
Rationale, design and effectiveness of R&D tax measures



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This article evaluates tax incentives for research & development (R&D) based on their attributes to correct externalities, relax liquidity constraints, increase international competitiveness and keep the administrative burden and distortion of competition moderate. This paper also provides estimates on the static budgetary impact of different tax measures. Input measures such as super deductions or tax credits, especially if they focus on an increase of R&D rather than the R&D stock, work well if the primary goal of tax policy is to reduce externalities. If these incentives are combined with a payout to newly established companies, then the liquidity constraints of start-up companies can also be successfully addressed. In contrast, IP-boxes are an instrument whose primary objective is to increase international competitiveness. The different instruments cannot adequately address all goals; therefore, policymakers have to introduce measures that accord with their priorities.

Der Aufsatz evaluiert verschiedene Instrumente einer steuerlichen Förderung von Forschung und Entwicklung (F&E) im Hinblick auf ihr Potenzial externe Effekte zu reduzieren, Liquiditätsrestriktionen junger Unternehmen abzubauen und ein international attraktives steuerliches Umfeld zu bieten. Darüber hinaus werden auch die Erhebungs- und Entrichtungskosten der Massnahmen, potenzielle Wettbewerbsverzerrungen einer Förderung sowie die (statischen) budgetären Effekte der einzelnen Instrumente thematisiert. Es zeigt sich, dass eine Steuergutschrift oder eine Mehrfachabzugsfähigkeit von F&E-Aufwand – insbesondere, wenn diese Instrumente in Form einer aufwuchsbasierten Förderung eingeführt würden – externe Effekte korrigieren können. Wenn die Förderung bei jungen und kleinen Unternehmen zu einer Auszahlung führen würde, könnten auch die Finanzierungsengpässe eben jener reduziert werden. Eine Lizenzbox ist dagegen ein Instrument, welches vor allem die Standortattraktivität des Steuersystems stärkt. Daraus folgt, dass keines der Instrumente den anderen Massnahmen hinsichtlich aller Beurteilungskriterien überlegen ist, so dass die Aus-

¹⁾ This working paper does not necessarily reflect the views of the Swiss Federal Tax Administration, the Swiss Department of Finance or the Swiss Federal Council. The opinions, findings, and conclusions expressed in this paper are those of the author. I thank my colleagues Alwin Moes, Bruno Jeitziner, Mario Morger and Martin Daepf for their helpful comments. All remaining errors are mine.

wahl eines Instruments von der Gewichtung der mit der Massnahme verfolgten Ziele abhängig sein wird.

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I. Introduction

Numerous studies, both theoretical and empirical, have shown that innovation and technical progress are key drivers of economic growth.²⁾ Because of market failures in the area of R&D, a majority of OECD countries began to introduce tax measures to boost economic growth through R&D investment.³⁾ Even governments that do not offer tax incentives – such as Switzerland – acknowledge the importance of R&D. These countries have established programs

²⁾ Pioneering theoretical studies on the relationship between R&D and growth are the following: *Romer, Paul*, Increasing Returns and Long Run Growth, *Journal of Political Economy* 94, 1986, 1002-1037 (cited: Increasing Returns) and *Romer, Paul*, Endogenous Technical Change, *Journal of Political Economy* 98, 1990, 71-102 (cited: Technical Change). Empirical studies include, among others, the following: *Bassanini, Andrea / Scarpetta, Stefano*, The Driving Forces of Economic Growth: Panel Data Evidence for the OECD Countries, *OECD Economic Studies* No. 33, 2001 (cited: Driving Forces); *Coe, David / Helpmann Elhanan* International R&D Spillovers, *NBER Working Papers* No. 4444, 1993 cited (R&D Spillovers); and *Westmore, Ben*, R&D, Patenting and Growth, *OECD Economics Department Working Papers* No. 1047, 2013 (cited: Patenting and Growth).

³⁾ For example, overviews are provided by the following: *Deloitte*, *Global Survey of R&D Tax Incentives*, 2013 (cited: Global Survey); *PWC Global Research & Development Incentives Group*, 2014 (cited: Global Research Group); *Spengel, Christoph*, *Steuerliche Förderung von Forschung und Entwicklung (FuE) in Deutschland. Ökonomische Begründung, Handlungsbedarf und Reformbedarf*. *MPI Studies on Intellectual Property, Competition Law and Tax Law* 8. Springer, 2009 (cited: *Steuerliche Förderung*), page 69 ff.

that offer subsidies or provide administrative assistance to newly established companies.⁴⁾

Governments have supported companies through the tax system by offering either output-based measures that incentivize the revenues generated from intellectual property (IP) or input-based measures that incentivize R&D expenditures. In these two broad classes, numerous variants exist.

The goal of this essay is to evaluate the most common tax measures on R&D offered in OECD countries. The essay begins by providing a rationale for the use of R&D tax measures from an economic perspective. The theoretical literature mainly discusses the following three reasons why governments should promote R&D policies (through the tax system): 1. externalities; 2. liquidity constraints; and 3. international competitiveness. Section 2 introduces different tax measures on R&D. Generally, these tax measures can be categorized as either input measures (e.g., tax credits or super deductions) or output measures (e.g., IP-boxes). Section 3 summarizes the criteria on which the evaluation of the tax measures in section 4 is based. Finally, section 5 concludes that no measure satisfactorily addresses all potential goals of governmental R&D policies. If political decision makers place significant emphasis on achieving international competitiveness, then the introduction of an IP-box is most promising. In contrast, input-based measures are superior if the reduction of externalities and the relaxation of liquidity constraints play a significant role in the government's objective.

II. Rationale, design and effectiveness of R&D tax measures

1. Rationale for R&D tax measures

Innovations are important determinants of economic growth. However, the fact that innovation-based economies grow faster is no justification for government intervention. To rationalize a government intervention, market failures concerning the innovation process must exist. In the industrial organization literature, three main channels have been identified that justify an active role of the state. Internalizing spillover effects and obtaining access to finances address market failures surrounding the R&D-process, whereas competition over the profits and jobs created by R&D-intensive companies refers to the distribution of an existing (worldwide) knowledge-based capital stock.

⁴⁾ In Switzerland, the commission for technology and investment (CTI) grants (financial) support to innovation-based projects. In 2013, CTI supported 331 projects with 109.3 million Swiss francs. See *Flückiger-Bäni, Sylvia Postulat 14.1039 Förderung der KMU-Landschaft in der Schweiz*, response of the Swiss Federal Council (cited: *Förderung der KMU-Landschaft*).

1.1 Spillover effects

The first – and perhaps most important – reason why governments actively should promote innovation-based policies involves spillover effects. These spillovers or, more generally, external effects exist if the utility of consumers or the profits of companies depend on the behavior of other economic actors that is not reflected in market prices. For innovations, the most important case constitutes the development of a new product that was preceded by large R&D expenditures of the innovating company. If property rights are weak or if it is impossible to patent the product, the innovating firm risks that its innovation will be copied by competing firms, but these firms do not have to bear the (often high) costs in developing the product.

Why do governments not simply protect property rights by allowing the firm to patent the product? There are several reasons why pecuniary support may sometimes be superior compared with granting patent protection.

- Some IP, such as trade secrets or a client base, cannot be patented.
- Even if the product can be patented, firms may hesitate to undertake this step if they fear that only modest changes of the product create the opportunity to circumvent the patent right.
- A patent provides a temporary monopoly. Ideas and efforts are reinforced and combined if companies compete in similar fields. This form of economic progress, where previous innovations provide the basis for follow-up-innovations, would be interrupted if a patent is granted to only one firm.
- Patent rights sometimes create the incentive to engage in socially wasteful «patent races».⁵⁾

Therefore, pecuniary support by the government may be superior because it does not depend on the possibility to patent the product, and it does not delay follow-up innovations by other firms.

1.2 Liquidity constraints

Large companies are responsible for a major portion of R&D expenditures, but this does not mean that small companies are less important. Especially start-up companies engage in R&D activities that sometimes result in radical new product solutions, and even innovations of large firms are often based on the preliminary work of start-up companies. This suggests that a government should monitor the potential barriers to start-up companies. Although the founding process of start-up companies can be cumbersome because of regulatory requirements and bureaucratic procedures, the government can influence this regulatory environment directly. In contrast, the financing of new projects is normally provided by private investors in market economies, and the government plays only a supplementary role.

⁵⁾ *Belleflamme, Pau / Peitz, Martin*, Industrial Organization. Markets and Strategies. Cambridge University Press, Cambridge, 2010, chapters 18&19 (cited: Industrial Organization).

If a company is financed through debt, the creditor receives an interest payment but does not participate in the potential success of the company. Because an investment in R&D is often risky, the distribution of risk and chances is disadvantageous for potential creditors. Furthermore, if the financial institution cannot effectively monitor the risk-profile of an investment, they either do not lend money or offer loans with high interest rates. With high interest rate loans, especially entrepreneurs with promising projects will find the financing conditions of the bank unattractive. Eventually, a phenomenon results that economists call «adverse selection».⁶⁾ This situation is characterized by the survival of low-quality companies.

Adverse selection occurs in the phase before the credit contract is signed, whereas another phenomenon called «moral hazard» arises after credit is provided to the firm. Because the returns to an investment above the risk-free interest rate remain under the control of the company owners, the company owners have an incentive to invest in exceptionally risky projects with above-average rates of return. The risk of failure is then borne by the creditors, whereas the risk premium is appropriated by the owners. Thus, after signing a credit contract, entrepreneurs have an incentive to change their behavior regarding the selection of the investment projects.

If financing through debt is no solution, equity could be an alternative. However, this solution is problematic because it provides too little incentive to contribute to the company's success. Again, moral hazard impedes market forces.⁷⁾

In principle, the above-mentioned problems concerning the financing process arise for all companies. However, the practical importance of these problems is more relevant for smaller and especially start-up companies. First, start-up companies normally cannot provide any collateral to potential financiers. The capital of R&D-intensive start-ups consists mainly of the entrepreneurs' brain, whereas the capital of «mature» firms comprises at least partly tangible capital and can serve as collateral if the company becomes bankrupt. Second, compared with well-established companies, start-ups lack a reputation that could be useful in reducing information asymmetries between potential capital providers and the company. Finally, an investment in a start-up company is by its nature risky. These characteristics – a strong focus on human capital, a lack of reputation and the inherent risks of R&D – make it much more difficult for R&D-intensive start-ups to obtain access to finances compared with other companies. Because of these characteristics, a government intervention can be legitimized.

⁶⁾ This problem was first formulated by *Akerlof, George*, The Market for Lemons, *Quarterly Journal of Economics*, 84(3), 488-500, 1970 (cited: Lemons) and applied to credit markets by *Stiglitz, Joseph / Weiss, Andrew*, Credit Rationing in Markets with Imperfect Information, *The American Economic Review* 71(3), 1981, 393-410 (cited: Credit Rationing).

⁷⁾ *Keuschnigg, Christian / Ribi, Evelyn* Volkswirtschaftliche Analyse der steuerlichen Förderung von Forschung und Entwicklung, p. 22, 2011 (cited: Volkswirtschaftliche Analyse).

1.3 International competitiveness

A final rationale why R&D may be subsidized is not caused by market failures but by international competition over scarce resources. OECD governments (and increasingly, developing countries) compete for multinational companies (MNCs). Although it is not exclusively observable for R&D-intensive MNCs, MNCs with a strong focus on new technologies provide specific benefits to an economy. First, spillover effects to the local economy can arise either through learning processes among competing companies or the reduction of transactions costs because of the spatial proximity of companies. Second, especially R&D-intensive companies offer job opportunities for highly qualified personnel. Third, compared with other MNCs, R&D-intensive companies have much more discretionary power over the decision concerning where to locate profits.⁸⁾

The first two benefits occur particularly if the MNC has located its R&D facilities in the respective country. However, even where the economic substance in the country is modest, governments have an incentive to compete for the profits of MNCs. For example, contract R&D allows MNCs to separate the ownership of intangibles from conducting research. Conducting research can occur in countries that offer a pool of highly qualified researchers, whereas ownership (and the associated risk) can be located in low-tax countries where the revenue is taxed. By either applying transfer pricing strategies or strategically locating IP in low-tax countries, profits can be shifted from high-tax to low-tax locations.⁹⁾

Countries compete over R&D-intensive companies. This competition can relate to either economic substance, i.e., the conduct of R&D including the creation of new and highly skilled jobs, or profit shifting.¹⁰⁾

⁸⁾ Recent studies on the special role of intangibles in profit shifting are the following, among others: *Dischinger, Matthias / Riedel Nadine*, Corporate Taxes and the Location of Patents Within Multinational Firms, *Journal of Public Economics* 95(7-8), 2011, 691-707 (cited: Location of Patents); *Grubert, Harry*, Intangible Income, Intercompany Transactions, Income Shifting and the Choice of Location, *National Tax Journal* 56, 2003, 221-242 (cited: Intangible Income); and *Karkinsky, Tom / Riedel, Nadine* Corporate Taxation and the Choice of Patent Location within Multinational Firms. *Journal of International Economics*, 88(1), 2012, 176-185 (Choice of Patent Location).

⁹⁾ Governments become increasingly aware of the strategies to manipulate transfer prices or optimize the financial structure of MNCs by introducing unilateral anti-tax avoidance measures. In addition, the OECDs' base erosion and profit shifting project is a multilateral approach to constrain profit shifting.

¹⁰⁾ Overview essays on the empirical relevance of profit shifting include the following: *De Mooij, Ruud Alosyius / Ederveen Sjed* Corporate Tax Elasticities: A Reader's Guide to Empirical Findings. *Oxford Review of Economic Policy* 24(4), 2008, 680-697; *Dharmapala Dammika* (2014) What Do We Know About Base Erosion and Profit Shifting? A Review of the Empirical Literature. *Illinois Public Law and Legal Theory Research Papers Series No. 14-23*; *Genschel, Philipp / Schwarz, Peter*, Tax Competition: A Literature Review. *Socio Economic Review* 9(2), 2011, 339-370; and *Heckemeyer, Jost / Overesch Michael*, Multinationals' Profit Response to Tax Differentials: Effect Size and Shifting Channels. *ZEW Discussion Paper 13-045*, 2013.

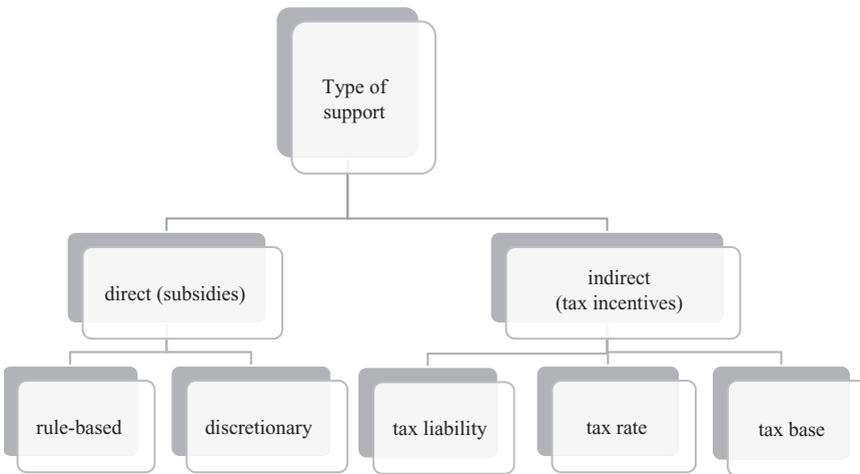
2. Instruments

At an aggregate level, governments can support R&D through the expenditure side of the budget (subsidies), through regulatory policies or through the tax system. Governmental budgetary programs refer to pecuniary support, whereas regulatory policies either decrease the regulatory burden on R&D companies or grant a temporary monopoly to the owner of an IP. Although tax incentives and subsidies both grant financial support, important differences between these two instruments exist. Typically, subsidies are not dependent on the economic success of a project. Sometimes subsidies can be – similar to tax incentives – applied universally as long as the companies fulfill the criteria (rule-based subsidies). In the majority of cases, however, subsidies are granted on a project basis. Thus, usually companies must submit a proposal, and eligibility for financial support is decided by a commission. Of course, the selection process accords with some *ex ante* specified criteria, but the commission has much more discretionary power compared with the universal case. Figure 1 summarizes the different forms of pecuniary support.

In principle, subsidies share the advantage that projects with the best prospects can be selected. In contrast to general tax incentives, however, subsidies share the disadvantage that more unsuccessful projects will be supported.¹¹⁾ In practice, the individuals who must judge the project's success prospects are typically not better informed than other market participants. Therefore, it is doubtful that government officials will overcome these information asymmetries described in 1.2 if financial institutions cannot. In addition, a commission consisting exclusively of government officials involves the risk that policies will be pursued that are not consistent with the application guidelines. For these reasons, in some countries – including Switzerland – in these commissions, experts from the private sector also participate in the jury.

¹¹⁾ Tax incentives share, however, the disadvantage that they may provide too little incentive in a situation characterized by uncertainty regarding the project's prospects at the level of the jury *and* the company founder.

Figure 1: Different forms of pecuniary support of R&D



Source: own illustration

2.1 Input measures

Although regulatory measures, subsidies and tax incentives are to some degree substitutes in some cases, they are also complements. In the following section, only the different forms of tax incentives will be analyzed, setting aside the different options to promote innovations through regulatory policies or subsidies.

Because tax incentives help overcome information asymmetries between investors who finance a project and those who receive the funds, they are used in a majority of OECD countries.¹²⁾ Governments have the option to support R&D by reducing the tax rate, granting a tax credit or allowing a super deduction (see figure 1). A super deduction allows companies to deduct their R&D allowances by more than 100%. In addition, governments have to specify the following:

- Whether the input or output side of the R&D process should be promoted;
- what R&D expenditures (or earnings) should be incentivized; and
- what companies should be eligible for support.

Support can be provided through the input or output side. If the government incentivizes the output side, only IPs that have become an economic success are supported. IP-boxes are a typical instrument for output-based support. IP-boxes are a relatively new instrument, and most countries only recently began to in-

¹²⁾ Tax incentives share the advantage that, in the majority of cases, successful projects are incentivized; therefore, tax incentives promote a screening of projects based on quality.

roduce this instrument. Alternatively, R&D can be incentivized through the input side. Thus, R&D expenditures, not revenues, are promoted. Compared with output-based measures, R&D projects can be subsidized across projects where earnings from profitable projects are used to claim a super deduction or tax credit. However, compared with subsidies, even tax incentives on the input side require that the company earns (at least in the future) profits.

If a government wants to promote R&D through the tax system, it must decide what expenditures (or earnings) qualify. Most countries offering input-based measures base their decision on the OECDs Frascati Manual,¹³⁾ implicating that all R&D-related expenses qualify. Several countries also offer specific measures, such as reduced social security contributions for foreign researchers. Of course, measures where qualifying R&D expenditures are more specifically defined discriminate in favor of those production factors that are incentivized. Reducing social security contributions on researchers makes it more attractive to use human capital instead of physical capital in the production process. Similarly, accelerated depreciation is a measure that discriminates among input factors because governments do not offer accelerated depreciation to the human capital stock of R&D personnel. Therefore, this measure incentivizes the use of physical capital.

Finally, governments must decide what companies are eligible. Tax measures can be open to all companies, regardless of their legal status or residence. However, in the past, countries engaged in preferential tax competition where tax incentives were reserved for mobile companies. Granting favorable tax conditions to foreign companies or foreign revenue is no longer a viable option because this «ring-fencing» is no longer accepted internationally. Increasingly, tax incentives on R&D are reserved for newly established companies. The UK is an example where the government grants to small companies a larger super deduction of 225% for qualifying R&D expenditures.¹⁴⁾ In addition, small companies can opt for a payout instead of a loss carry-forward. This approach reduces liquidity constraints for start-up companies because these companies often do not generate profits in the beginning.

While output-based tax measures have gained increasing importance, tax incentives through the input side are more common among OECD countries. Several countries, such as France or the Netherlands, combine output and input measures. Among the input measures, accelerated depreciation of R&D capital, tax credits and super deductions are the most common. In the following discriminatory measures, such as accelerated depreciation or reduced social security contributions to R&D personnel, will not be discussed in detail. Among the

¹³⁾ See *OECD, Frascati Manual. Proposed Standard Practice for Surveys on Research and Experimental Design*, 6th edition, 2012 (cited: Frascati Manual).

¹⁴⁾ A small company is eligible for the super deduction if either its turnover does not exceed 100 million £ or its balance sheet does not exceed 86 million £. A small company is defined by less than 500 employees. For detailed information on the UK scheme, consult <http://www.hmrc.gov.uk/ct/forms-rates/claims/randd.html> (accessed 31 March 2015).

non-discriminatory measures, the following instruments will be evaluated in more detail in section 4:

- A super deduction on the stock of R&D expenditures;
- a tax credit on the stock of R&D expenditures;
- a super deduction on the increase of R&D expenditures relative to a benchmark scenario;
- a tax credit on the increase of R&D expenditures relative to a benchmark scenario; and
- an IP-box.

Compared with other R&D tax incentives, general tax credits or super deductions are non-discriminatory and input-based measures. A tax credit reduces the tax burden, whereas a super deduction allows companies to deduct R&D expenses by more than 100%. Therefore, a super deduction reduces the tax base. As long as the corporate tax is proportional, the properties of a tax credit and a super deduction are comparable. Only with progressive taxes, super deductions share the characteristic of significantly benefitting highly profitable companies. This benefit occurs, for example, if two otherwise identical companies qualify for the super deduction and pay (the progressive) income tax instead of the corporate tax. Specifically in Switzerland, with its fiscal federalism tradition, an unequal tax treatment results also within the corporate sector. A super deduction in the canton of Geneva is worth more than a super deduction in the canton of Schwyz because of the higher tax burden in Geneva. A final difference pertains to company status. Even in Geneva, for example, an unequal treatment under a super deduction results if one compares ordinary taxed companies with status companies. For status companies, the super deduction is less valuable because their effective tax rate is much lower than the tax rate of an ordinary taxed company. The appendix summarizes the tax treatment of super deductions and tax credits and compares these incentives with general subsidies.

Tax credits and super deductions can refer to the stock of R&D expenditures or the tax system can incentivize the increase of R&D efforts of companies. In a tax system that incentivizes the increase of R&D efforts, a company can claim tax credits or a super deduction if its R&D expenditures exceed some benchmark level. To reduce business cycle effects and the strategic behavior of companies, the benchmark should be calculated on an average based on several years instead of the previous year's R&D expenditures.¹⁵⁾ Thus, tax credits and super deductions can be designed as stock or flow measures.

¹⁵⁾ The following is an example of strategic behavior based on the previous year's R&D. A company with (constant) 100 CHF of R&D expenditures is never eligible for an incremental R&D measure. Therefore, the company has an incentive to reduce its expenditures in one period to zero and to increase it in the next period to 200 CHF. On average, the company also invests 100 CHF, but compared with the first case, it would be eligible for the tax incentive in the second period.

2.2 Output measures

IP-boxes are output-based measures because the tax incentives refer to revenues instead of expenditures. IP-boxes have become increasingly popular in recent years, but their design differs among countries.¹⁶⁾ IP-boxes can be differentiated among the following issues:

- What revenue from IPs should be taxed favorably?
- Are the tax incentives also offered when the IP is sold or is self-exploited?
- Is contract R&D, where the IP is not developed by the owner of the IP, also part of the regime?
- What standards are required regarding economic substance?
- Are the tax incentives offered through reduced tax rates or a narrow tax base?
- How is the tax base determined?

The first issue defines the broadness of the IP-box. Some countries offer favorable tax treatment only to patents, whereas in other countries, the definition of IP is much broader and is based on Art. 12 of the OECD model tax convention. One example for a broader approach is the IP-box of the canton of Nidwalden, which was introduced in 2011.¹⁷⁾ Broadly defined, IP-boxes often expand favorable tax treatment beyond patents to other IP, such as trademarks or copyrights.

Second, it should not matter whether the company receives revenue from selling the IP on the market, self-exploiting or licensing. However, some IP-boxes restrict tax incentives solely to licensing. Furthermore, tax incentives can be

¹⁶⁾ For a discussion of country practices and the details of IP-boxes, see *Van Den Berghe, Pieter / Kelley, Patrick*, New Patent Deduction in Belgium: A Powerful Incentive, *Bulletin for international taxation*, August / September 2008, S. 374ff. (cited: Patent Deduction in Belgium); *Evers, Lisa / Miller, Helen / Spengel, Christoph*, Intellectual Property Box Regimes: Effective Tax Rates and Tax Policy Considerations, *International Tax & Public Finance*, 2013 (cited: Intellectual Property Box Regimes); *Hausmann, Rainer / Roth, Philipp / Kruppenacher, Oliver*, Lizenzbox als alternatives Modell zur gemischten Gesellschaft. Besteuerung von Lizenzzerträgen unter Berücksichtigung internationaler und europarechtlicher Bestimmungen, *Der Schweizer Treuhänder*, 87-94 (cited: Lizenzbox als alternatives Modell); *Muntendam, Frank / Chiarella, Jose*, New Luxembourg Tax Regime for Intellectual Property Income, *European Taxation*, Mai 2008, S. 223 ff.; *Schäuble, Günter, Giger Reto*, Lizenzbox in Nidwalden. Ein Steilpass für andere Kantone und den Bund, *Der Schweizer Treuhänder* 2010/10, 711 ff. (cited: Lizenzbox in Nidwalden); *Hosp, Thomas / Langer, Matthias*, Standortvorteil Liechtenstein: Welche Chancen bietet Liechtenstein ab 2011 dem internationalen Investor?, *StR* 7-8/2011, S. 550ff.; *European Commission*, State aid N 480/2007 – Spain – The reduction of tax from intangible assets, C(2008)467 final; and *Dutler, Claudia Prendina*, IP-Boxen in Europa Ein Blick über die Grenze auf die europäischen Entwicklungen bei der Besteuerung von Immaterialgüterrechten, *FStR* 2013/2, S. 135ff.

¹⁷⁾ A more detailed discussion of the Nidwalden IP-box is provided by *Hausmann, Rainer / Roth, Philipp / Kruppenacher, Oliver*, Lizenzbox als alternatives Modell, s. Fn. 15; *Schäuble, Günter, Giger Reto*, Lizenzbox in Nidwalden, s. Fn 15.

restricted to self-developed IP, but other regimes allow contract R&D where MNCs can separate the ownership of intangibles from conducting research. Conducting research can occur in countries offering a pool of highly qualified researchers, whereas ownership (and the associated risk) can be located in low-tax countries where the resulting revenue is taxed. However, some criteria related to economic substance usually must be fulfilled. Finally, output-based measures allow for favorable tax treatment by either a reduced statutory tax rate or excluding some percent of the profits from taxation.

3. Evaluation criteria

The majority of OECD countries support R&D in some form through the tax system, but the specific design of these measures are manifold and often complex. This heterogeneity is partly attributed to different objectives. Therefore, the analysis in the next section will evaluate these measures by utilizing the following criteria:

- Correction of external effects;
- relaxation of liquidity constraints;
- international competitiveness;
- distortion of competition;
- administrative burden; and
- budgetary impact.

Specifically, we ask whether the measures introduced in the last section to some degree internalize external effects, solve liquidity constraints of start-up firms and are attractive to MNCs. Beyond these reasons for supporting R&D through the tax system, several restrictions must be considered. First, one must determine whether the introduction of R&D tax incentives creates distortions in competition. Second, a measure may be well-founded on theoretical grounds, but it must be applied in reality. Its administrative complexity, both for taxpayers and the tax administration, will be therefore evaluated. Finally, what matters from a policy perspective is the efficiency of a measure, i.e., how much value is created per 1 CHF support. Therefore, the budgetary impact of the measures will also be evaluated. Thus, 6 different criteria are used to evaluate the different fiscal measures.

4. Results

4.1 External effects

In principle, all proposed measures can reduce external effects compared with the benchmark scenario characterized by the absence of tax incentives. However, a tax credit or super deduction that supports only an increase of R&D appears to be the best measure in reducing external effects. Compared with tax incentives that are based on the R&D stock, these measures favor only marginal invest-

ments in R&D. Economic theory suggests that under external effects, investment in R&D may be too low, but it does not claim that no R&D will be undertaken.¹⁸⁾ Therefore, measures that support marginal investments in R&D are more appropriate than stock measures. Compared with an IP-box, input-based measures are more carefully designed because they incentivize R&D not only if it is successful, i.e., the product is patented. Although input measures also require that the company is profitable, companies can cross-subsidize projects that are at the developmental stage with projects that are already profitable. Furthermore, an IP-box may also include revenue streams (for example, from trademarks) that cannot be characterized by the existence of externalities. One could even ask whether these activities are to some degree socially wasteful. From the viewpoint of a single company, it may be useful to invest in a strong trademark. However, expenditures related to marketing and advertising may be classified as a negative-sum game because they do not change the relative position of firms and provide little value added to consumers. Thus, a narrowly defined IP-box including only patents may be more suitable to solve problems related to external effects than a broader box. Regardless of the specific design of the IP-box, however, it is a less effective instrument in addressing external effects.

4.2 Liquidity constraints

No single measure can adequately relax liquidity constraints and provide start-up financing support. Start-up companies typically invest in one idea that does not generate profits – at least at the beginning of the project. Furthermore, many ideas will not translate to profitable investments. From this perspective, IP-boxes and a super deduction or tax credit are ill-designed measures. However, a super deduction or tax credit could be combined with a payout to small companies. For example, the British scheme allows a higher deduction for small companies and provides a payout, which is also restricted to small companies. Similarly, France offers a rebate to small companies and start-up firms. Even without a payout option, a tax credit or a super deduction performs somewhat better compared with an IP-box if losses can be carry-forward. R&D expenditures can be immediately subtracted when calculating taxable income as long as the company earns profits (on other projects). In contrast, patent ownership is a necessary condition for patent box eligibility and is granted at the end of the research process. Usually, it is not possible to cross-subsidize IP-related ex-

¹⁸⁾ Governments should subsidize R&D only as long as private marginal productivity is lower than the private marginal cost *and* social marginal productivity is higher. In reality, neither policymakers nor researchers will know this exactly. Therefore, it is reasonable to assume that the existing R&D stock reflects the point where private marginal revenue equals marginal costs. From this assumption, it follows that only incremental incentives are consistent with an economic rationale for R&D. On this issue, see *Lentile, Damien / Mairesse, Jacques*, A Policy to Boost R&D: Does the R&D Tax Credit Work? EIB Papers 14(1), 2009, 144-170 (cited: Tax Credit Work).

penditures with non-IP income. Although start-ups may claim tax incentives in future periods under an input-based scheme, this loss carry-forward does not relax the liquidity constraints of start-up companies.

4.3 International competitiveness

International competitiveness must be distinguished between competition over production facilities / R&D research units and competition over mobile profits. Although a tax credit or a super deduction may be a powerful incentive for MNCs to relocate their research units to countries that offer favorable tax treatment to R&D, these instruments are inadequate if a country wants to prevent profit shifting. When MNCs make decisions to shift profits, they first must calculate taxable income in each of the countries where they operate. The decision to shift profits is made after all expenditures that determine the tax base are subtracted. Therefore, the statutory corporate tax rate is relevant to profit shifting. In addition to an overall low statutory corporate tax rate, IP-boxes are a more powerful instrument in preventing profit shifting because revenue from IP is taxed with a favorable tax rate. Thus, IP-boxes perform best if the primary objective is to offer an international tax-attractive environment to MNCs.

4.4 Competition

By their nature, all R&D measures favor R&D-intensive companies compared with less innovative companies. However, this preference should be no problem if the objectives are to relax liquidity constraints and reduce external effects. More problematic are measures that favor – at least implicitly – MNCs or large companies at the expense of small companies.¹⁹⁾ The absence of a level-playing field may induce dynamic inefficiencies.

The measures have various implications for different types of firms. IP-boxes favor mature companies because a patent is the result at the end of the R&D process. Within the input measures, incremental measures favor fast-growing firms, whereas stock measures implicate that most of the tax support benefits large companies. All measures focus on profitable investments. However, incremental measures support fast-growing (and perhaps young) firms, whereas IP-boxes and stock measures favor mature firms in R&D-intensive industries characterized by large economies of scale, such as the pharmaceutical or chemical industry. All stock-based measures and IP-boxes do not discriminate *de jure* against small companies, but large companies will more effectively respond to these tax incentives.

¹⁹⁾ However, optimal tax theory suggests that – in the absence of international tax coordination – it may be worthwhile to tax mobile company functions at a lower rate compared with relatively inelastic tax bases.

4.5 Administrative complexity

The introduction of R&D tax incentives raises many administrative issues. More generous tax incentives encourage firms to manipulate revenue and expenditures. To counteract this incentive, tax authorities must perform more and more complex audits.

Regarding IP-boxes, income must be separated in qualifying and non-qualifying income. Moreover, if the box also privileges self-exploitation of the IP, tax authorities must control the extracted revenue streams. A broader box therefore increases administrative costs more than proportionally.²⁰⁾ Concerning patents, eligibility for the box can easily be determined by ownership (and perhaps development) of the patent, whereas it is more difficult to determine the revenue component from IPs such as trademarks and copyrights.

Administrative costs also accrue with input measures. Measures on the R&D capital stock and flow measures create incentives to declare non-R&D expenditures eligible. Additionally, administrative costs for both firms and tax authorities increase under flow measures because it is more difficult to determine the tax base. Incremental measures additionally promote a split of the company, where R&D occurs in newly founded «start-up» firms. Thus, tax authorities must determine whether the company is really a start-up company or simply reflects tax avoidance. The same logic holds for newly registered foreign companies. Therefore, there are more options to claim unjustified tax benefits under an incremental scheme. IP-boxes, especially if they include IPs beyond patents, and incremental measures bear the highest administrative complexity, whereas the administrative costs for input measures on R&D stock are somewhat lower.

4.6 Budgetary impact

The budgetary impact of the measures depends on their specific design. In 2012, the intramuros R&D expenditures of companies amounted to approximately 13 billion CHF. Companies with more than 100 employees undertook a large portion of R&D expenditures (i.e., more than 85%). Typically, larger companies have different R&D projects in their pipeline allowing them to cross-subsidize projects in their early stages with mature projects. Thus, it is reasonable to assume that these companies are profitable and can exploit the proposed R&D measures. Corporate tax rates ranged from 12.1% (Lucerne) to 24.2% (Geneva) in 2012. In the following section, a corporate tax rate of 20% for ordinary taxed companies is assumed when calculating the budgetary impact of a super deduction. In addition, R&D expenditures are partly undertaken by so-called status companies that face a lower tax rate. Estimates of the Swiss Federal Tax Administration indicate that status companies undertake approximately 43% of all R&D expenditures in Switzerland. Assuming a corporate tax

²⁰⁾ Its advantage is that it does not economically discriminate among licensing, selling or self-exploitation.

burden of 9% for status companies, one can calculate the static budgetary impact of a super deduction of 150% on qualifying R&D expenditures and a tax credit of 10% of R&D tax expenditures.

A super deduction of 150% yields budgetary losses of roughly one billion CHF. For status companies or, more generally, for companies facing a low statutory tax rate, the tax incentive is less valuable compared with ordinary taxed companies domiciled in high-tax cantons. This unequal treatment across companies is circumvented if one implements a tax credit. A 10% tax credit on R&D expenditures then simply yields a revenue shortfall of 1.3 billion CHF (or approximately 0.2 percentage points of the Swiss GDP).

It is more difficult to estimate the budgetary impact if the tax incentive is based on the increase of R&D expenditures rather than the stock. The R&D stock roughly quadrupled from 3.1 billion CHF in 1981 to 12.8 in 2012. This increase implicates that R&D expenditures grew annually by approximately 4.5%. Based on the latest available data for 2012, an increase of approximately 600 million CHF is forecast for 2013. The (static) revenue losses for a 10% R&D expenditure tax credit based on the increase of R&D would then total 60 million CHF and would be 50 million CHF for a 150% super deduction on the increase of R&D expenditures. Because the base for these tax incentives is a flow instead of a stock measure, the revenue losses of these instruments are much more moderate.

Concerning the budgetary impact of an IP-box, the Swiss Federal Council proposed in its draft for company tax reform («Unternehmenssteuerreform III») a narrowly designed box, which mainly applies to patented products. Revenue losses result because it is assumed that 5% of formerly ordinary taxed revenue will benefit from the box.²¹⁾ For status companies, the revenue losses are negligible because their current tax burden is relatively the same as the tax burden under a newly introduced IP-box.

Several important caveats apply when interpreting these numbers because an over- as well as an underestimation can result. First, the calculations assume that the companies are profitable. Although profitability may be true for the majority of companies, smaller companies that are less project-diversified than large companies may not utilize the financial support. This possibility implies that the figures overestimate the true budgetary impact.

Second, the estimates are static in nature. As the last section has shown, the introduction of R&D tax measures will be accompanied by additional administrative and compliance costs and may offer companies new opportunities to exploit the loopholes in tax legislation. One could therefore reason that companies have an incentive to manipulate their expenditures and claim as many R&D expenditures as possible. In addition, the objective of the R&D tax measure is to promote R&D investment. If companies do not increase their R&D efforts, then

²¹⁾ *Eidgenössisches Finanzdepartement, Erläuternder Bericht zur Vernehmlassungsvorlage über das Bundesgesetz über steuerliche Massnahmen zur Stärkung der Wettbewerbsfähigkeit des Unternehmensstandorts Schweiz (Unternehmenssteuerreform III), 2014, page 42 and 100ff. <http://www.efd.admin.ch/themen/steuern/02720/> (accessed 31 March 2015).*

this measure is simply a windfall gain for companies. Therefore, it is reasonable to assume that companies increase their R&D expenditures after an R&D tax incentive is introduced. Empirical studies indicate that a 1\$ tax advantage will increase R&D investment by 1\$.²²⁾ Both effects – manipulation of R&D expenditures and a real increase in R&D expenditures – point to larger revenue losses.

A final dynamic effect involves the potential influx of foreign companies and profits. A new tax-favored regime on R&D makes it more likely that the Swiss economy will gain new foreign direct investment. In addition, if an IP-box is introduced, more revenue is to be expected from the tax-planning activities of MNCs.

Table 1 summarizes the findings among the different criteria. These results show that no measure is superior. Therefore, the different instruments cannot address all goals adequately, and policymakers must introduce measures that accord with their priorities.

Table 1: Evaluation of different tax instruments to promote R&D

| Instrument | Correction of external effects? | Relaxation of liquidity constraints? | International tax competitiveness | Distortion of competition | Administrative complexity? | Impact per CHF tax support |
|---|---------------------------------|--------------------------------------|--|--|---|-------------------------------|
| super deduction (e.g., 150%) | partially | no (yes with payout) | profit shifting not prevented | support for profitable and mature companies | middle | middle |
| super deduction (e.g., 150% increase in R&D expenditures) | yes | no (yes with payout) | profit shifting not prevented | rapidly growing (profitable) firms supported | high | high |
| tax credit (e.g., 10% of R&D expenditures) | partially | no (yes with payout) | profit shifting prevented to some degree | support for profitable and mature companies | middle | middle |
| tax credit (e.g., 10% increase of R&D expenditures) | yes | no (yes with payout) | profit shifting not prevented | rapidly growing (profitable) firms supported | high | high |
| IP-box | limited (only indirect effects) | no | profit shifting prevented | support for profitable and mature companies | high for broad box; middle for a patent box | ? (lack of empirical studies) |

Source: own illustration

²²⁾ *Lentile, Damien / Mairesse, Jacques*, Tax Credit Work, see Fn. 17. *Keuschnigg, Christian, Ribi Evelyn*, Volkswirtschaftliche Analyse, see Fn 6. *Spengel, Christoph* Steuerliche Förderung, page 14 ff., see Fn 2.

III. Conclusion

This essay has evaluated different forms of R&D tax incentives from an economic perspective. Although super deductions and tax credits have similar impacts, tax credits have the advantage that the tax gain is uniformly distributed across locations, legal forms and company status. Therefore, the specific circumstances do not matter for the value of the tax incentive.

Super deductions or tax credits that subsidize an increase of R&D investment rather than the R&D stock are more grounded in economic theory. In addition, these schemes help reduce potential windfalls gains for companies that would already undertake R&D in the absence of privileged taxation.

All measures perform poorly if the primary objective is to relax the liquidity constraints of newly established companies. However, IP-boxes are the least effective instrument involving this criterion. In contrast, IP-boxes are the best-performing instruments in attracting R&D investment of foreign companies, and they prevent the corporate tax base against profit shifting. Alternatively, input measures perform poorly regarding profit shifting activities.

All measures involve new administrative obligations, both for taxpayers and tax authorities. Regarding input measures, tax administrations must distinguish between qualifying and non-qualifying expenditures, whereas concerning an IP-box, there are different options available in determining taxable income. If privileged taxation is broadly applied, the administrative burden of an IP-box is relatively high. Compared with stock measures, flow measures can also be administratively complex, and companies have a strong incentive to manipulate their R&D expenditures.

Concerning the budgetary impact, flow measures produce much less revenue loss than measures that are based on the R&D stock. Super deductions produce less revenue loss than tax credits, but this reduction comes at the cost of distorted incentives across cantons, legal forms and tax status.

Super deductions or tax credits, especially if the tax incentive focuses on an increase of R&D, work well if the primary objective is to reduce externalities. If these incentives are combined with a payout to newly established companies, then the liquidity constraints of start-ups can also be successfully addressed. In contrast, IP-boxes' primary goal is to increase international competitiveness. The different instruments cannot address every goal adequately; therefore, policymakers must introduce measures that accord with their priorities.

However, input and output measures are not mutually exclusive. Within the OECD project on base erosion and profit shifting (BEPS), the Forum of Harmful Tax Practices (FHTF) evaluates IP-boxes and discusses different alternatives on how to split profits across countries. According to the modified Nexus approach the base for tax-favored revenue from an IP will be related to own qualifying R&D expenditures and an uplift (with a ceiling of 30% of the qualifying expenditures) scaled by overall R&D expenditures. The uplift refers to outsourcing or acquisition costs, which do not constitute qualifying expenditure. In that case, a simultaneous introduction of an IP-box and a stock input

measure may increase Switzerland's tax attractiveness in the future. The introduction of input measures increases incentives to undertake R&D in Switzerland, a necessary condition for revenues from IPs to be later taxed under the IP-box regime.

Appendix

The consequences and differences of tax credits, subsidies and super deductions can be described analytically as follows:

Π = Profit after tax;

E = Revenue;

K = Costs (for simplicity, it is assumed that all expenditures are R&D-related expenditures);

λ = Support factor, $\lambda > 0$; and

T = Statutory corporate tax burden.

1. No support / status quo:

$$\Pi = (E - K) \cdot (1 - T)$$

2. Super deduction:

$$\Pi = (E - (1 + \lambda) \cdot K) \cdot (1 - T)$$

3. Tax credit

$$\Pi = (E - K) \cdot (1 - T) + \lambda \cdot K$$

If the government does not offer a payout option, the restriction $\lambda \cdot K \leq (E - K) \cdot T$ is binding, and the unused tax credit must be carry-forward.

4. Non-taxable subsidy

$$\Pi = (E - K) \cdot (1 - T) + \lambda \cdot K$$

From this relationship, it follows that every form of financial support is – from the perspective of a company – at least as good as a situation with no support. In the absence of a payout-option, a tax credit is identical to a subsidy if $\lambda \cdot K \leq (E - K)$. A tax credit and a subsidy are independent of the tax rate, whereas a super deduction is not. A higher tax rate increases the value of the super deduction because the measure affects the tax base.

