin (Foreign/Dutch, 1/0) | 0.344 | 0.475 | 0 | 0 | 1 |

*Note*: Summary statistics of the overall sample consisting of 4,166 panel firm-year observations. Number of firms is 1,192.

**Table 7A.2 Corporate tax payments and patents**

| PANEL A | | | (III) | |
|---|---|---|---|---|
| *Indep. Var-s* | (I) | (II) | Foreign | Domestic |
| Log Assets | 0.010*** | 0.015*** | 0.013*** | 0.013*** |
| | (0.001) | (0.002) | (0.005) | (0.002) |
| Leverage | −0.048** | −0.034** | −0.043 | −0.083*** |
| | (0.019) | (0.019) | (0.040) | (0.020) |
| ROA | 0.251*** | 0.248*** | 0.184*** | 0.292*** |
| | (0.040) | (0.037) | (0.063) | (0.045) |
| Inventory | 0.068*** | 0.028 | −0.005 | −0.044* |
| | (0.019) | (0.021) | (0.063) | (0.022) |
| Tangibles | 0.110*** | 0.129*** | 0.138*** | 0.139*** |
| | (0.020) | (0.021) | (0.041) | (0.027) |
| Intangibles | 0.114*** | 0.120*** | 0.087 | 0.132*** |
| | (0.039) | (0.036) | (0.066) | (0.046) |
| Ownership | 0.038*** | 0.038*** | | |
| | (0.009) | (0.009) | | |
| Lag log (1+R&D per employee) | −0.016*** | −0.010*** | −0.008 | −0.010** |
| | (0.002) | (0.003) | (0.006) | (0.003) |
| Lag log (1+patent applications) | −0.012*** | −0.015*** | −0.007 | −0.019*** |
| | (0.004) | (0.004) | (0.009) | (0.005) |
| Sector Effect | No | Yes | Yes | Yes |
| Year dummies | No | Yes | Yes | Yes |
| Intercept | 0.094*** | 0.089** | 0.158 | 0.088** |
| | (0.020) | (0.044) | (0.102) | (0.049) |
| $R^2$ | 0.071 | 0.142 | 0.113 | 0.207 |

*Note*: Dependent variable is share of corporate tax payment in total finance. OLS with (robust) standard errors. 3,598 panel firm-year observations. Number of firms is 1,053.

*$p < .1$, **$p < .05$, *** $p < .01$

**Table 7A.3** **Corporate tax payments and patents, alternative panels**

| | **PANEL B** Adding R&D Missing firms | **PANEL C** Adding R&D Missing firms AND setting their R&D expenditure = 0 | **PANEL D** Adding non-patenting firms | **PANEL E** Innovation quality |
|---|---|---|---|---|
| Lag log (1+patent applications) | −0.022*** | −0.021*** | −0.021*** | |
| | (0.003) | (0.002) | (0.003) | |
| Zero Patent | | | 0.012*** | |
| | | | (0.003) | |
| Lag log (1+R&D per employee) | | −0.003* | | |
| | | (0.001) | | |
| Lag (patents/R&D 3YR) | | | | −2.672 |
| | | | | (1.627) |
| Sector Effect | Yes | Yes | Yes | Yes |
| Year dummies | Yes | Yes | Yes | Yes |
| Observations | 13797 | 13797 | 31736 | 1723 |
| $R^2$ | 0.170 | 0.164 | 0.205 | 0.136 |

*Note*: Dependent variable is corporate tax payment. OLS with (robust) standard errors.
$*p < .1$, $**p < .05$, $*** p < .01$

**Table 7A.4** **Corporate tax payments and patents, innovation box regime, year 2010**

| | **PANEL E** Innovation Box **(YR 2010)** | **PANEL F** Innovation Box **(YR 2010)** |
|---|---|---|
| Lag log (1+patent applications) | 0.004 | 0.005 |
| | (0.020) | (0.010) |
| Lag log (1+patent applications)* InnBox | | −0.014 |
| | | (0.028) |
| InnBox | −0.020 | −0.082* |
| | (0.026) | (0.045) |
| Lag log (1+R&D per employee)* InnBox | | 0.038* |
| | | (0.021) |
| Lag log (1+R&D per employee) | −0.022** | −0.032** |
| | (0.010) | (0.013) |
| Sector Effect | Yes | Yes |
| Year dummies | Yes | Yes |
| Observations | 259 | 259 |
| $R^2$ | 0.301 | 0.309 |

*Note*: Dependent variable is corporate tax payment. OLS with (robust) standard errors.
$*p < .1$, $**p < .05$, $*** p < .01$

**Table 7A.5** **Average relative labor productivity (LP), 2011–2015**

| Industry | #Firm- year Inn Box | LP ratio IB firms | #Firm_Inn Box AND WBSO | LP ratio Inn Box& WBSO firms | LP (all firms) | Average Employment (all firms) |
|---|---|---|---|---|---|---|
| Food (10–12) | 569 | 1.032 (0.102) | 506 | 1.033 (0.081) | 156.123 | 28.163 |
| Textiles, clothing (13–15) | 36 | 1.291 (0.125) | 32 | 1.258 (0.106) | 65.930 | 19.446 |
| Wood, paper, printing (16–18) | 101 | 1.124 (0.172) | 82 | 1.122 (0.171) | 78.884 | 23.176 |
| Chemicals, pharmaceuticals (19–21) | 320 | 1.082 (0.115) | 270 | 1.091 (0.122) | 161.261 | 121.988 |
| Plastics, non-metallic minerals (22–23) | 286 | 1.066 (0.094) | 254 | 1.061 (0.093) | 80.860 | 34.120 |
| Basic, fabricated metals (24–25) | 507 | 1.211 (0.057) | 438 | 1.227 (0.061) | 78.965 | 27.859 |
| Computers, electrical equipment (26–27) | 391 | 1.150 (0.308) | 363 | 1.184 (0.328) | 130.631 | 43.584 |
| Machinery, equipment n.e.c. (28) | 782 | 1.302 (0.247) | 663 | 1.334 (0.259) | 109.533 | 40.797 |
| Motor vehicles, other transp. (29–30) | 172 | 1.162 (0.133) | 152 | 0.869 (0.119) | 88.971 | 54.145 |
| Furniture, n.e.c. & recycling (31–33) | 306 | 1.438 (0.144) | 262 | 1.424 (0.187) | 56.542 | 18.960 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Distribution natural resources (35–39) | 70 | 0.570<br>(1.472) | 56 | 0.593<br>(1.464) | 131.920 | 74.552 |
| Construction (41–43) | 263 | 1.059<br>(0.070) | 240 | 1.064<br>(0.071) | 66.364 | 17.914 |
| Retail and wholesale (45–47) | 1467 | 0.820<br>(0.163) | 1229 | 0.820<br>(0.163) | 53.580 | 22.834 |
| Transportation and storage (49–53) | 56 | 0.595<br>(0.083) | 43 | 0.642<br>(0.122) | 69.765 | 51.046 |
| Publishing & audio (58–60) | 45 | 1.388<br>(0.628) | 26 | 0.966<br>(0.732) | 74.718 | 17.911 |
| Telecommunications (61) | 62 | 1.085<br>(0.021) | 24 | 1.070<br>(0.060) | 218.916 | 93.406 |
| IT & related services (62–63) | 1784 | 1.131<br>(0.084) | 1541 | 1.089<br>(0.139) | 84.258 | 11.050 |
| Financial institutions (64–66) | n.a. | | | | | |
| Consulting & architectural and engineering activities (69–71) | 1155 | 1.116<br>(0.073) | 901 | 1.189<br>(0.135) | 83.669 | 5.314 |
| R&D (72) | 269 | 1.403<br>(0.169) | 210 | 1.477<br>(0.151) | 59.511 | 16.654 |
| Advertising & other professional activities (73–75) | 155 | 1.463<br>(0.426) | 105 | 1.492<br>0.461) | 58.906 | 8.051 |
| OTHER Services, n.e.c. (77–82) | 290 | 1.655<br>(0.761) | 210 | 1.185<br>(0.850) | 51.477 | 60.102 |

*Note*: Standard deviations are in parentheses.

**Table 7A.6** **Average relative labor productivity (LP) according to ownership status and foreign subsidiaries, selected main sectors, 2011–2015**

| Industry | All firms | Only Local firms | Only Foreign MNEs | Local firms AND NO foreign subsidiaries |
|---|---|---|---|---|
| All firms (all sectors) | 1.125 | 1.133 | 1.254 | 1.187 |
| | (0.334) | (0.275) | (1.190) | (0.359) |
| | [9161] | [8476] | [685] | [3001] |
| Food (10–12) | 1.032 | 1.025 | 1.016 | 1.124 |
| | (0.102) | (0.127) | (0.330) | (0.119) |
| | [569] | [524] | [45] | [176] |
| Basic, fabricated metals (24–25) | 1.211 | 1.205 | 1.103 | 1.329 |
| | (0.057) | (0.045) | (0.128) | (0.093) |
| | [507] | [475] | [32] | [132] |
| Machinery, equipment n.e.c. (28) | 1.302 | 1.348 | 1.151 | 1.296 |
| | (0.247) | (0.294) | (0.097) | (0.240) |
| | [782] | [708] | [74] | [202] |
| Retail and wholesale (45–47) | 0.820 | 0.858 | 1.228 | 0.888 |
| | (0.163) | (0.181) | (0.181) | (0.194) |
| | [1467] | [1388] | [79] | [463] |
| IT & related services (62–63) | 1.131 | 1.130 | 1.162 | 1.186 |
| | (0.084) | (0.094) | (0.133) | (0.076) |
| | [1784] | [1704] | [80] | [683] |
| Consulting & architectural and engineering activities (69–71) | 1.116 | 1.097 | 1.436 | 1.147 |
| | (0.073) | (0.065) | (0.218) | (0.074) |
| | [1155] | [1116] | [39] | [452] |

*Note*: Standard deviations are in parentheses and numbers of firm-year observations are in brackets.

**Table 7A.7** **Average relative profit-wage ratio according to ownership status and foreign subsidiaries, selected main sectors, 2011–2015**

| Industry | All firms | Only Local firms | Only Foreign MNEs | Local firms AND NO foreign subsidiaries |
|---|---|---|---|---|
| All firms (all sectors) | 1.279 | 1.193 | 1.835 | 1.167 |
| | (2.492) | (1.195) | (2.133) | (1.706) |
| | [9161] | [8476] | [685] | [3001] |
| Food (10–12) | 1.506 | 1.699 | 0.910 | 0.534 |
| | (0.454) | (0.575) | (0.354) | (0.298) |
| | [569] | [524] | [45] | [176] |
| Basic, fabricated metals (24–25) | 1.298 | 1.388 | 0.660 | 0.830 |
| | (1.258) | (0.525) | (0.849) | (0.414) |
| | [507] | [475] | [32] | [132] |
| Machinery, equipment n.e.c. (28) | 1.525 | 1.621 | 1.348 | 1.461 |
| | (0.573) | (0.545) | (0.554) | (0.388) |
| | [782] | [708] | [74] | [202] |
| Retail and wholesale (45–47) | 1.504 | 1.765 | 1.876 | 0.951 |
| | (0.685) | (0.732) | (0.478) | (0.377) |
| | [1467] | [1388] | [79] | [463] |
| IT & related services (62–63) | 0.308 | 0.302 | –1.252 | 2.004 |
| | (2.296) | (2.095) | (5.478) | (0.924) |
| | [1784] | [1704] | [80] | [683] |
| Consulting & architectural and engineering activities(69–71) | 0.420 | 0.683 | 0.980 | 0.263 |
| | (0.410) | (0.564) | (1.102) | (0.980) |
| | [1155] | [1116] | [39] | [452] |

*Note*: Standard deviations are in parentheses and numbers of firm-year observations are in brackets.

# Appendix B

## *Additional Tables*

**Table 7B.1** **List of variables**

| Variable | Definition |
|---|---|
| Basic firm characteristics | |
| TAX_PAY | MNE's tax payments, defined as the ratio of taxes paid divided by pretax financial income (V14/V13). TAX_PAY values above one (below zero) are set to one (zero). (see also Mills et al. 2013) |
| Assets | Natural logarithm of assets (D80) |
| Leverage | Ratio of long-term debt to total assets (C50/D80) |
| ROA | The ratio of total profitability divided by total assets (V6+V7)/D80 |
| Tangible | Ratio of tangible assets divided by total assets (D20/D80) |
| Intangible | Ratio of intangible assets divided by total assets (D10/D80) |
| Inventory | Ratio of inventory to total assets (D50/D80) |
| Foreign | Ratio of pretax foreign income to total income of subsidiaries (V71/V7) |
| Firm size | Natural logarithm of average number of employees in each firm of the year, collected in September of that year |
| Ownership | = 1 if firm is foreign owned; = 0 if firm is in the hands of a Dutch company |
| Value-added | Turnover (V1) minus intermediate costs (V4) |
| Profits | On the basis of Net financial results (V17) |
| Wages | Gross labor costs (V2) |
| Firm innovative activities | |
| PATENT | The number of patent applications (counts) recorded by EPO for a firm during the application year, measured as log(1+PATENT) in regression analysis |
| R&D | R&D intensity, calculated as total R&D expenditures to total employment. R&D missing data were not imputed with 0. |

*Note*: Variable names in brackets refer to items compiled from the Statistics Netherlands financial database on non-financial enterprises (NFO)

**Table 7B.2** **Correlation matrix**

| Variables 2000-2010 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| TAX_PAY 1 | 1.000 | | | | | | | | | |
| Assets 2 | 0.052 | 1.000 | | | | | | | | |
| Leverage 3 | −0.029 | 0.032 | 1.000 | | | | | | | |
| ROA 4 | 0.123 | −0.116 | −0.100 | 1.000 | | | | | | |
| Inventory 5 | 0.043 | −0.197 | −0.051 | −0.021 | 1.000 | | | | | |
| Tangible 6 | 0.084 | −0.057 | 0.164 | −0.057 | −0.071 | 1.000 | | | | |
| Intangible 7 | 0.051 | 0.162 | 0.223 | −0.076 | −0.123 | −0.191 | 1.000 | | | |
| Origin 8 | 0.007 | 0.475 | −0.020 | −0.075 | −0.121 | −0.219 | 0.142 | 1.000 | | |
| R&D 9 | −0.093 | −0.095 | 0.004 | 0.012 | −0.036 | −0.114 | 0.016 | −0.003 | 1.000 | |
| PAT 10 | −0.075 | 0.392 | 0.045 | −0.035 | −0.099 | −0.164 | 0.082 | 0.243 | 0.276 | 1.000 |

**Table 7B.3** **WBSO, innovation box, 2011–2015**

| | Innovation Box NO | Innovation Box YES | Total |
|---|---|---|---|
| R&D, WBSO NO | 320678 | 2031 | 322709 |
| R&D, WBSO YES | 17004 | 3312 | 20316 |
| Total | 337682 | 5343 | 343025 |

*Note*: Table 7B.3 gives an overview of the number of firms that applied for the innovation box and that have applied for a WBSO tax credit during the period 2011–2015. The table indicates that there is complementarity between R&D input and innovation output: out of the 5,343 innovation box users, 3,312 firms have also applied for the WBSO. Notice that there are also still a significant number of firms that are granted a WBSO tax credit, but that does not apply for the innovation box. Or in other terms, a considerable number of firms report R&D input but no innovation output.

## Appendix C

## *Innovation Tax Incentives in the Netherlands*

In the Netherlands, there are a number of tax schemes that aim to incentivize firms to innovate. From the perspective of the input side of the innovation process, the so-called WBSO and RDA are tax credit schemes that enable firms to reduce R&D costs. At this stage of the innovation process, firms are rewarded for their innovation efforts regardless of their innovation success. So, at the output side of innovation, the introduction of the innovation box rather focuses on the outcome of R&D whereby profits as the results of successful patenting behavior receive a lower tax rate. In this sense, firms are stimulated to engage in R&D because not only innovation input but also the innovation output as a result of successful R&D merits are subject to lower tax rates.

### R&D Tax Credits

Since 1994 the Dutch government introduced the WBSO, which is an acronym for the Wage Tax and Social Insurance Act (in Dutch, Wet Bevordering Speur- en Ontwikkelingswerk, WBSO hereafter) to stimulate firms' R&D activities in the Netherlands. The WBSO is considered an important driver of the ongoing Dutch innovation policy. Its aim is to stimulate R&D expenditures for firms located in the Netherlands. Additionally, there is an extra provision for small and medium sized firms as well as starting firms. The WBSO provides an R&D grant, primarily an R&D wage subsidy that can be granted to any R&D performing firm located in the Netherlands regardless of size. The WBSO adds additional funding under the so-called

RDA (in Dutch, R&D aftrek), which allows firms to deduct an (annually set) fixed amount for R&D on their income tax payment. As of 2016, both the WBSO and the RDA are merged together under the WBSO scheme.

The range of R&D projects suitable for assistance include the development of new products, processes and IT software, technical and process oriented scientific research as well as innovation feasibility studies. Concerning the eligibility criteria, R&D development projects must include some degree of technical risks or uncertainties. The most important evaluation criteria that the WBSO consider are the embodied technological novelty in the R&D development project. The technological novelty itself must include a research component whereby technical obstacles as well as possible solutions are defined. R&D projects based on technical scientific research are categorized in domains such as physics, chemistry, biotechnology, production technology, and ICT. Concerning innovation feasibility analysis, the WBSO stipulates that the purpose of the R&D project is already structured and known. Economic and financial aspects surrounding the R&D project is of less importance.

While there have been some changes in the provision of grants over time, the application procedures that make projects eligible for assistance are as follows. The applicant (usually a firm) has to show that he or she is involved with the technical analysis as part of an ongoing R&D project that must take place within the European Union. Additionally, the firm must pay corporate income tax returns as well as wage tax and national insurance contributions for those employees who are involved with R&D. The actual WBSO grant level is calculated on the basis of total R&D working hours multiplied by an average R&D hourly wage.

**Innovation Box**

An innovation box is a fiscal instrument in the corporate tax regime that can be applied to all firms that have a corporate tax obligation in the Netherlands, that is, local and foreign-owned firms. The point of departure for the application of an innovation box are intangible assets that cover primarily patents and associated patent rights, and to a lesser extent, designs and models, copyrights, and trade secrets.[19] The innovation box entails that the profits that are generated from the eligible intangible assets enjoy a tax deduction. Since 2010, the effective tariff on profits within the innovation box in the Netherlands is 5 percent. Prior to 2010, the official rate was 10 percent.

We note that Evers, Miller, and Spengel (2014) provide a detailed overview across countries. In addition, the authors also calculate a so-called effective tax rate so that non-fiscal country-specificities are netted out. Focusing on

19. We note that the scope of intangible assets to which an innovation box is applicable depends by country. We refer Alstadsaeter et al. (2015) for a cross-country comparison.

the official tax rates, we may conclude that the Netherlands belongs to most favorite tax regime countries, along with Belgium, Luxembourg, Lichtenstein, and Malta.

The effectiveness of an innovation box on tax revenues depends on some additional provisions. In the Netherlands, the innovation box applies to intangible assets that are considered as outcomes from R&D related activities. In that sense, especially, the focus is on technical innovation. Firms that are eligible for WBSO are also eligible for the innovation box; although, the related profits that are generated from the innovation must at least come from patenting activities (den Hertog et al. 2015).

With the innovation box in place, pure fiscal motives may remain. The eligibility criteria make it very attractive for firms that are able to be successful innovators both from the R&D input and the R&D outcome perspective, in terms of patenting. In addition, the so-called 30 percent rule provides an extra stimulus for attracting highly skilled personnel from abroad. In combination with other fiscal incentives (e.g., negotiation with tax authorities is allowed), this makes the Netherlands a fiscally attractive place, apart from the question of whether these firms also play a significant role in the real economy. A recent online survey conducted by the Dutch Ministry of Economic Affairs (den Hertog et al. 2015) concludes that firms do indicate that the favorite fiscal regime as the result of the innovation box does seem to be important.

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## **Comment** Robert E. Yuskavage

In this chapter, the authors study the behavior of business enterprises located in the Netherlands to determine the extent to which firms engaged in innovative activities are able to reduce their income taxes by taking advantage of related tax incentives, and whether the local economic activity requirements of these incentives prevent a mismatch between where production occurs and where income is reported. This is an important issue for national accounts because the intellectual property (IP)-related profits of multinational enterprises (MNEs) can be shifted to lower tax jurisdictions. It is also important in the context of the Organisation for Economic Co-operation and Development's (OECD) Base Erosion and Profit Shifting (BEPS) initiative, which seeks to align taxation with real economic activity.

The Netherlands has become a favorite location for foreign direct investment by MNEs around the world for many reasons, only some of which are tax related. According to the OECD, foreign firms in the Netherlands account for 15–20 percent of employment and 25–30 percent of private nonfarm business value added. A study of MNE behavior in the Netherlands can thus provide useful insights about how global innovative activity affects national accounts. Two innovation-related tax incentives figure

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