

On the effectivity of tax incentives: Patent Box Regimes and Allowance for Corporate Equity

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Summary

In this paper we assess two tax incentives, Patent Boxes and Allowance for Corporate Equity. The former aims at stimulating R&D through a lower effective tax on patent than on current income, the latter at offsetting debt bias via the deduction of a notional interest on equity.

We use a Differences in Differences approach completed by another one based on Effective Tax Rates. In the experimentation with Patent Box, treated countries are Belgium and Netherlands, and control group is Austria, Germany and Italy. In the second one, Allowance for Corporate Equity, treated is Italy – compared to Belgium –, the control being France, and for a robustness test, Germany.

The conclusion is rather favorable to the instruments but needs qualification: if Patent Boxes are attractive for intellectual property rights, there is less or no evidence of an effect on real investment and employment in R&D; Allowance for Corporate Equity reduces firm leverage but its real effect on investment and employment is unclear.

Keywords: Patent Box, R&D, Allowance for Corporate Equity, Debt bias, Thin capitalization, Investment, Employment, Differences in differences

JEL: C21, F23, H22, H25, H26, K34

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1. Introduction

Several countries in the World have recently adopted, and sometimes then repealed, tax reforms aimed at increasing their interest for the location of specific functions of Multinational Enterprises. In today tax competition it is no longer question indeed, especially for high labor cost advanced economies, to be attractive for MNEs in general, but instead to be the best location for specific activities of those companies, e.g. those requiring highly qualified people like Research and Development, R&D, or focusing on the most mobile factors like intellectual property rights, in top of them patents at source of royalties, or still on the pooling of financial resources management, through intra group loans within the MNE. All in all today MNE appears to be a decentered network of functions located in jurisdictions which offer comparative advantages often incentivized by tax systems – see Desai (2009).

In this paper we examine the effectiveness of two among those tax incentives, the Patent Box regimes, PBR, and the Allowance for Corporate Equity, ACE. For both instruments, we start with a brief theoretical section, accompanied by a short survey of literature; then we propose an original empirical investigation whose results are compared with those already suggested by literature. For the needs of our empirical analysis we use data from the Amadeus data base and Differences in Differences modelling strategy.

As we explain in the section devoted to that instrument, Patent Box regimes have been forbidden by the European Union considering that they were against EU law. However, due to a grandfathering provision, they are still in application for some years.

2. Patent Box Regimes

Already in 1972 the question raised, asked by Södersten (1972): does tax influences investment decision? Since then many articles attempted to provide an answer to that question, see e.g. Devereux and Griffith (1998).

A specific form of investment is R&D. Today, it is a main issue when discussing the strategy of a company. It represents a key fraction of the GDP of advanced economies – 2.37 % of combined GDP of OECD countries in 2014 –, it is a condition for innovation and progress, and one of the priorities set forth by the European Union for the year 2020 - Eurostat (2015). In the recent past a growing number of countries have therefore undertaken tax reforms in order to improve their attractiveness for R&D activity and related intellectual property rights, like patents. Let us mention Belgium, France, Luxembourg and The Netherlands, just to cite European Union member states.

On the research side, several empirical studies – Dischinger and Riedel (2011), Böhm et al. (2011), Griffith et al. (2011), Karkinsky and Riedel (2012), Griffith et al. (2014), Alstadsæter et al. (2015) – have shown that tax has an impact on the location of patents. However one may question whether those studies actually deal with the effectiveness of those reforms. With this paper we hope to shed some light on that issue. Our work uses Differences in Differences and focuses on two countries, Belgium and The Netherlands; the choice of those countries is motivated by the availability of several years of data.

But before focusing on Patent Box regimes, let us notice that Patent Boxes doesn't exhaust incentives to R&D. Actually those incentives basically consist of two types of instruments, one incentivizes input of R&D, the other concentrates on output of that activity. The tools related to the former attempt to act on investment in equipment, like laboratories, through e.g. tax credits – CPB Netherlands Bureau for Economic Policy Analysis (2014), Köhler et al. (2012) –, deductions against the corporate income tax base or more favorable mechanisms of depreciation allowances – Van Pottelsberghe et al. (2003). They also attempt to directly act on the number of scientists employed in R&D activity, basically via cuts in social security charges. To take an example consider the case of Belgium: when a company, a research center or a university hires a scientist, it may benefit of a rebate of up to 75 per cent on the withholding tax paid out by the employer as an advance payment on personal tax liabilities of her employees.

Patent Box is a typical instruments acting on the output of R&D: a fraction of the amount of royalties received for the use of a patent, or more generally for the use of an intellectual property right, is deductible against the corporate income tax base of the entity.² In Belgium, Luxembourg and The Netherlands, that fraction is as high as 80 per cent so that royalties which reach The Netherlands to be turned into dividends, are subject to a tax price of 5 per cent instead of 25, the normal corporate income tax rate in that country. But a question immediately arises, that of the correspondence between property rights and R&D, especially of their respective location. In Belgium, to qualify for the deductibility, royalties must be related to patents at least modified in Belgium, but not necessarily based on research entirely developed in that country. In Luxembourg, qualified royalties may compensate various forms of intellectual property rights like brand names, or web domain names.

In this paper we analyze a single instrument, Patent Box regimes, and we measure the outcome of R&D by the fraction of intangible assets in total assets of a company. We agree that such approach doesn't exhaust the issue. A complementary investigation should assess the effect of, say, the size of social security charge rebates on the number of scientists. But, at this moment, we cannot match adequate information.

In addition, when reading the paragraphs above, one immediately realizes that patents may be easily moved from one to another company of a given MNE and so becomes an instrument of tax strategy to avoid paying tax rather than being a tool for stimulating R&D.

We understand that tax lobbyists may be very active in that field, but also that the use of Patent Box regimes has been removed by EU authorities. Its study however deserves interest for at least two reasons: because it is an example of the use of taxation to incentivize the production and location of an especially mobile asset, and because, despite its removal in 2016 in Europe, it still has effect on royalties created before that year, due to a grandfathering provision.

² The definition of a Patent Box is proposed by the French DGCIS, an acronym for the Direction Générale de la Compétitivité, de l'Industrie et des Services, i.e. "a Patent Box regime is a regime of tax incentives such that patent income is taxed at a lower effective rate than current income" [DGCIS (2012), p.10, our translation]. France and Ireland were the first to propose that instrument, in the early 70's, aiming at increasing the employment rate in R&D and Innovation. Unlike most applications of the Patent Box mechanism, the French system was based on a lower tax rate for patent income, rather than on a deductibility against the tax base. Initially set to 15.5%, that rate increased in 2011 to 16.245% - European Commission (2015). Notice that Ireland gave up that regime in 2010.

2.1. Literature

The literature on the efficiency of tax policy favoring R&D or innovation is still scarce, especially in terms of empirical studies, as recognized by most contributors. E.g. Böhm et al. (2011) writes (p.1) that "empirical studies which assess the link between corporate taxation, R&D investment and intangible asset holdings are, however, still scarce at best". Let us mention some of them.

Griffith et al. (2010, 2011), focus on the effect of taxation on the choice of the best location for intellectual properties made by MNEs. They notice that most studies concentrate on the location of tangible assets, though Grubert (2003) shows that intangible assets like intellectual properties can easily be used for the purposes of profit shifting –a see also Dyreng et al. (2013). Therefore Griffith et al. is based on the observation that "intellectual property is more mobile than other forms of capital" [Griffith et al. (2011), p. 2]. The aim of that study is to show that firms active in the innovation tend to relocate their intellectual property in low tax countries, and even in tax havens; thus that study attempts to forecast the behavior of firms in response to a hypothetical change in the Corporate Income Tax Rate, CIT. Therefore that contribution proposes a simulation of the introduction of a Patent Box regime based on the use of a logit function with random coefficients. However, the data cover the period 1985-2005 so that the exercise is only theoretical; indeed Patent Boxes didn't exist before 2007 in The Netherlands, Belgium and Luxembourg and were just a project in the UK at that time. Three years later the same team comes again with a complementary publication – Griffith et al. (2014).

Other teams have also worked on the impact of taxation on the location of patents, but without focusing on Patent Box regimes, like Dischinger and Riedel (2011), which sets forth (p. 693) that "intangibles often earn a significant fraction of the corporate return". Although that research uses the same period as Griffith et al., it works differently, comparing subsidiaries belonging to the same group but located in different countries. Another difference is that Dischinger-Riedel paper is not primarily based on the number of patents but on intangible assets.

In 2011 Böhm et al. put forward that many patents located in low tax countries have been developed elsewhere: up to 35% in Ireland and even around 80% in tax havens. In 2015, the European Commission also addresses that issue through the paper "Patent Boxes design, Patent Location and Local R&D" by Alstadsæter et al. (2015). When released it was the only paper so far, focused on Patent Box regimes and their effect, specifically. That inquiry is based on a sample of nearly 2,000 firms active in three distinct industries, information and communication, pharmaceuticals and cars i.e. the most active in R&D. That study covers the years 2000 to 2011 and 25 countries, among them 12 experiment Patent Box regimes but in different ways. The improvement w.r.t. Griffith et al. (2014) consists in the decomposition of the impact of the measure in three effects, including the CIT rate and the reduction of the tax base. Unsurprisingly CIT rate is negatively related with the number of patents. Moreover effects of Patent Box regimes differ between industries and even within an industry. Actually the quality of the patent much matters. Finally there is a negative correlation between Patent Boxes and local investment in R&D.

All that confirms the raising criticism that Patent Box regimes benefit more in terms of tax evasion than of research. That result is in line with Böhm et al. (2011) stressing that few patents are located where the research was developed.

To conclude that section, we note that economic literature agrees to stress that too few contributions are dedicated to Patent Box regimes. Moreover, most publications deal with the number of patents

and their location, or relocation. Only the study of 2015, ordered by the European Commission [Alstadsæter et al. (2015), p. 21], specifically focuses on Patent Boxes.

With respect to existing literature, the originality of our paper is to test the efficiency of Patent Boxes in the specific case of Belgium and The Netherlands, empirically.

2.2. Empirical analysis

In this section we first present the data set, then the model and the variables, and finally the results.

2.21. Data

Our empirical analysis is conducted using the Amadeus database which provides information from the accounts of 21 million firms all over Europe. Our data set covers the years 2005-2014. We focus on two countries which have experienced Patent Box regimes for the sub-period 2007–2014, i.e. The Netherlands and Belgium; firms of those two countries thus have received the treatment for part of the period. For the sake of comparison we have a control group consisting of firms which do not have received the treatment because it is not available in their country, although they evolve in similar conditions as those in the treatment group; the control group thus consist of firms located in Austria, Germany and Italy.

The selection of firms is similar as for the Differences in Differences, DID, model of Princen (2012)]; that latter aimed at studying Belgian ACE, and we will come back to it in Section 3 dedicated to that tax measure. Therefore, as in Princen, we have excluded firms from the public, banking and financial industries, as well as outliers. At the end, we have kept 17,893 firms from five countries, observed over 9 years – due to the unavailability of data for some variables from outside Amadeus, the year 2014 has been withdrawn from the sample. Two subsamples have then be created, one with 14,741 companies from Belgium, Austria, Germany and Italy; the other of 16,741 firms from The Netherlands and the three countries of the control group.

Macroeconomic information coming from the OECD has been added.

2.22. Model and variables

The model is basically of the DID type. We make a distinction between the treatment group, exposed to the reform, and the control group, not subject to the reform; and between the period before the reform, 2005-2006, and the period after the reform, 2007-2014. We study the effect of the reform on intangible assets hold by the firm, as in Böhm at al. (2011).

In our model we don't investigate the effect of Patent Box regimes on the amount of intangible assets but on their relative importance in the balance sheet of the firm. So doing we rule out the issue of the overall growth of the firms. Thus we define, and use as dependent variable

$$R = \left(\frac{\text{Intangible Assets}}{\text{Total Assets}} \right) \times 100 \quad (1.1)$$

The key equation of the model is,

$$R_{icy} = \beta_0 + \beta_1 DID_{yc} + \beta_2 Y_y + \beta_3 C_c + \beta_v V^T + \varepsilon_{icy} \quad (1.2)$$

In that equation, subscripts i , c and y respectively stand for the firm, the country and the year. Y , C and DID are dummy variables such that

$$\begin{aligned} Y_y &= 1, y \geq 2008, \text{ treatment period} \\ &= 0, y < 2008, \text{ before treatment period} \\ C_c &= 1, c \in \text{ treatment group} \\ &= 0, c \in \text{ control group} \\ DID_{cy} &= C_c Y_y = 1, \text{ treatment group and period} \\ &= C_c Y_y = 0, \text{ otherwise} \end{aligned} \quad (1.3)$$

DID_{cy} is the main independent variable, showing whether an observation has been subject to the treatment. Its value is 1 for Belgium and The Netherlands after 2007; it is zero otherwise. In addition, V is a column vector with the control variables, and ε_{icy} is the error term.

In the first version of the model – equation 1 – the V -vector is empty. Then – equation 2 – we introduce variables referring to firms³ and patents.⁴ In equation 3, we add macroeconomic variables.⁵ Finally in equation 4, also referred to as ETR, we try another approach and, instead of Y , C and DID we use the modified equation

$$R_{icy} = \beta_0 + \beta_4 ETR_{yc} + \beta_v V^T + \varepsilon_{icy} \quad (1.4)$$

In that equation the Effective Tax Rate on patent income ETR_{yc} is defined as

$$ETR_{yc} = \tau_{yc} - Y_y C_c \lambda_{yv} \tau_{yc} \quad (1.5)$$

In that equation, τ_{yc} stands for the statutory tax rate in country c in year y , and λ_{yv} for the fraction of the income from patent boxes which escapes corporate income tax. Then

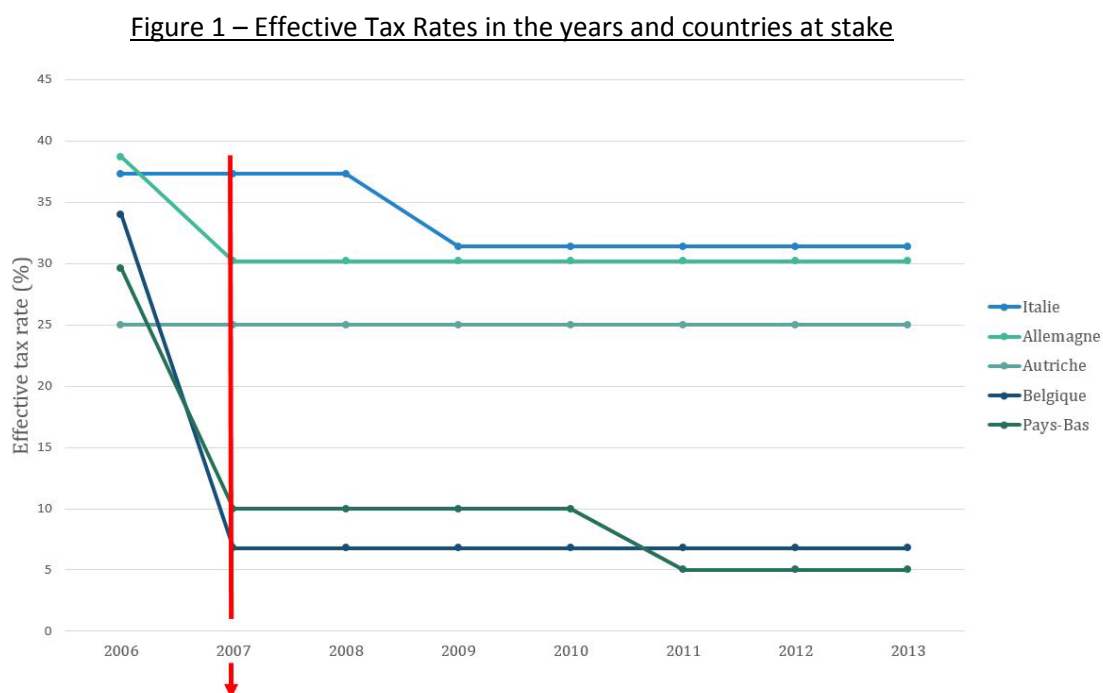
³ Return on Equity, RoE , and Current assets over current liabilities, $Curr$, which document on the financial health of the firm; and Employment in the firm, $Empl$, which captures its size. Most textbooks in Industrial Organization or Industrial Economics offer a discussion of the incentives to R&D, see e.g. Hay and Morris (1978) among the first ones.

⁴ Exp represents the investments in R&D as a percentage of GDP per country and per year. For Alstadsæter et al. (2015) that information depicts the potential of innovation in the country. $Index$ is a value computed by Park (2008), and updated till 2005, which measures the degree of protection of intellectual property rights in the country at stake, based on five criteria.

⁵ $LGdp$ is the logarithm of country GDP, an indicator of the economic health of the country as well as a proxy for the size of the market. $Gdppc$ is the GDP per inhabitant, a proxy for consumers' wealth in the country.

$$\begin{aligned}
 ETR_{yc} &= \tau_{yc} - \lambda_{yv} \tau_{yc}, Y_y C_c = 1, \text{ treatment group and period} \\
 &= \tau_{yc}, Y_y C_c = 0, \text{ otherwise}
 \end{aligned}
 \tag{1.6}$$

It turns out that, thanks to equation (1.6) we explicitly introduce the high of the tax rebate. Figure 1 shows the value of ETR for the period and the countries at stake in this research.



↓
Patent Box Introduction in Belgium and in the Netherlands

2.23. Results

Let us first show some descriptive statistics. In Table 1 below we present for Belgium, The Netherlands and the member countries of the control group – Austria, Germany and Italy – the relative change of the average R ratio introduced above. Here, by average, we mean an average on the pre- and current treatment period. Inspection of that table set forth two features. On the one hand, during both periods – before 2008 and the starting of the treatment, and during the treatment – the average ratio for Belgium lies below that of the control group, while that of The Netherlands is clearly higher. But on the other hand, a kind of catching up effect seems to appear, which speeds up the increase of the ratio in the two treated countries.

That twofold observation may help us understanding the econometric results below.

		Belgium	Netherlands	Control Group
Ratio	Before 2008	2.85	3.83	3.20
	2008 and later	3.07	4.28	3.33
Δ (%)		7.66 %	9.82 %	3.96 %

Those econometric results are presented in Table 2 and in Table 3 for Belgium and The Netherlands respectively; *, ** and *** indicate that the corresponding coefficient is significantly different from zero at 90, 95 or 99 per cent. Variables have been defined earlier in the paper.

Ratio	Equation 1	Equation 2	Equation 3	Equation ETR
<i>Intercept</i>	3.1996***	34.9099***	-78.9434***	16.31
<i>DID</i>	0.0916	0.2859	0.2379	
<i>Y</i>	0.1267**	0.2322***	0.0228	
<i>C</i>	-0.3498	0.4322**	1.5842***	
<i>ROE</i>		-0.804***	-0.7853***	-0.7942***
<i>Curr.</i>		-15.1761***	-15.26***	-15.2***
<i>Empl.</i>		0.0000***	0.0000***	0.0000***
<i>Exp</i>		-1.1942***	0.6966**	-0.7304***
<i>Index</i>		-6.3853***	10.5936***	-2.8876
<i>Lgdp</i>			2.9537***	0.3347
<i>Gdppc</i>			-0.0644***	-0.218
<i>ETR</i>				-3.037***
<i>R</i> ²	0.002	0.0162	0.0165	0.0162
<i>Adj R</i> ²	0.001	0.0161	0.0164	0.0161

Ratio	Equation 1	Equation 2	Equation 3	Equation ETR
<i>Intercept</i>	3.1994***	33.3.22***	-49.0437**	44.0815***
<i>DID</i>	0.2594	0.2411*	0.4326***	
<i>Y</i>	0.1267**	0.2406***	0.0705	
<i>C</i>	0.7014***	1.3184***	2.0043***	
<i>ROE</i>		-0.7508	-0.7397***	-0.7442***
<i>Curr.</i>		-17.0961***	-17.1473***	-17.1006***
<i>Empl.</i>		0.0001***	0.0001***	0.0001***
<i>Exp</i>		-1.1829***	-0.134	-1.4633***
<i>Index</i>		-6.0706***	5.5501**	-7.3181***
<i>Lgdp</i>			2.3436***	-0.4070
<i>Gdppc</i>			-0.03**	0.0318***
<i>ETR</i>				-3.4099***
<i>R</i> ²	0.0021	0.0211	0.0213	0.0208
<i>Adj R</i> ²	0.0021	0.0211	0.0212	0.0208

Inspection of Tables 2 and 3 put forward a remarkable coherence with the descriptive results reported in Table 1. Indeed, from Tables 2 and 3 we can compute

Table 4 – Coherence between equation 1 and Table 1		
	Belgium	Netherlands
Before 2008		
Equation 1	$3.20 - .35 = 2.85$	$3.20 + .70 = 3.90$
Table 1	2.85	3.83
2008 and later		
Equation 1	$2.85 + .13 + .09 = 3.07$	$3.90 + .13 + .26 = 4.29$
Table 1	3.07	4.28

Then, we observe that the econometric results repeat the outcome of the descriptive exercise of Table 1, and that for Belgium as well as for The Netherlands. Nevertheless, especially for Belgium, since *DID* is not significantly different from zero while *Y* is, we cannot exclude that the introduction of a Patent Box regime has no effect on the ratio between intangible assets and total assets. This is especially the case for Belgium since *DID* remains not significantly different from zero in that country even when we add a series of control variables. Figure A1 in the Appendix set forth a raising trend in the observed number of registered patents.

However, when *ETR* is substituted for *DID* – see equation *ETR* –, we obtain an effect of the Patent Box regimes significantly different from zero and then Table 4 becomes

Table 5 – Coherence between equation <i>ETR</i> and Table 1		
	Belgium	Netherlands
ΔR^*		
Equation <i>ETR</i>	$.30 \times .80 \times .3399 = .82$	$.34 \times .80 \times .25 = .68$
Table 1	.22	.45
* Difference between <i>R</i> before 2008 and in 2008 and later		

Although the comparison proposed in Table 4 may be subject to criticism, it brings an empirical support to the effectivity of Patent Box regimes in the two countries investigated. In our opinion, the explicit inclusion of the CIT rates in the *ETR* approach makes that latter approach more convincing, or enough convincing for us to support that view of the superiority of *ETR* over *DID*.

Moreover, we also test the robustness of the above results. Therefore we limit our sample to the “before” years 2005 and 2006, and we assume the reform occurring in 2006. Then not only *DID* coefficient is not significantly different of zero, with a *p*-value larger than .50; but *ETR* is also not significantly different from zero, and with a *p*-value larger than .60.

We then conclude that the model is robust. Notice that we could use *ETR* to simulate the effect of the withdrawal of Patent Box regimes and its substitution by another tax design.

Let us complete the presentation and discussion of the results by an examination of the control variables. Let us start with the three variables related to the firm, the return on equity, the relative size of current assets over current liabilities and the size of the firms captured by the level of employment provided. The results are remarkably regular across the equations and the countries. From a theoretical point of view we observe a tradeoff between the profitability and the relative amount of

intangible assets; that seems to rejoin the views expressed a long time ago by Marris (1963) in the *QJE* and also by Hay and Morris (1978) in their textbook. The positive effect of the size of the firm on the relative holding of intangible assets echoes the flow of literature in the tradition of Galbraith (1972) quoted by Hay and Morris (1978) that “profits earned by large monopolistic corporations would be a major source of funds for R&D and this could lead to a pre-eminence of such firms in innovation”.

2.3. Conclusion on Patent Box and R&D

In 2007 Belgium and The Netherlands, followed by Luxembourg in 2008, have introduced a Patent Box regime, also called Innovation Box or Knowledge Box, which basically consists in allowing firms to deduct a large part of received patent income against their Corporate Income Tax Base. That measure aimed at attracting R&D investment. In that paper we want to check whether that measure is successful.

Therefore we conduct an empirical analysis using the Amadeus database and a Differences in Differences approach supplemented by an alternative one exploiting Effective Tax Rates. We especially focus on two applications, where Belgium and The Netherlands are successive treated countries, and where Austria, Germany and Italy form the control group. We capture the effectiveness of the measure through its effect on the ratio, valued at firm level, of intangible assets on total assets.

Our results are in line with the literature: a cut in the tax rate on patent income has a positive effect on intangible assets hold by the firm relative to its total assets. And that result is supported by a robust model.

However a large concentration of patents in a firm located in a given country does not mean necessarily more R&D investment in that firm, or more people employed in the local research sector. Indeed patents are an especially mobile factor. And, country depending, deductibility of patent income against the Corporate Income Tax Base requires a link, more or less strong, between the qualified patent and the local research activity.

3. Allowance for Corporate Equity, ACE

The question of the effect of the corporate income tax on the financing choice of companies is not a new question, see e.g. MacKie-Mason (1990). Today literature recognizes that a debt bias is at work in most tax systems – European Commission (2011), see also Table 6 below. That debt bias is a source of increasing financial risk for firms, as stated by Aujean et al. (2014). Therefore an alternative view of corporate tax has been developed by Boadway and Bruce (1984) which reduces or even cancels that bias, it is called Allowance for Corporate Equity, in short ACE, and consists in permitting firms to deduct against their corporate income tax base, a notional or fictive interest computed on their own funds.

That alternative system has been discussed in depth at the Institute of Fiscal Studies, a.o. by Devereux and Freeman (1991)]. Some years later Croatia was the first country to implement such system.

	France	Germany	Italy	UK	USA
Own capital	20	29	19	20	24
Debt	-36	-37	-48	-28	-46

Source: Aujean et al. (2014), p. 51

That system however is not the only way to fight debt bias. Two alternative solutions are well known and much investigated as well. One is the mechanism known as Comprehensive Business Income Tax or CBIT, which disallows the deduction of any paid out financial income – see de Mooij and Devereux (2011). The other is Thin Capitalization Rules. Under that system, interest payments are no longer deductible against the corporate tax base of the debtor when they are above a threshold; that threshold may be determined by a ratio between debt and equity, e.g. 5 or 7 to 1, or by a percentage of the EBITDA, the earnings before interest, tax and depreciation allowances of the firm.

A discussion of the pros and cons of those three mechanisms is proposed by various authors including Massimi and Petroni (2012) or Klemm (2006) who argues that "in a closed economy this [ACE] should not distort investment, as normal profits are untaxed. In an open economy, however, in which multinationals decide on where to undertake their profitable discrete investment projects, the after-tax economic rent may be increasingly important" [Klemm (2006) p. 3]. Massimi and Petroni (2012) shares that opinion, stating that ACE increases transfer of profits to low corporate tax rate countries. Other studies in the same vein include Bond (2000), Fuest and Hemmelgarn (2005), Sorensen (2007), Radulescu and Stimmelmayer (2007), Keuschnigg and Dietz (2007), Buettner et al. (2008, 2012), Haufler and Runkel (2012), and Blouin et al. (2014).

ACE has been given up by Croatia but adopted by some countries including Belgium, Brazil, Portugal and Italy. However the motivation for those latter countries to adapt ACE might be different, as well as the precise design chosen. E.g. the true motivation in Belgium was to create a substitute for the coordination centers; those allowed special purposes subsidiary of a MNE, located in Belgium, to accumulate interest payments quasi free of corporate tax, a feature regarded by the European commission as against European law; moreover the deduction of fictive interests applied to the whole corporate own capital while in Italy the measure is incremental, thus applied only to capital increases.

In 2012 the empirical study conducted by Princen (Princen, 2012) showed that Belgian ACE had turned to a 3 per cent increase in the equity to debts ratio, but failed to find out an effect on investment or on employment at firm level. The present paper aims at reproducing Princen's work for Italy. The rest of the section is organized like that of the previous one.

3.1. Literature

There is no room here for a detailed theoretical discussion of ACE, CBIT and Thin Capitalization Rules here beyond what we have done so far in this section; or for a complete survey of the possible effects of the tax system on the financial structure of firms.

Some relevant pieces of literature have been already mentioned above. Let us mention however the seminal contribution by Modigliani and Miller (1958) on the irrelevance of corporate finance. The debate as to the deductibility of interest payments and the non-deductibility of dividends, has been fueled by Kay and King (1978) and more recently highlighted by de Mooij and Devereux (2009).

Let us rather focus on Italy. In that country, ACE is used in Italian and means "Aiuto alla Crescita Economica", which can be translated by "Help for Economic Growth" [Panteghini et al. (2012)]. That measure is part of a larger program reforms named Salva Italia and whose goal was to rescue Italian Public Finances [Aujean et al. (2014)]. Italy had already introduced a similar measure fifteen years earlier under the name of Dual Income Tax, DIT.

The idea was to tax at a reduced rate of 19 per cent, instead of 37, a theoretical return of 7 per cent computed on new equity. Launched in 1996, the measure was repealed in 2003 and replaced by Thin Capitalization Rules, which in turn stopped in 2008 for budgetary reasons [Massimi and Petroni (2012)]. ACE came back in 2011 as an emergency measure to fuel economic growth, especially by reducing the risk of bankruptcy through a decrease of the leverage effect and the attraction of new capital. Notice that at that time Italy had one of the highest 12indebtedness in Europe.

Unlike in Belgium, but like DIT, Italian ACE is incremental – mimicking Belgium would have costed 4 billion euros according to Arachi et al. (2012). The rate of notional interest was initially of 3 per cent, for 3 years; that rate went up to 3 per cent in 2014, 4.5 in 2015 and finally reached 4.75. The measure also include anti-abuse provisions [Aujean et al. (2014)].

Regarding the efficiency of the ACE reform in Italy, a study has been conducted by Panteghini et al. (2012). It concludes that the measure can reduce the leverage of 6.4 per cent. However the study was performed just one year after the implementation of the reform; therefore the figures reported in that study basically are a priori estimations.

3.2. Empirical Analysis, Princen (2012) and Belgium's ACE

The aim of Savina Princen thesis was to assess the effect of an ACE tax reform. Therefore she investigates the case of Belgium, a true laboratory country for that purposes. Princen uses a Differences in Differences approach and figures for individual firms from the Amadeus data set, with Belgium as the treated country, France as the control group and German data to test the robustness of the model. The data cover a seven year period, from 2001 till 2007, of which the last two belong to the post-treatment period one. The whole data set includes 20,000 firms, among them 3,332 are Belgian, and a peculiarity of Princen's work is the use of a propensity score matching.⁶ Some industries have been excluded from the sample: Immovable property, financial institutions, and public sector and primary industries.

The model estimated by Princen is, using our own notation,

$$L_{icy} = \beta_0 + \beta_1 DID_{yc} + \beta_2 Y_y + \beta_3 C_c + \beta_v V^T + \varepsilon_{icy} \quad (1.7)$$

In that model, L stands for the leverage of the firm. The other variables are similar to those of equation (1.2) of section 2 and have been defined then.

Savina Princen's results forecast a decrease in the corporate leverage, due to the treatment, comprise between 2 and 7 per cent and significantly different from zero. They also show that large firms benefits

⁶ For a justification, see Table A2 in the Appendix showing divergent trends in the leverage of firms between the two countries at stake.

more from the ACE system. Finally a robustness test is conducted using Germany instead of France, which confirms the results.

The next sub-section asks whether similar results occur in the case of Italy.

3.3. Empirical Analysis, Italian ACE

Thereafter we present the data set, then the model and the variables, and finally the results.

3.31. Data

Again, data come from the Amadeus data base. This time they relate to Italy, the treated country, and to France, the control group, and they cover the period from 2006 till 2015. The treatment of Italy has been initiated in 2011; therefore our ample covers pre-treatment as well as treatment years. However since aggregate data used as control variables and provided by the OECD are not available for 2015, we reduce the length of the sample to the 2006-2014 period. Like Princen (2012) we have excluded some industries, actually the same ones. All in all we have 17,000 observations for 1,923 firms over 9 years. Figures on Germany will be added for the robustness test.

3.32. Model and variables

We use the same model as in section 2 and in Princen (2012), i.e. the one depicted by equation (1.7) and reproduced here,

$$L_{icy} = \beta_0 + \beta_1 DID_{yc} + \beta_2 Y_y + \beta_3 C_c + \beta_v V^T + \varepsilon_{icy} \quad (1.8)$$

In that equation, L stands for the leverage of the firm captured by its debt-to-equity ratio, V is a vector gathering the control variables and Y , L and DID are dummy variables such that

$$\begin{aligned} Y_y &= 1, y \geq 2011, \text{ treatment period} \\ &= 0, y < 2011, \text{ before treatment period} \\ C_c &= 1, c \in \text{ treatment group} \\ &= 0, c \in \text{ control group} \\ DID_{cy} &= C_c Y_y = 1, \text{ treatment group and period} \\ &= C_c Y_y = 0, \text{ otherwise} \end{aligned} \quad (1.9)$$

Control variables gathered in vector V are the following,

$$V^T = [Tot_{icy}, Tgb_{icy}, RoE_{icy}, NOL_{icy}, Empl_i, Infl_{cy}, growth_{cy}] \quad (1.10)$$

They correspond respectively to

- The total amount of the assets hold by the firm, a proxy for its size
- The ratio of tangible to total assets⁷
- The return on equity, an indicator of profitability of the firm
- A dummy variable equal to 1 if the firm makes losses
- The level of employment in the firm, another measure for its size
- The rate of inflation in the country
- The growth rate of GDP in the country.

The last two variables assess the economic health of the country.

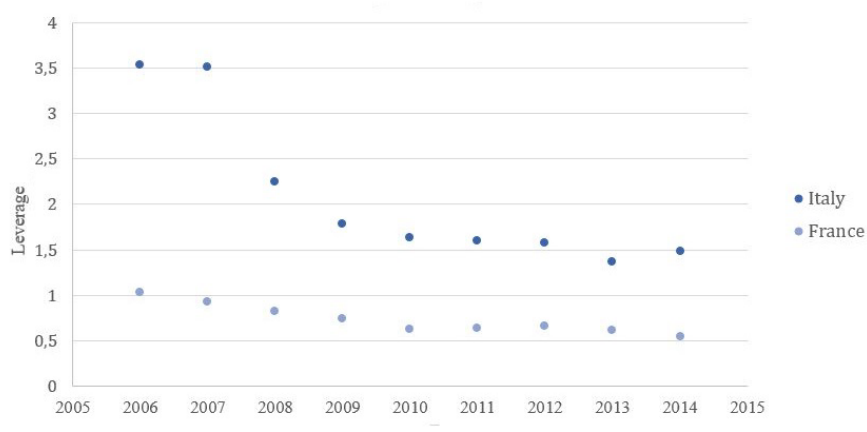
3.33. Results

Let us start with a descriptive exercise. Inspection of the data base allows us to produce Table 7.

Table 7 - Relative Change of the Average L Ratio			
		Italy	France = Control Group
Ratio	Before 2011	2.54	.83
	2011 and later	1.51	.62
Δ (%)		-68.33 %	-34.99

Two observations arise from that inspection. First the leverage is much higher in Italy than in its neighboring country. Second, the decrease in the leverage is much more important in Italy. However we cannot conclude too fast that such strong decrease is due to the ACE reform introduced by Prime Minister Monti. Indeed, as indicated by Figure 2, the leverage was abnormally high in Italy in 2006 and 2007, and it already declined before 2011 and the introduction of the measure.

Figure 2 – Average leverage of firms in Italy and France, 2006-2014



Therefore the years 2006 and 2007 will be considered as outliers and removed before starting the econometric work and the Differences in Differences estimation; otherwise the common trend assumption of that latter method will not hold.

⁷ According to Campello and Giambona (2010) that value impacts the structure of the capital of the firm.

We can now proceed to the econometric analysis. Results are summarized in Table 8.

Table 8 – Allowance for Corporate Equity, Italy			
Ratio	Equation 1	Equation 2	Equation 3
<i>Intercept</i>	-7.2349***	7.1407***	5.6329**
<i>DID</i>	2.4694	-7.623***	-6.9535***
<i>Y</i>	1.2906	-3.1934**	-2.8990**
<i>C</i>	-11.5185***	11.5461***	12.2147***
<i>Total assets</i>		.00	.00
<i>Tangibility</i>		.1892***	.1914***
<i>Return on Equity</i>		-16.9789***	-17.4265***
<i>Employment</i>		.00	.00
<i>NOL</i>			-.412
<i>Inflation</i>			.5655
<i>Growth</i>			.877*
<i>R²</i>	.0096	.0179	.0185
<i>Adjusted R²</i>	.0094	.0175	.0179
*, **, *** are significantly different from zero at 90, 95 and 99 per cent respectively			

The results from equation 1 give unexpected signs, which in addition do not significantly differ from zero in two cases out of four. In contrast, those generated by the other two regressions are significantly different from zero and have the expected sign. They show a decrease in the leverage in Italy lying between 7.62 and 6.95. Moreover they are consistent with both the results obtained by Princen (2012) for Belgium and forecasted by Panthegini et al. (2012) for Italy.

In order to make the results more credible we have conducted two robustness tests. In the first one we have substituted Germany for France as control country; in the second we have limited the period to the years 2008, 2009 and 2010 (instead of 2008-2014) assuming that the treatment starts in 2010 (instead of 2011). The first test leads to coefficients for *DID*, *Y* and *C* variables which no longer significantly differ from zero so that we should recognize that, based on that test, the model doesn't support the hypothesis of ACE being an effective reform for Italy; however the question then arises of the comparability between Italy and Germany and thus of substitutability between France and Germany.

The other test is more conclusive: when we use an inconsistent period of time and a wrong starting time for the treatment, both *DID* and *Y* no longer significantly differ from zero; *C* does but that just illustrates that leverage is much higher in Italy than in France.

We are up to accept the argument that Italy and Germany are too different economies for one serving as control for the other. Then we consider that the second test is more credible and that the model is robust. However additional arguments should be welcome.

3.34. Real or just financial effects?

Before concluding this paper let us address a final, often raised, question: does ACE increase investment and employment, and not just reduce the leverage. In other words, has ACE positive real effects next to financial effects.

Our model makes possible to answer that question, at least partially. Take equation (1.8) again and introduce two changes. First replace leverage by tangible assets in percentage of total assets, as dependent variable. Second, remove total assets, tangibility and NOL from the vector of control variables and put instead the own funds of the firm. Table 9 reports the results obtained.

Tangible assets	Equation 4	<i>Own funds</i>	.00*
<i>Intercept</i>	20.5728***	<i>Employment</i>	.00
<i>DID</i>	.2474	<i>Inflation</i>	.1709
<i>Y</i>	.2051	<i>Growth</i>	-.2576*
<i>C</i>	14.0486***	<i>R²</i>	.0929
<i>Return on Equity</i>	-.9859	<i>Adjusted R²</i>	.0924
*, **, *** are significantly different from zero at 90, 95 and 99 per cent respectively			

Inspection of Table 9 reveals that *DID* doesn't significantly differ from zero. Moreover the corresponding *p*-value exceeds 70 per cent. As a consequence we cannot reject that the Italian ACE has no effect on real investment, more precisely on the relative importance of tangible assets into total assets of the firm. That lack of real effect on the relative share of tangible assets might signal an absence of impact on employment though that link needs to be qualified.

3.4. Conclusion on ACE in Italy

Five years after Belgium and its notional interests, Italy has introduced in its tax system, in 2011, an ACE mechanism renamed "Aiuto alla Crescita Economica"; unlike Belgium however, Italy adopted an incremental, less expensive for the government budget, version of the mechanism. Repeating the econometric exercise that Princen (2012) conducted for Belgium five years ago, we have undertaken to assess the Italian reform.

Results are consistent with the predictions of Panteghini et al. (2012) which shows that the leverage effect should decrease of a figure between 2.5 and 7.6 per cent. Thus, despite a smaller incentive than in Belgium, at least in terms of revenue cost, the reform initiated by the Monti government seems to have reached its objective of decreasing the indebtedness of Italian firms.

However, like Princen for Belgium, we do not find for Italy more than a financial effect – a decrease in the leverage ratio and thus in the financial risk for firms. Of course reducing such risk may incentivize investment indirectly, but beyond that argument we have no evidence of real effect on investment and employment.

4. Conclusion

Several countries in the World have recently adopted, and sometimes then repealed, tax reforms aimed at increasing their interest for the location of specific functions of Multinational Enterprises. In today tax competition it is no longer question indeed, especially for high labor cost advanced

economies, to be attractive for MNEs in general, but instead to be the best location for specific activities of those companies, e.g. those requiring highly qualified people like Research and Development, R&D, or focusing on the most mobile factors like intellectual property rights, in top of them patents at source of royalties, or still on the pooling of financial resources management, through intra group loans within the MNE. All in all today MNE appears to be a decentered network of functions located in jurisdictions which offer comparative advantages often incentivized by tax systems – see Desai (2009).

In this paper we examine the effectiveness of two among those tax incentives, the Patent Box regimes, PBR, and the Allowance for Corporate Equity, ACE. For both instruments, we start with a brief theoretical section, accompanied by a short survey of literature; then we propose an original empirical investigation whose results are compared with those already suggested by literature. For the needs of our empirical analysis we use data from the Amadeus data base and Differences in Differences modelling strategy.

As we explain in the section devoted to that instrument, Patent Box regimes have been forbidden by the European Union considering that they were against EU law. However, due to a grandfathering provision, they are still in application for some years.

Practically, in 2007 Belgium and The Netherlands have introduced a Patent Box regime, also called Innovation Box or Knowledge Box, which basically consists in allowing firms to deduct a large part of received patent income against their Corporate Income Tax Base. That measure aimed at attracting R&D investment. In that paper we attempted to check whether that measure was successful.

Therefore we have conducted an empirical analysis using the Amadeus database and a Differences in Differences approach supplemented by an alternative one exploiting Effective Tax Rates. We especially focus on two applications, where Belgium and The Netherlands are successive treated countries, and where Austria, Germany and Italy form the control group. We capture the effectiveness of the measure through its effect on the ratio, valued at firm level, of intangible assets on total assets.

Our results are in line with the literature: a cut in the tax rate on patent income has a positive effect on intangible assets hold by the firm relative to its total assets. And that result is supported by a robust model.

However a large concentration of patents in a firm located in a given country does not mean necessarily more R&D investment in that firm, or more people employed in the local research sector. Indeed patents are an especially mobile factor. And, country depending, deductibility of patent income against the Corporate Income Tax Base requires a link, more or less strong, between the qualified patent and the local research activity.

Otherwise, five years after Belgium and its notional interests, Italy has introduced in its tax system, in 2011, an ACE mechanism renamed “Aiuto alla Crescita Economica”; unlike Belgium however, Italy adopted an incremental, less expensive for the government budget, version of the mechanism. Repeating the econometric exercise that Princen (2012) conducted for Belgium five years ago, we have undertaken to assess the Italian reform.

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However, like Princen for Belgium, we do not find for Italy more than a financial effect – a decrease in the leverage ratio and thus in the financial risk for firms. Of course reducing such risk may incentivize investment indirectly, but beyond that argument we have no evidence of a real effect on investment and employment.

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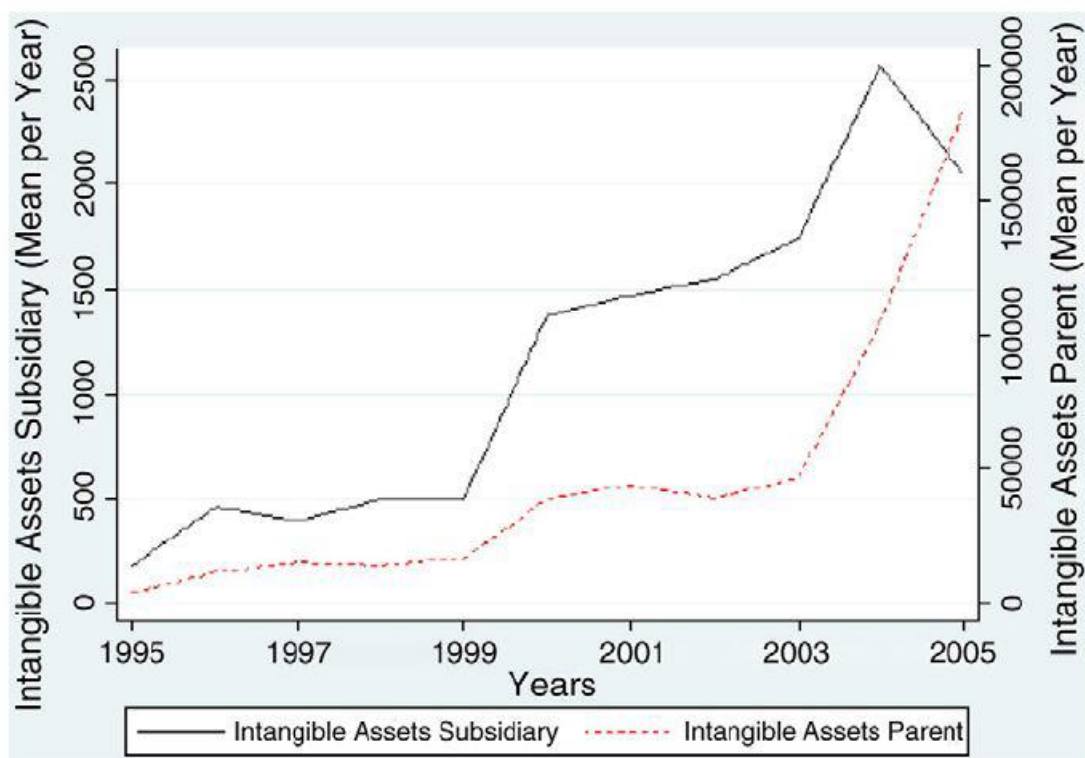
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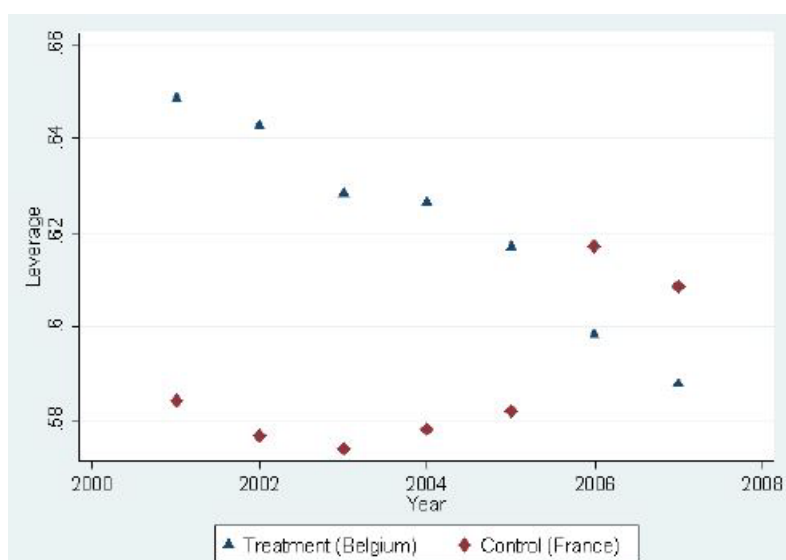
Appendix

Figure A1 – Upward trend in intangible assets, 1995-2005



Source: Dischinger and Riedl (2011)

Table A2 - Divergent trend in the leverage, Belgium and France, 2000-2008



Source: Princen (2012)