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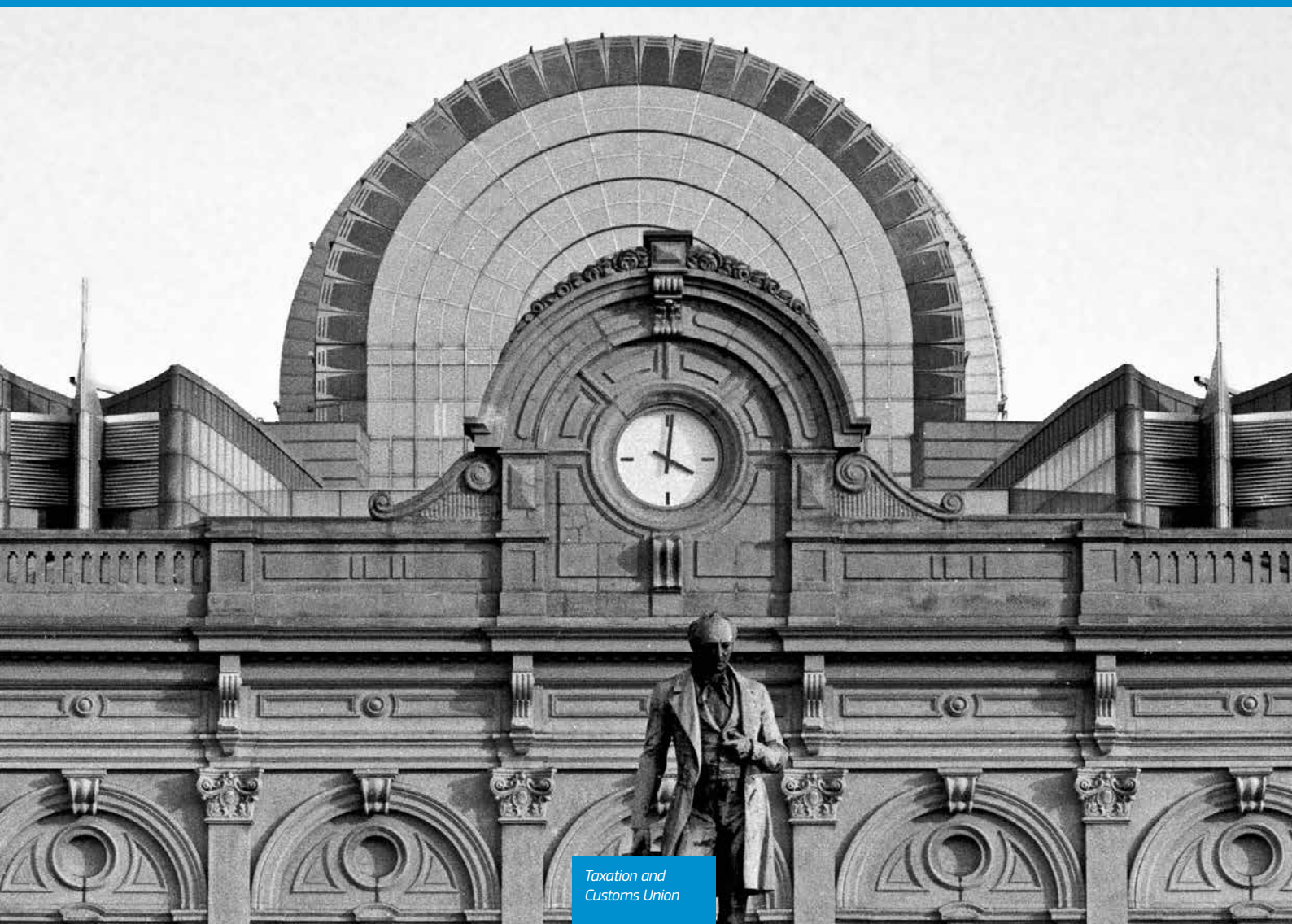
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Taxation and Customs Union

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Tax Uncertainty:
Economic Evidence
and Policy Responses

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Abstract: Tax uncertainty typically derives from institutional flaws of the tax policy process and unclear tax rules at the domestic level. At the international level tax uncertainty has its roots in the lack of tax coordination and cooperation between countries, as well as in the increased globalization and the emergence of new business models. Uncertainty may have negative effects on investment, trade and compliance. In this paper, we discuss the main sources of tax uncertainty, review the economic and empirical literature on the effects of tax uncertainty, and examine the policy measures to tackle the issue at the domestic level and the recent policy initiatives at the international level, with a focus on the EU. This survey concludes that to improve tax certainty policy makers should focus their attention on planning tax reforms and tax changes properly, clearly communicating their content and timing, and more generally establishing a structured approach in managing the tax policy process. At the international level, the best policy answers are boosting the cooperation on tax matters, developing common approaches to fighting aggressive tax planning, as well as agreeing on a clear and sustainable distribution of tax revenues for cross-border investment and more generally on a transparent and non-harmful tax competition.

Non-Technical Summary

After the financial crisis, there has been a strong policy push to reform corporate taxation at the international level. Several important initiatives have been launched with the aim of making the international corporate tax system more robust to aggressive tax planning. These initiatives are now in their implementation stage.

Against this background, tax uncertainty has been recently receiving increasing attention in the policy debate, becoming one of the taxation issues of discussion at the G20 during the 2016 Chinese Presidency, taken over by the German Presidency in 2017. This increased focus on tax uncertainty by policymakers reflects concerns about the potential negative effects of tax uncertainty on investment and trade as a result of the interplay of high global economic and political uncertainty, evolving business models, as well as numerous changes in international tax rules.

Tax uncertainty can derive from several sources. Weaknesses of the institutional framework of tax policy, at domestic and international level, are the main drivers.

At the domestic level, typical sources of uncertainty are the lack of precision of the tax code and the frequent tax changes. Tinkering yearly with the tax code – often to change tax expenditures – clearly generates tax uncertainty. Another potential source of domestic tax uncertainty stems from the overall political and administrative process of pursuing a tax reform: from the announcement and preparation, to the implementation and the following fine-tuning. The direct effects of a tax reform on tax uncertainty are rarely considered in its cost-benefit analysis, but only indirectly – and often only partially – through the relationship between compliance costs and tax uncertainty. However, these costs could be relevant, especially if the changes in important elements of the corporate tax system occur frequently, because CIT rules may become a sort of permanent work in progress, with compliance costs and tax uncertainty remaining higher than normal for a long time.

At the international level, the existence of different tax systems unavoidably generates uncertainty for cross-border investments. There is both a static and a dynamic dimension to consider. At the static level, for a firm active in several countries, dealing with different tax systems may clearly be a source of uncertainty regarding the final tax treatment of a specific investment. The dynamic dimension in the relationship between tax uncertainty and the international tax system has to do with the incentives that the international tax system may provide to governments and corporations to make choices that further complicate the system and thereby increase tax uncertainty. With regard to governments, tax competition between countries can increase tax uncertainty along an active and a passive channel. The active channel is that countries may try to

attract capital, profits and corporations by introducing specific regimes mainly targeted to cross-border investments. These regimes create discontinuities in the tax treatment of investment and they may ultimately generate tax uncertainty. The passive channel describes countries trying to protect their domestic tax revenues in the process of tax competition, complicating further the international tax environment. As regards the corporations, a complex international tax system with loopholes may clearly provide occasions for minimizing the final tax bill, by choosing specific structures for cross-border investments. These structures may be complex and opaque mainly with the aim of minimizing the tax burden and they may be associated with increased tax uncertainty.

The theoretical literature shows that the effects of tax uncertainty depend on many factors and in some cases the results are counterintuitive. Overall, tax uncertainty is more likely to affect growth negatively if one considers more realistic assumptions about the nature of corporate investment compared to the classical investment models. For example the existence of unrecoverable investment costs; more complete theoretical investment frameworks, including monetary policy, market power and price stickiness; and cases very relevant for growth, like investments in innovation and start-ups.

Empirical evidence of the effects of tax uncertainty at the firm level is still limited due to the difficulties in measuring tax uncertainty. However, the existing studies consistently support the view that tax uncertainty has a negative impact on investment. Some studies also find a positive association between the reported significant uncertainty of a firm's tax position and corporate tax avoidance and a dampening effect of tax planning on investment. Recent survey evidence suggests that uncertainty on the effective tax rate on profits ranks as the third most important factor for investment and location decisions, after political uncertainty and macroeconomic conditions. Also, the most important sources of tax uncertainty are the complexity in the tax code, followed by unpredictable or inconsistent treatment by the tax authority and by frequent changes in the tax system.

Tax certainty can be improved with policy initiatives both at the domestic and international level. At the domestic level, the key aspects to consider are the simplification of the tax system and the features of process generating the tax law. Designing a simpler tax system, in terms of tax rules and tax compliance, may improve substantially tax certainty. This is especially the case for smaller businesses that have fewer resources to deal with increased tax uncertainty. A structured approach in the development of tax policy can generate positive effects on tax certainty along several channels, for instance by engaging key participants of the private sector in the consultation, pre- and post-reform/change, and by having safeguards to guarantee a good drafting of tax law and ultimately the clarity of tax legislation.

At the international level, the best policy answer is boosting broadly the cooperation on tax matters, which means – not only more exchange of information - but also common approaches in fighting aggressive tax planning, agreement on a fair distribution of the tax revenues for cross-border investment, as well as agreeing on a transparent and fair tax competition game. This agenda would dramatically improve tax certainty in the long-run. The recent initiatives in the field on international corporate taxation are going in the right direction. The BEPS initiative and the EU agenda to fight aggressive tax planning are promoting more coordination among governments. This should result in higher tax certainty. The reasons are that corporations will have less scope for tax avoidance by complicating their business structures, while at the same time governments will have less need to unilaterally protect themselves against aggressive tax planning. A more transparent international corporate tax system will also lead to a more transparent tax competition game through the tax rate, with probably less scope for the governments to complicate their tax system to attract profits, corporations and capital. Other initiatives at the European level also promise to have positive effects on tax certainty, like those explicitly aiming at simplifying the taxation system for businesses, both in the field of direct taxation (e.g. with the CCCTB proposal) and in the field of indirect taxation (e.g. with the Action Plan on VAT).

For the future, more empirical research is needed to shed light on the effects of tax uncertainty on economic outcomes, as well as on the positive effects of the main policy measures to tackle tax uncertainty. This research would also be useful to identify measures of tax (un)certainty to be used in the tax policy evaluation process. More research is also needed with regard to better understand the institutional frameworks and arrangements that promote clarity and stability of the tax law generating process.

1. Introduction

Since the beginning of the financial and economic crises, the international tax policy debate has been particularly focussing on corporate taxation with a view to limit tax avoidance while improving investment conditions. The fiscal constraints imposed on public budgets together with slow growth after the crisis have led to a discussion about how to generate safeguard and additional revenues, while at the same time minimizing the negative impacts of taxes on investment and growth. Corporate income taxation (CIT) has been one of the most relevant issues in this debate. The reason is that a number of leaks showed that some multinational corporations, sometimes with the help of governments, systematically lower their tax bill by exploiting differences in tax system. This created strong political pressure to act. In addition, corporate taxes are usually considered to be very detrimental to investment which created a discussion on how to tax more efficiently.

As a result, numerous changes and reforms of domestic and international corporate tax law have been implemented or are in the pipeline, with the aim of increasing tax revenues from multinationals by curbing their tax avoidance practices. The G20/OECD project to fight against base erosion and profits shifting (BEPS), as well as the anti-tax avoidance package (ATAP) recently adopted at the European level, are examples of international initiatives in this area which aim at securing national tax bases and increasing tax revenues.

At the same time, policy makers are concerned with the negative effects of business taxation on growth, as well as with the complexity and instability of the corporate tax system. This has led to a discussion of policy measures which may improve the system along these dimensions, enhancing the business environment.

More recently, the role of tax uncertainty in corporate taxation have been receiving increasing interest by policy-makers at the international level. Uncertainty on corporate taxation has become a topic of discussion at the G20 and OECD level during the Chinese Presidency in 2016. Germany - that took over the G20 presidency in 2017 - announced that tax certainty would have remained on the agenda. The debate – originated basically when the BEPS project has entered its implementation stage - is expected to provide insights on options for enhancing tax certainty at the international level.

At the European level, over the last years several tax policy initiatives have been tabled with potential relevant effects on tax certainty. The general aims of these initiatives are strengthening the single market by removing tax obstacles, increasing the growth potential of the European economy by improving the business environment, fighting against tax avoidance and tax evasion

and enhancing the fairness of the European tax system. Although improving tax certainty has not been an explicit policy objective, basically every EU tax initiative has positive externalities in this regard. By promoting coordinated approaches in the field of taxation, the European Union can enhance tax certainty at the international level. Important recent achievements are the anti-tax avoidance directives (ATAD and ATAD2) which were adopted by the Council in July 2016 (ATAD) and February 2017 (ATAD2). They ensure a common EU approach to the implementation of BEPS and avoid a patchwork of different national implementation measures of the BEPS actions. In perspective, the new common consolidated corporate tax base, proposed in October 2016, promises to simplify the corporate tax system for companies which are or plan to be active in more than one Member State, to reduce the compliance costs and ultimately to promote tax certainty.

This paper adds to the current policy debate by reviewing the economic literature on the economic effects of (tax) uncertainty, and by highlighting the impact of recent policy initiatives on tax certainty, with a focus on the EU level. The paper is organized as follows. Section 2 discusses the main sources of tax uncertainty. Section 3 reviews the theoretical and empirical evidence on tax uncertainty. Section 4 discusses the recent policy developments at the international and EU level and their effects on tax certainty. Section 5 concludes.

2. Sources of tax uncertainty

Uncertainty may arise from any economic policy process. While it is on common sense that uncertainty brings about negative effects on the economy, it is much more difficult to specify exactly the relevant sources of uncertainty. More importantly, the challenge is to explain how exactly uncertainty in its different expressions may affect economic decision making. In very general terms, any policy reform and any policy measure affecting economic actors such as households, companies or the government itself may generate uncertainty. The reason is that policy outcomes and their exact impact are often unknown to the economic actors. At the international level the (uncoordinated) interactions between countries add an additional layer of uncertainty.

Taxation can be a source of uncertainty and - in very general terms – it is possible to identify a macro and a micro dimension of tax uncertainty. The macro level refers to the overall structure of the revenue system. At this macro level, tax uncertainty is related to overall taxation policy, as reflected in variables such as the overall level of tax revenues and the shares of different taxes in the tax mix.

At the micro level, tax uncertainty concerns the individuals' and firms' tax bill, and it basically derives from the following two factors: a) the inherent incompleteness of the law and

its often enormous legislative, judicial and administrative modifications in the tax reform process; b) the different tax rules applied internationally in cross-border situations. Note that the first source of tax uncertainty would exist even if the national tax systems were completely harmonized. At the micro level, the tax reform process may create uncertainty for taxpayers. While governments need to have enough scope and flexibility for adapting the tax system to achieve policy objectives, such as addressing redistributive issues or negative externalities, the process of change can increase uncertainty as a side effect.

Uncertainty usually starts spreading already before the implementation of a tax reform or a change in the law: preparatory studies are carried out, political announcements are made, and a draft bill is submitted to parliament and changed during the consultation. In some cases, announced changes are cancelled or postponed. Tax payers are often uncertain whether the reform will actually take place, as well as about the timing direction. Uncertainty about the timing of the changes could be particularly damaging for taxes such as the VAT, since these changes have an immediate and strong impact. The more complex the design of the reform, the more difficult it is to estimate the change for the tax payers. With regard to the legislative tax law process, the frequent changes due to tinkering with the tax code, modifying tax expenditures, may generate uncertainty for both households and businesses[1]. This may hold true also for the way the maintenance process of the tax law is organized. A very specific source of uncertainty stemming from the tax law generating process is related to implementation of temporary tax measures with expiration dates that are unclear and/or not credible[2]. For businesses, a particularly undesirable outcome of these distortions is ultimately an increasing volatility of the rate-of-return for the investment.

Other typical sources of tax uncertainty are the lack of precision in tax code and the possibility of conflicting tax provisions, also due to different interpretations over time. As tax laws are often too complicated to be correctly interpreted, the possibility of making mistakes may result in either too high or too law tax payments. Even if the tax law remains unchanged tax uncertainty may stem from the possibility of different interpretations of the provisions by fiscal authorities, tax courts and taxpayers. While these sources of uncertainty may regard any tax provision, the issue is particularly worrying for tax reforms, given the extent of the changes of the tax code. Indeed, tax reforms are very rarely born perfect. Often adjustments are needed; not all

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[1] IMF-OECD (2017) analyse the frequency of changes in corporate taxation for 12 advanced countries over the period 1983-2014 separating tax rate and tax base changes. They find that on average each country has implemented 17 policy changes. Italy and France feature more frequent changes (40 and 32 changes, respectively), while Denmark and Korea are at the other extreme (with 9 and 10 changes, respectively).

[2] See Baker et al. (2016).

details have been dealt with in advance; secondary legislation (regulations) and instructions (interpretations) by tax administrations are needed; different interpretations may seem plausible at the beginning, and clarifications may take time; litigation may arise; unfavourable sentences by the national constitutional courts or by the ECJ may occur, and corrections of the law become necessary; until courts emit the final verdict the cases remain open and taxpayers remain uncertain on what the correct behavior should be; tax administrations may change their interpretation of the law at any time. The adjustment process is usually lengthy and imposes high compliance costs. This is particularly true for CIT reforms: companies have to learn about the reform, understand what is to be done and change internal procedures by modifying accounting and IT processes as well as internal controls. Once the adjustment is completed, compliance costs tend to return to their normal level. If changes in important aspects of the CIT occur frequently, CIT rules become a constant work in progress and compliance costs remain higher than normal for a longer period[3].

Tax audit uncertainty may also rise with a stricter enforcement of tax rules. Companies are now paying much closer attention to tax risk (i.e., the risk of being considered non-compliant when audited) than they did in the past. This change in attitude has been prompted by the legislations that many countries have enacted in the wake of the Enron and similar scandals. The new and stricter laws require a more transparent internal reporting and enhanced systems of control within the companies. Also, in recent years and especially after the 2008 financial crisis and the consequent strain on public finances, tax administrations have become stricter in enforcing tax legislation. In many countries general anti-avoidance rules have become more stringent. The concept of "abuse of the law" has been updated or introduced for the first time in several countries[4]. Specific anti-abuse measures (controlled-foreign-company (CFC) legislation, thin capitalization rules, transfer pricing), aimed at protecting the domestic tax bases from profit shifting towards low-taxing jurisdictions, have been adjusted and made more stringent; deductibility of expenses towards non-cooperative jurisdictions has been disallowed. Exit taxes on assets transferred abroad have been introduced. The OECD has launched an action plan on how to curb tax base erosion and profit shifting (BEPS). The European Commission has tabled many proposals (mostly based on BEPS actions) to increase the robustness of the corporate tax system to tax planning. Ultimately, the border between legitimate and

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[3] Hall (1994) analyses the compliance costs of frequent tax reforms in the US and he provides evidence of an upsurge of IRS regulations and of tax court litigations after major tax reforms. Also, the literature surveyed by Eichfelder and Vaillancourt (2014), as well as by Evans et al. (2014), suggests that compliance costs increase with the number of laws, and decline in relative terms with the size of the business, whether measured by reference to turnover, income, the number of employees or any other proxy. The research also shows that compliance costs do not appear to be diminishing over time (Lignier and Evans, 2012; Lignier, Evans and Tran-Nam, 2014).

[4] The concept "abuse of the law" differs between jurisdictions. In general, it encompasses any behavior which is undertaken with the aim of reducing the taxes due while respecting all tax rules.

illegitimate tax planning has moved: behaviors which in the past were considered legitimate fall now in the domain of illegitimate avoidance or abuse of the law.[5]

Tax uncertainty may also derive from the interplay between a tax system evolving laboriously and a rapidly changing economic environment. The increased digitalization of the economy and more generally the emergence of new business models may be an *indirect* additional source of tax uncertainty since it is not always clear what is the tax treatment of these economic transactions.[6] The business models of multinational companies have become more complex, intra-group transactions have multiplied and multinationals' integrated value chains make it difficult to determine where profits are actually created. Governments struggle to determine within the current set of international tax rules which country should tax a multinational's income. The problem for cross-border investments in identifying a permanent establishment and - as a consequence - in deciding which country has the right to tax is an example of the difficulties due to the interaction between the tax law and an economic context always more complex.

The lack of coordination between different countries on tax matters may be a very important source of tax uncertainty. Although tax uncertainty affects all firms, companies operating in a cross-border environment are particularly sensible to this issue, since they have to face multiple tax regimes potentially subject to frequent changes. A specific form of this type of uncertainty also stems merely from the debates on tax reforms/tax changes by "big players" in the tax competition game, as shown by Brexit – with the debate about its tax consequences[7] - and the election of President Trump, with the debate around the proposals of corporate tax reform in the US[8]. Given increasing investment mobility and the deepening of the global markets, the economy-wide costs caused by a fragmented tax landscape may be relevant. At the international level, over the last

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[5] In a survey conducted in January 2014 by EY, 81% of the tax and finance executives surveyed in 25 jurisdictions agreed or strongly agreed that tax risk and tax controversy will become more important in the next two years; 69% felt that tax audits had become more aggressive and frequent in the last two years; 74% felt that tax administrators were then challenging existing structures due to changes in the law or changes in their enforcement approach (see EY, *2014 Tax risk and controversy survey*: http://www.ey.com/gl/en/services/tax/tax-policy-and-controversy/ey-2014-tax-risk-controversy-survey-01-summary).

[6] New digital technologies can of course also reduce uncertainty. One example which is currently discussed in many fora is blockchain and distributed ledger technology which could significantly reduce administrative burden while increasing trust between business and tax administrations. It is however too early to draw stable conclusions on the impact on uncertainty.

[7] See for instance International Tax Review (2016), Global tax 50 2016: Geopolitical event that has created unprecedented tax uncertainty, December (http://www.internationaltaxreview.com/Article/3644906/Global-Tax-50-2016-Brexit.html); EY (2016), Brexit: working through uncertainty (http://www.ey.com/gl/en/industries/financial-services/fso-insights-brexit-working-through-uncertainty).

[8] See for instance International Tax Review (2016), Global tax 50 2016: Trump, December (http://www.internationaltaxreview.com/Article/3644913/Global-Tax-50-2016-Donald-Trump.html); Summers, L. (2017), *Trump and Ryan are right to tackle corporate taxes. But their approach would do harm*, Washington Post, 8 January.

decades a reduction of tax uncertainty has been facilitated by the extension of the network of tax treaties and of bilateral and multilateral trade agreements. However, there is a concern that taxation could still be a relevant barrier to trade, given the growing complexity of the international tax system. Important tax barriers to investment and trade include, for instance: the possibility of unrelieved double taxation on cross-border income and capital; the differences in the application of transfer pricing regulations across customs, VAT and direct tax authorities.

At the EU level, the fragmentation of the EU system into 28 national systems is particularly worrying and considered to be a main obstacle for the completion of the single market. With its single market and a common currency in the Euro area, the EU offers important advantages to business and citizens. The economic integration within the EU has increased welfare by lowering prices, increasing choices and removing borders. While the integration of markets has made progress, the taxation of income from activities across the EU has remained largely a national task. This can lead to frictions in the single market due to tax obstacles and also to an increased tax uncertainty for cross-border investments, due the complexity of the European tax system.

To sum up, tax uncertainty may derive from several sources, at the domestic and international level, and it is mainly related to weaknesses of the institutional framework of tax policy. At the domestic level, the lack of precision of the tax code, conflicting tax provisions and interpretations over time and frequent changes of the tax rules are the main sources of tax uncertainty. At the international level, the lack of tax coordination/cooperation between countries, as well as the globalization and the emergence of new business models, are the main reasons of increased tax uncertainty regarding the tax treatment of cross-border investment.

3. Economic effects of tax uncertainty: theory and evidence

This section summarizes the existing literature on (tax) uncertainty. Section 3.1 starts off by explaining the impact of general uncertainty on business investments. Section 3.2 then turns to the theoretical models which analyse specifically tax uncertainty[9]. Section 3.3 concludes the section by summarizing the existing empirical work.

3.1 General uncertainty and its impact on investment

The economic effects of tax uncertainty may crucially depend on its impact on investment, given the importance of capital accumulation for growth and welfare. The discussion of the

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[9]   See Annex 1 for a review of the earlier literature on the impact of tax uncertainty on individual taxpayers.

economic channels through which uncertainty affects *in general* investment is a useful starting point for the more specific analysis of the effects of tax uncertainty in section 4.2.

When investment is reversible and cannot be postponed (*now-or-never* type), uncertainty may have counterintuitive effects on capital accumulation. These assumptions are typical in the traditional theory. Under these assumptions, if the firm can flexibly react to shocks by varying for instance labour input and/or capital utilization, the marginal product of capital may overreact to the movement of the relevant economic variables. In these cases, increased uncertainty – reflected into changes in the volatility of output and input prices (given their expected values), possibly also induced by tax factors – may trigger expansionary investment responses. These are the so called Oi-Hartman-Abel effects (see Annex 2 for more details).

More realistically, when investment is (partially) irreversible and it is possible to choose the investment timing (*now-or-later* type), uncertainty is detrimental under very general conditions. The assumptions that an investment is reversible and that is a *now-or-never* decision are quite strong. They are relaxed in the modern investment theory that analyses the more realistic possibility of (partial) irreversibility of investment, emphasizes the option-like features of the investment opportunities ("real option" investment theory), and solves for the optimal investment choice through dynamic programming[10]. If the investment is (partially) irreversible, the firm has to take into account future costs and opportunities because capital expenditures are at least partly sunk. For instance, in the case of partial irreversibility the decision to install capital gives the firm an option to resell the capital in the future. This is a benefit that derives from investing now, not recognized in the traditional theory. Moreover, a firm has often the opportunity but not the obligation to invest, namely the investment can be a *now-or-later* type, rather than a *now-or-never* type. In this case, when a firm decides to invest, it gives up the possibility to wait, to see what happens in the future and to decide not to invest if the market conditions were to change adversely ("wait and see" behaviour). Investing now is equivalent to incur a cost that has to be balanced with the foregone profits if the firm decides to wait. This cost – stemming from exercising the option to invest – is also not recognized in the traditional theory. When uncertainty increases both, the cost of investing now and the benefit to sell potentially the capital later, increases. However, when the investment is partially irreversible, the benefit to possibly sell the capital in the future is lower (at the limit, it is equal to zero for irreversible investments), therefore the cost of investing now

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[10] Annex 2 describes more in details the differences between the traditional investment theory and the modern theory, as regards the effects of uncertainty on investment.

becomes relatively more important, and it is more likely that uncertainty will have negative effects on investment.

Investment irreversibility not only plays a crucial role in driving the sign of the investment response to uncertainty, but also it affects the extent of the response. Rodrick (1991) and more recently Chen and Funke (2008) show this result for the effects of uncertainty on FDI. Rodrick (1991) analyses the effects of political uncertainty on private investments in developing countries. His analysis can be extended to the uncertainty about the duration of tax policies and tax reforms. The author shows that uncertainty about the survival of reforms enacted to raise investments may be particularly harmful when investment is (partly) irreversible. In fact, this uncertainty acts as an implicit tax on investment, which is increasing in the subjective probability that the reform will collapse. Interestingly, the effect is increasing in the level of investment irreversibility. Chen and Funke (2008) explore the effect of political uncertainty on FDI in an investment model with adjustment costs. Political uncertainty is modelled with a random productivity parameter assumed to change continuously as a random walk process, but at random points in time it takes upward or downward jumps of a fixed size with a given probability. This type of process could describe for instance the uncertainty associated with discontinues changes in the tax environment unrelated one to another. They show that as the probability of the downward jump increases, the minimum threshold of the marginal product of capital over which investment is undertaken rises, and firms invest less. This happens because the expected profitability of the investment drops, but also because the cost of investing now (the option value of waiting) increases. Interestingly, the authors also find that the (positive) sensitivity of the investment minimum threshold with respect to the arrival rate of the upward jump is lower than the (negative) sensitivity with respect to the probability of the downward jump. This is because of the existence of two offsetting effects in the case of the upward jump: on the one hand, as the probability of the "good" jump increases, the expected profitability of the investment rises, and this pushes investment; on the other hand, again, the option value of waiting increases, since the incentive to "wait and see" rises, and this tends to delay investment. Overall, the results are consistent with Bernanke's "bad news principle", according to which with irreversible investment only bad news affect the propensity to invest.[11] The same conclusions are reached when the analysis is referred to the magnitude of the downward and upward jumps: the "bad jump" has a much powerful (negative) effect than the "good jump".

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[11] When an investor decides not to invest at time t, he gives up short run returns, "buying" in exchange an option to invest at time t+1. In doing so, he takes into account only the "bad" states at time t+1. The reason is that it is the ability to avoid the consequences of bad news that induces the investor to wait (see Bernanke, 1983).

Strategic interaction between governments and firms and lack of government commitment to a specific tax policy may however induce counterintuitive effect of uncertainty on investment, even in the case of investment irreversibility. Janeba (2000) shows that the lack of government commitment regarding the tax rate that will be set after sunk investments are made could induce a multinational to invest in more countries and to invest in an excess of capacity. In doing so, the multinational will trigger tax competition between governments by threatening each government to leave the country and to serve its market from the other country if the tax rate is set too high. The consequence is that uncertainty over the tax rate stimulates investment, although not always this over-investment will be associated to an improved welfare.

General equilibrium economic channels may reverse the counterintuitive result regarding the effects of uncertainty on investment and economic activity derived in partial equilibrium frameworks, and they may even amplify these effects when they are negative. More recent general equilibrium models allow combining several channels through which uncertainty may affect investment and more generally economic activity.[12] Some channels have been described already above, namely: the Oi-Hartman-Abel expansionary effect on investment, associated with the firms' flexibility in labour demand and variable capital utilization; and the "real option" channel associated with the extent of investment irreversibility, that implies ambiguous effects since uncertainty has opposite effects on the option to invest and the option to possibly sell the capital in the future. An earlier economic literature also highlights a "precautionary savings" channel that will bring households to save more and to increase labour supply to self-ensure against future shocks (Annex 1). But there are at least three other general equilibrium channels through which uncertainty may affect negatively investment, two of them associated directly with sticky prices typical of new-Keynesian models and the other related to monetary policy.

The first channel is called the "inverse Oi-Hartman-Abel" channel. When prices are sticky, generally firms will tend to choose higher prices since they prefer to sell a lower quantity of goods at a higher profit per unit to the alternative of getting stuck with too low prices, selling more goods but with a lower markup or with a loss. Therefore, as uncertainty increases: firms will tend to increase prices; given marginal costs, this will result in higher markups; higher markups will dampen aggregate demand, investment and economic activity in the short run.

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[12]   See the discussion in Born and Pfeifer (2014).

The second channel is related to the "precautionary savings" channel. When uncertainty increases, households supply more labour and this will tend to reduce wages. With sticky prices and monopolistic competition, this will increase markups and reduce output.

The third channel operates through monetary policy. In principle, if monetary policy has reached the zero lower bound, the aggregate negative effect of uncertainty may be larger since in this case it will not be possible lowering real interest rate to ameliorate the negative effects of the uncertainty shock.[13] Using an estimated new-Keynesian DSGE model, Born and Pfeifer (2014) investigate the role policy uncertainty in shaping business cycles and combine all the previous channels, but the possibility of the zero lower bound for monetary policy. They analyse uncertainty on capital and labour taxes, as well as on government spending and monetary policy. They find negative effects of tax rate uncertainty on output, driven by both households' and firms' responses to increased uncertainty. However, these negative effects appear to be small. This is explained by the fact that policy shocks do not seem large enough to induce a big output loss and - at the same time - by a propagation mechanism of these shocks that is not strong enough to amplify the effects of the shocks. One element that in theory could amplify the effects of the uncertainty – also discussed in Born and Pfeifer (2014) - is the existence of a zero lower bound for monetary policy. In this regard, the empirical results in Villaverde et al. (2015) are interesting. They estimate on US data policy rules for capital taxes, labor income taxes and consumption taxes, as well as for government spending, allowing for time-varying volatility in the shocks to the rules. Results show that unexpected changes in the volatility of capital income taxes produce sizeable negative effects on economic activity. In line with theoretical predictions, these effects are much larger when monetary policy is at zero lower bound.[14]

3.2 Tax uncertainty and investment

The literature focused on tax uncertainty - built on modern investment theory - also finds that uncertainty may have counterintuitive effects on investment, depending on the assumptions. This literature analyses more in details uncertainty regarding tax rates, tax base, tax payments, as well as tax reforms. The crucial assumptions regard the relative volatilities of the tax variables and the investment's pre-tax cash flow, the basic time series pattern of the cash flow (increasing vs.

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[13] For analysis of the interaction between zero lower bound of monetary policy and the effects of taxation policy uncertainty, see also Johannsen (2014). As regards the interaction between monetary policy and uncertainty on taxation policy, Danciulescu (2014) shows that welfare losses arising from tax uncertainty could be lowered through an adequate design of monetary policy that takes systematically into account such uncertainty.

[14] Recent research also suggests that uncertainty about government action has negative effects on financial markets and spillovers across countries (Sialm 2006; Pastor and Veronesi 2013; Kelly, Pastor and Veronesi 2016). Julio and Yook (2012) find negative effects of political electoral uncertainty on investment.

decreasing), the stochastic process used to model tax uncertainty (continuous vs. discrete; stationary vs. no mean-reverting), the dimensions over which there is uncertainty (timing, direction, magnitude), the way the investment is funded (all-equity vs. partly debt-funded), the channel through which uncertainty affects investment (direct on cash flows vs. indirect via demand side).

Tax uncertainty will be more likely to have negative effects on investment when the volatility of the tax parameters is high – given the overall volatility of the pre-tax cash flow – and the pre-tax cash flows are increasing over time. Three papers showing these results are Niemann (2004a), Niemann (2011) and Niemann and Sureth-Sloane (2016). Niemann (2004a) analyses the effects of tax rate uncertainty on investment under risk neutrality and risk aversion. He finds that the effects of tax uncertainty can go either way. More precisely, in the risk adverse case he finds that the negative effects of tax uncertainty on investment are in general more likely; interestingly, in the risk-neutral case investments are more likely to be discouraged by tax uncertainty if pre-tax cash flows are increasing. This latter result could imply that tax uncertainty may have negative effects especially on innovative investments and start-ups that are typically characterized by increasing cash flows. Niemann (2011) analyses the investment by a risk neutral firm, assuming irreversibility and considering a stochastic pre-tax cash flow and a tax payment, that both evolve over time as random walks, so that the state of the variable in each period does not convey any information on the state of the variable in the next period. He assumes that the two processes are correlated, leaving unrestricted the sign of the correlation, and derives a closed-form solution for the hurdle net cash flow that separates, in the set of all the possible realizations of the net cash flow, the "continuation region", where the option to invest is kept alive, and the "stopping region", where the option is exercised. He finds that the effect of tax uncertainty on investment depends on the relative volatilities of the tax payment and the pre-tax cash flow, as well as by the correlation between the two processes. The higher is the tax volatility and the lower the correlation between tax payment and pre-tax cash flow, the more likely tax volatility will have negative effects on investment. Annex 3 elaborates on this point, in order to derive some quantitative indications of the conditions that have to be satisfied in order to get results in line with the common sense that uncertainty affects negatively investment. Results similar to Niemann's (2011) are also found by Niemann and Sureth-Sloane (2016) who analyse the category of capital taxes. They find that when tax uncertainty is already high, further increases tend to delay investments. In their framework, due to tax uncertainty, broadening the capital tax base from a special asset tax to a general wealth tax may delay investment if total volatility is high.

Negative effects of tax uncertainty are more likely when tax variables change over time in a more erratic way. The changes in the tax environment can take many forms: there could be large, discrete changes – like with a tax reform – or small changes, like the ones deriving from tinkering yearly with the tax code and tax expenditures; the changes could be more or less frequent over time and therefore the states could be more or less persistent; the changes could be more or less predictable with respect to timing, magnitude and direction. All of these features may matter for the effects of tax uncertainty on investment. Overall, whenever tax variables are more erratic, the effects on investment tend to be negative. This point is made in an important contribution in the tax uncertainty literature by Hassett and Metcalf (1999). They consider the pattern of the investment tax credits (ITC) in the US in the post-war period and built an investment model with the output price following a Brownian motion[15], and an investment tax credit (ITC) that evolves according to either a Brownian motion, or as a Poisson jump process. [16] The Poisson process is built such that the ITC switches stochastically between two different values, say a good and a bad state. [17] Differently from the Brownian motion, this Poisson process is bounded, since the values that it can take are limited, and mean-reverting, since the jumps occur in the opposite direction with respect to the prevailing state; the process is therefore stationary. When tax policy uncertainty is modelled as a Brownian motion, more uncertainty delays investments; so, a typical option-type "wait-and-see" effect stemming from greater uncertainty (Pindyck 1988). When, instead, tax uncertainty is modeled as a jump process, the result depends on the correlation between the jump process and the output price. For the case of no correlation between output price/profits and ITC, Hassett and Metcalf derive what is the most quoted result of their paper, namely that investment increases with larger variance of the Poisson distribution. Note that this is a completely opposite result with respect to Niemann (2011) where – with no correlation between pre-tax cash flow and tax payment – tax uncertainty has unambiguously negative effects on investments (see Annex 2). The difference in results between the two models used by Hassett and Metcalf can be better understood if one considers the situation of a

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[15] The Brownian motion or Wiener process is basically a continuous-time random walk. It has three fundamental properties. First, the probability distribution of all the future values depends only on the current value of the process; this is the Markov property. Second, the increments of the process are independent; this means that the probability distribution of the change of the process over any time interval is independent on any other (non-overlapping) time interval. Third, the changes in the process are normally distributed (see, for instance, Dixit and Pindyck, 1994, pp. 59-92).

[16] "A Poisson process is a process subject to jumps of fixed or random size, for which the arrival times follow a Poisson distribution" (Dixit and Pindyck, 1994, p. 85).

[17] See Metcalf and Hasset (1995) for an earlier contribution. See also Agliardi (2001) and Chen and Funke (2008). Chen and Funke (2008) find negative investment effects of political uncertainty modelled with a Poisson jump process that – compared to Hassett and Metcalf (1999) - does not have any built-in reverting mechanism that - say - after an upward jump it would increase the probability of a downward jump in the future (in time series terminology, it is not stationary).

firm in the "good" state. When uncertainty is modelled as a random walk, in the good state there is an equal probability that in the next period the cost of capital will be lower or larger; and - in any case - the change will be small. This implies that the cost of waiting for a better realization is small, and this may bring about a delay of the investment. With a Poisson process, unrelated to firm's profitability, in the good state the cost of waiting is very high since, given the mean-reversion property, there is a growing probability that soon the system will "revert" to the lower investment tax credit state; this high cost of waiting tends to reduce the average time to investment and increase the amount of capital purchased conditional on investing. Although the results in Hassett and Metcalf are very interesting since they show the counterintuitive effects that a stationary tax policy may have on investment choices, they do not appear very robust with respect to several modelling assumptions. For instance, Böhm and Funke (2000) use the same stochastic process as Hassett and Metcalf and show that - in the case of imperfect competition and decreasing returns to scale - tax uncertainty is basically irrelevant for investment[18].

Tax uncertainty with respect jointly to timing, direction and magnitude of the policy change is more likely to have negative effects on the investment with respect to tax uncertainty only on timing. The stochastic process used in Hassett and Metcalf (1999) – necessary to derive the counterintuitive effects on tax uncertainty on investment – implies that firms expect a policy change but they do not know the timing; crucially, conditional on being in a given state, firms know with certainty the direction of the change, as well as the magnitude. In sum, Hassett and Metcalf consider the effects of larger uncertainty regarding only the *timing* of the policy change. Differently from Hasset and Metcalf (1999), Altug *et al*. (2009) model the ITC as a three-state (high/medium/low) Poisson process in order to investigate the impact of uncertainty not only in the timing of the change in the ITC, but also with respect to the *direction* and *magnitude*. It is noteworthy that even the Poisson process they use is stationary and that they consider imperfect competition. In this more general framework, they find that greater randomness of the ITC lowers investment and that the negative effects are larger, the less persistent are the ITC states.

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[18] Pawlina and Kort (2005) extend Hasset and Metcalf's model by considering a firm that has information about the probability distribution of the policy change, rather than just expecting the policy change without knowing the exact timing. More precisely, they consider a firm that is expecting – say – a reduction in the tax incentives when the economy is booming and the incentive is not needed. They find a result very common in the literature, namely that the optimal investment rule maximizing the value of the firm is not monotonic. More precisely, if the uncertainty is sufficiently low, then the investment threshold decreases with uncertainty. However, a rise in the uncertainty beyond a certain critical value reverses this relationship and leads to an increase of the investment threshold with negative effects on investment.

Uncertainty with respect to the timing and the details of far-reaching reforms may amplify the typical expectation (positive or negative) effects of the reform on investment.[19] Tax changes could differ regarding the expectation of their reversal during time. In some cases, the uncertainty is such that firms know with certainty that a tax change will be followed in the near future by another change, with a certain probability (for instance, as in Hassett and Metcalf, 1999). There are also tax changes - like a far-reaching reform - which are not expected to be reversed soon after their implementation. Alvarez et al. (1998) analyse the effects on investments of these far-reaching tax reforms, that are anticipated, understood in their direction, but that are uncertain with respect to timing and details of the reform. They argue that these reforms are very frequent in OECD countries. Their framework is therefore suitable for instance to analyse *rate-cut cum base-broadening* type reforms. In a dynamic investment model with adjustment costs, they find that an expected tax rate decrease (increase) tends to accelerate (decelerate) investments; this is the "expectation" effect. More interestingly, there is also an "uncertainty" effect due to the uncertainty with respect to timing of the change that will reinforce the first (positive or negative) effect. Consider for instance the case of the expectation of a tax rate decrease. The "uncertainty" effect is due to the more aggressive behaviour of the firms, uncertain on the timing of the tax change, that may find optimal to start investing before because of the convexity of the adjustment costs and because, with a given probability, the change may happen sooner. The same two effects are found for expected tax base changes. One consequence of their analysis is that – overall – in a *rate-cut cum base-broadening* reform, uncertainty regarding both the tax rate and the tax base has ambiguous effects on investment[20].

Tax uncertainty affecting indirectly profitability via the demand side may affect negatively investment by decreasing the average level of investment conditional on investing, even if it is not found to systematically delay investment. Applying a dynamic model of irreversible investment, Böckem (2001) considers the case of a tax threat consisting in a possible increase of the

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[19] Auerbach and Hines (1988) analyse the same problems as Hassett and Metcalf (1999). They explore the short-run effects on investment of anticipated tax changes, based on the impressive record of changes of the US tax law since the post-war period and they estimate effective tax rates allowing for varying degrees of foresight on the part of the agents. More precisely, they assume either that the agents are so myopic to believe that the current tax system will continue forever or, on the contrary, that they are perfectly aware of future tax developments, the perfect foresight assumption. They find that models based on the assumption of myopic behaviour perform poorly in explaining the pattern of the US post-war corporate investment; instead, this pattern can be broadly understood as the outcome of a process where the agents anticipate the future tax changes. In order to derive their results, they assume that in each period there is a probability that the tax system will change and they solve the model by making linear approximations around the steady state. This means that they only focus on the anticipatory effects of tax reforms, since the information about the variance of tax policies is lost with linear approximations and this does not allow to analyse the effects of tax uncertainty. See also Auerbach (1986) and Auerbach and Hines (1987).

[20] The comparisons made in the Alvarez *et al.* (1998) may mix uncertainty effects and effects due to variations of expected revenues across different scenarios (IMF-OECD, 2016, p.25).

rate of an indirect tax, like the VAT. To model this tax threat she uses a Poisson process that shifts the demand function downward with a certain probability. Interestingly, by numerical simulation she finds that average investment is *typically* a decreasing function of the probability of the tax change; thus, also in this case uncertainty affects negatively investment, but not for timing reasons.

When tax uncertainty has negative effects on investment, these effects turn out to be mitigated in a more realistic framework of (partially) debt-financed investment. Fedele *et al.* (2011) depart from previous studies that relay on the rather unrealistic assumption of equity-financed investment decisions. Tax uncertainty is modelled through a stochastic tax rate that follows a Poisson process without mean reversion, uncorrelated with the other stochastic process of the model (that is the EBIT - Earning before interest and taxes). Consistently with existing studies based on analogous modelling approach,[21] they show that tax uncertainty has negative effects on investment. More interestingly, they find that debt, not only encourages investment, since firms want to enjoy as soon as possible the benefit of tax deductibility, but can also mitigate the negative effects of tax uncertainty on investment. The latter result is driven by the larger flexibility of the firm's financial structure with respect to the all-equity scenario.[22]

The effects of tax uncertainty on investment are indirectly analysed in the optimal taxation literature that provides interesting neutrality results regarding some taxation structures, such as the cash flow tax and the ACE. An early contribution is Devereux and Bond (1995) who focus on existing tax schemes and show that neutrality of the cash-flow tax and the ACE-type system (namely a system that allows to deduct an imputation rate from the firm's return) still holds under income uncertainty and bankruptcy risk, provided that the treatment of taxable profit and losses is symmetric and the statutory tax rate is both known and constant. However, their analysis is based on the implicit assumption of full investment reversibility[23], and it does not take explicitly into account tax uncertainty. A strand of the real option-type literature on tax uncertainty deal with these neutrality conditions under more general assumptions. Niemann (1999, 2004) defines first and second-order tax neutrality in presence of tax uncertainty: first-order tax neutrality is defined as the complete ineffectiveness of taxes on investment decisions; second-order tax neutrality as the ineffectiveness of the stochastic nature of taxation, while an effect of deterministic tax parameters

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[21] See Chen and Funke (2008).

[22] However, they rely on some other simplifying assumptions, like the symmetric treatment of profits and losses and the absence of the agency costs.

[23] Several papers have studied the effects of irreversibility on some existing schemes without considering policy uncertainty. Alvarez and Kannianen (1997) show that under irreversibility the Johansson-Samuelson theorem fails to hold, as well as the cash-flow tax turns out to be distortive. McKenzie (1994) and Faig and Shum (1999) also argue that the higher the degree of irreversibility, the more distortive is a corporate tax system.

might remain. He derives conditions for first-order tax neutrality and shows that two well-known neutral tax systems – the Johansson-Samuelson tax and the cash flow tax - may be neutral also under tax rate uncertainty (see also Sureth 2002). Panteghini (2001a) develops an investment model under irreversibility, assuming a Poisson process for the tax rate, as well as an asymmetric treatment of profits and losses and she hows that neutrality holds for an ACE-type tax system even under tax policy uncertainty [24]. The economic intuition is that when the imputation rate is high enough, the firm investing now enjoys a tax holiday and only future taxation does matter. Like a firm investing later, the firm investing now will only pay taxes in the future; therefore, the choice between investing now or in the future is not affected by uncertainty.

To sum up, the theoretical literature shows that the effects of tax uncertainty depend on many factors, but under more realistic assumptions it is more likely to have negative economic effects. In particular, as regards the investment response to increased tax uncertainty, negative effects are more likely if one considers the more realistic scenario of investment irreversibility, more complete theoretical frameworks - including monetary policy, market power and price stickiness - and cases very relevant for growth, like investments in innovation and start-ups.

3.3 Empirical evidence

The empirical evidence on the economic effects of tax (policy) uncertainty is still limited. Overall, in line with common sense, this literature suggests a negative relationship between uncertainty in tax matters and economic outcomes.[25] Given the ambiguities in the theoretical literature, whether tax uncertainty matters and in which direction are ultimately empirical questions. Unfortunately, tax uncertainty is hard to measure since it cannot be directly observed. Recent empirical works have benefited from the increased availability of online news database, proxies for uncertainty based on panels of firm-level outcomes, as well as surveys. Other empirical works have tried to shed light on the relationship between tax uncertainty and tax avoidance and on the effects of tax arrangements that improve the business environment reducing the uncertainty for corporations, such as tax treaties, tax rulings and Mutual Agreement Procedures (MAPs).

As regards the macro dimension of tax uncertainty, a promising stream of empirical literature exploits the frequency of newspaper articles on policy uncertainty and the uncertainty on the tax measures set to expire in the near future. Baker et al. (2016) have developed an index of economic policy uncertainty (henceforth EPU index) based on a weighted

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[24] This outcome is consistent with previous analysis based on the neoclassical approach (Panteghini 2001b).

[25] This is also consistent with the literature on the effect of uncertainty on the sensitivity of investment to demand shocks (see among others Bloom, Bond and Van Reenen, 2007).

average of three different components. The first component is derived from a count of newspaper articles containing key terms related to policy uncertainty. The second component try to capture more explicitly tax uncertainty about future changes in the tax code by using the dollar value of tax provisions set to expire in the near future. The third component uses the dispersion in economic forecasts of the CPI and government spending to proxy the uncertainty about fiscal and monetary policy. The authors show that policy-induced uncertainty increases substantially during recessions and they provide firm-level evidence for US firms, as well as US and cross-country (for 12 countries) time series evidence, that policy uncertainty affects significantly and negatively employment, investment and output. For instance, a shock to the EPU index with a magnitude equal to the actual increase of the EPU index from 2005-06 to 2011-12 determines declines that reach 6% for investment, 1.2% for industrial production and 0.35% for employment, before coming back to the starting values after more than one year. Building on Baker *et al*. (2015)'s uncertainty measure (EPU index), more recent studies find broadly similar results. Using quarterly data for US public corporations from 1987 to 2013, Gulen and Ion (2016) find a negative response of corporate investment to the aggregate level of uncertainty associated with future policy and regulatory outcomes. In their preferred specification, a doubling in the level of the EPU index decrease investment rates by approximately 8.7% relative to average investment rate in the sample. They argue that this effect is quite sizeable based on the fact that during the financial crisis the EPU index nearly tripled. While the news-based component of the EPU index is found to have the highest effects, the tax uncertainty component is also found to have statistically significant effects, counting for about 1/3 of the overall effect. Significantly, they also show that the relation between policy uncertainty and capital investment is much stronger for firms with a higher degree of investment irreversibility. Therefore, their results lend empirical support to the notion that policy uncertainty can depress corporate investment by inducing precautionary delays due to investment irreversibility, in line with the theoretical predictions discussed in section 4.1[26].

With regard to the micro dimension of tax uncertainty, some firm-level studies use volatility in effective tax rates as a proxy for tax uncertainty in future tax payments. Edmiston (2004) uses the deviation of the effective tax rate (ETR) on capital income from firms' expectations as a

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[26] Kang et al. (2014) also rely on the EPU index to analyse the effects of policy uncertainty, using yearly data on US public corporations from 1985 to 2010. As Gulen and Ion (2016), they provide empirical support to the real option theory of investment. In addition, their findings suggest that policy uncertainty does not influence investment decisions by very large firms and, consistently with the macroeconomic literature described in section 4.1, that the depressing effect of policy uncertainty on investment is higher during recessions. Differently from Gulen and Ion (2016), they do not however find statistically significant effects of the tax uncertainty index on investment. Wang, Chen and Huang (2014) build an EPU index for China and they also find that economic policy uncertainty negatively affects investment.

proxy for uncertainty in tax rates.[27] She finds a significant negative impact of volatility in tax rates on investment in a panel of 15 European countries, the US, and Japan, observed for 28 years. Guenther et al. (2013) use the standard deviation of the firm's annual cash ETR to measure tax-related uncertainties in the assessment of the firm's future after-tax cash flows in order to investigate the relation between tax risk and firm risk, as perceived by market participants. Volatile effective tax rates reflect uncertainty in the application of the tax law to company facts, changing tax laws and also the likelihood of audit by tax authorities. Using a US panel of companies, they find that greater tax risk is consistently associated with increased firm risk measured by stock price volatility. Similar evidence is provided by Hutchens and Rego (2015) for cash ETR volatility[28]. Even though the relationship between tax risk and cost of capital is not clear, there exists the possibility that higher stock price volatility may ultimately affect negatively the cost of capital and therefore investment[29].

Micro-based uncertainty in tax law is also modelled based on factors such as multiple rates, presence of ambiguous language, and changes in tax parameters in opposing directions. Edmiston *et al.* (2003) use a several measures to assess the complexity and uncertainty of taxes in the countries of former Soviet Union and Eastern and Central Europe in order to investigate the deterring effect of these elements on inward FDI. In particular, they consider the number of different tax rates, the number of lines used to define the tax base in the tax provisions, the presence of indefinite phrases in the tax law, the number of changes in tax parameters and the number of inconsistent changes of tax parameters. In order to build these variables, the authors have relied on a the information from a special tablature of tax laws published by the IBFD from 1993 to 1998. In line with the expectations, they find that tax complexity and tax uncertainty had a statistically significant effect on inward FDI for the analysed transition economies.

Recent surveys allow identifying which sources of tax uncertainty are relatively more important for economic choices. One survey conducted by Michael Devereux of the Oxford University Centre for Business Taxation for the European Tax Policy Forum in early 2016 – aimed at senior figures in tax departments of large multinational companies – has suggested that uncertainty about the effective tax rate on profit is considered the third most important factor for investment and location decisions, right after political uncertainty and macroeconomic conditions

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[27] The computation is based assuming adaptive expectations, based on experimental evidence on tax credit provided by Swenson (1997).

[28] Hutchens and Rego (2015) also find a positive relation between book-tax differences (considered as another proxy of tax risk) and firm risk.

[29] Note that the shocks to the Economic Policy Uncertainty (EPU) index in Baker et al. (2016), not only negatively affects investment and employment, but it also raises stock price volatility.

(Devereux, 2016). Also, the most important sources of tax uncertainty are complexity in the tax code, followed by unpredictable or inconsistent treatment by the tax authority. Frequent changes in the tax system are the third most important factor in this ranking. Two other surveys on tax uncertainty have been conducted by the OECD in late 2016 and early 2017 among businesses and tax administrations (IMF-OECD, 2017). According to businesses, uncertainty in corporate taxation and VAT is considered relevant for investment and location decisions. Issues related to tax administration rank among the major drivers of uncertainty; in particular, "considerable bureaucracy to comply with the tax legislation, including documentation requirements" and "unpredictable or inconsistent treatment by the tax authority" are considered as the two most important sources of tax uncertainty. In order to enhance tax certainty, according to businesses the most effective tools are reducing the frequency of tax changes, reducing bureaucracy, providing detailed guidance in tax regulations and announcing important changes in advance. As regards tax administrations, the most important sources of tax uncertainty are related to tax policy design and legislation, dispute resolution, as well as taxpayer behavior in particular related to aggressive tax planning; the views by tax administrations on the most effective tools to improve tax certainty closely match those indicated by businesses.

A part of the literature investigates the relation between tax uncertainty and corporate tax avoidance. In a preliminary paper, Blouin *et al*. (2012) examine how tax uncertainty arising from intentional tax avoidance may affect firm's investment decisions. The authors argue that companies may try to use complicated structures in order to mask profit shifting activities and that ultimately this may result in an increased tax uncertainty. They measure tax uncertainty with accounting firm-level information on uncertainty on income taxes[30]. Based on a dataset of US companies, over the period 2007-2011, they find that tax savings from aggressive tax planning increase investment in R&D and fixed assets, but at a decreasing rate, a result consistent with tax uncertainty from aggressive tax planning having dampening effects on investment. Taylor and Richardson (2014) also analyse the association between the reporting of uncertain tax positions and tax avoidance for Australian firms over 2006-2010. They also find that the disclosure of uncertainty regarding the tax positions is positively correlated with tax avoidance.

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[30] Some tax items in the tax return may rely on ambiguous or unclear tax provisions and therefore they can be deemed to be uncertain. If the company believes likely that the tax authorities would prevail in case of a tax audit, the tax savings deemed uncertain cannot be included in book income ("unrecognized tax benefits"). The summary information about these uncertain items has to be disclosed in the footnotes of the financial statement.

Empirical analyses focusing on the effects of tax arrangements, such as bilateral tax treaties, provide (indirect) evidence on the effects of tax uncertainty on investment.[31] Blonigen et al. (2014) examine the effects of bilateral tax treaties (BTTs) on FDI activities by US based multinationals from 1987 to 2007. They show that the availability of a Mutual Agreement Procedure (MAP) - a cooperative procedure for tax authorities to coordinate on a common tax treatment of a cross-border investment, avoiding double taxation - raises the incentives of multinational firms to engage in foreign affiliate activities in the cases they are more likely to experience double taxation due to differing tax practices between countries, as for instance for investments in industries where firms typically use differentiated inputs with their foreign affiliates. They find such effects of BTTs on FDI, not only at the intensive margin (greater sales for existing affiliates), but also at the extensive margin (more FDI). Although the focus of the paper is on avoiding double taxation, clearly a part of the positive effects of BTTs and MAPs is likely due to the dramatic reduction of tax uncertainty that such arrangements allow, as shown in related theoretical literature[32].

4. Policy responses to improve tax certainty

Tax certainty can be improved with initiatives both at the domestic and the international level. At the domestic level, the key aspects to consider are the simplification of tax rules and tax compliance and the features of process generating the tax law. At the international level, the key strategy to deal with tax uncertainty is better cooperation and more coordination between countries.

4.1 Domestic level

Designing a simpler tax system - both in terms of tax rules to determine the due amount and in terms of compliance requirements for taxpayers - may generate substantial advantages in terms of tax certainty. This may be especially the case for smaller businesses that have fewer resources to cope with uncertainty and therefore that are likely to be more hampered by a complex and uncertain tax system. Simplified compliance rules and specific simplified tax regimes are options to improve tax uncertainty for these types of companies. The challenge is to ensure that

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[31] In many countries tax authorities are required by law to issue ATRs (see section 5 for more details). If the ruling turns out to induce a higher tax burden and be disadvantageous for the investor, she will be able to refrain from the planned investment.

[32] Diller et al. (2016) provide theoretical underpinning for the empirical evidence on the impact of Advanced Tax Rulings (ATR) and similar tax arrangements on investment decisions. They show under what conditions investors have an incentive to request ATRs according to the investment's characteristics and derive the optimal fee that the tax authorities should charge for ATRs. They argue that ATR fees could be used as a measure of tax uncertainty in empirical analysis.

these rules and regimes do not cause other distortions, such as disincentives for firms to grow in order to avoid entering the regular tax regime.

The institutional process steering the development of tax policy needs to be transparent and predictable, with positive side effects on tax certainty. The tax law process can be considered composed of several phases: strategic/tactical phases, where the links between tax policy/reform, the overall economic policy and the general economic context are making explicit; the operational phases, with the detailed policy design and a clear communication of the content and timing of the changes; the legislative phase, where proposals are translated into legislation; and finally the implementation and review phases[33]. Having a transparent and predictable tax law process – recognizing the different phases - may improve tax certainty along several channels, for instance by having safeguards in order to guarantee a good drafting of tax law, and by engaging key participants of the private sector in the consultation process pre- and post-reform/change[34]. A more structured approach of tax policy may also limit too frequent changes of the tax law, countering the bias of the political process to tinker with the tax expenditures. In this regard, for instance, a yearly review of the tax expenditures could have positive side-effects on tax certainty by enforcing a more effective parliamentary control of tax expenditures that could make more difficult not only to introduce new tax expenditures, but also to tinker with the existing ones[35].

In terms of tax compliance, improving the relationship between taxpayers and tax authority may more generally promote tax certainty, as with the co-operative compliance framework. Following the publication in 2008 of the Study into the Role of Tax Intermediaries by the Forum on Tax Administration (FTA), a number of EU Member States have introduced co-operative compliance regimes or are in the implementation process[36]. A co-operative compliance regime can be described as a voluntary relationship between a tax administration and business taxpayers based upon mutual increased transparency, cooperation and collaboration. A co-operative compliance regime is intended to change the nature of the dialogue between revenue administrations and taxpayers. Taxpayers pro-actively notify the administration of any issues with a possible or significant tax risk and disclose all facts and circumstances to speed up the audit process and

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[33] See Little et al. (2013).

[34] See the discussion in IMF-OECD (2016: 13-17).

[35] An example of this structured approach in tax policy and tax reform can be found in New Zealand with the "Generic Tax Policy Process" (see http://taxpolicy.ird.govt.nz/how-we-develop-tax-policy).

[36] The measures are in line with the OECD studies and recommendation on tax compliance. See OECD (2008), *Study into the Role of Tax Intermediaries*; OECD (2013a), *Co-operative Compliance: A Framework - From Enhanced Relationship to Co-operative Compliance;* OECD (2016a), *Co-operative Tax Compliance: Building Better Tax Control Frameworks*.

resolve uncertain positions quicker. Tax payers' participation is voluntary. The only necessary condition is that of having in place a system to identify, monitor, measure and manage the tax risk (a so called Tax Control Framework). There are several advantages for the taxpayers associated to the participation to the co-operative compliance regime, such as a shortened ruling procedure, reduced need for large reserves for tax risks in the financial statement, reduce compliance cost by reducing the need for revenue bodies to conduct frequent audits, reduced administrative fines if the taxpayer did not follow the solution as agreed with the tax administration. The tax administration gains from increased compliance and reduced auditing costs. As regards tax uncertainty, since the idea behind the co-operative compliance regime is moving from an *ex-post* to an *ex-ante* assessment, this regime is expected to eliminate *de facto* the uncertainty regarding the tax treatment of specific transactions before the submission of the tax form.

A well-designed compliance system also needs clear rules for tax rulings – consistent with fair tax competition between countries – and it may improve tax certainty by clarifying *ex-ante* the tax treatment of a specific transaction. In many countries taxpayers can submit a request to tax authorities to grant a tax ruling concerning the application of existing national tax provisions to a particular transaction[37]. In some cases, these rulings allow reaching an advanced agreement with the Revenue Body regarding the taxation of income derived from specific transactions. Since the rulings allow clarifying in advance the tax treatment for a specific investment, they are very useful to deal with tax uncertainty and they improve substantially the tax environment for businesses, when they are effective for instance in terms of timing of the response by the Revenue Body. However, tax rulings have an important international dimension that has to be considered in their assessment. Indeed, in cross-border cases tax rulings end up affecting the allocation of a group's taxable profits between its subsidiaries located in different countries. For instance, a particular type of tax ruling - known as Advance Pricing Arrangement (APA) - is used to confirm a company's transfer pricing arrangements i.e. the prices for goods or services provided by one subsidiary of a corporate group to another subsidiary of the same group. Given this international dimension, tax rulings may be used as a tool of harmful tax competition if they give preferential treatment to certain companies or (intentionally or not) facilitate aggressive tax planning. For example, tax rulings offering tax advantages in one country can encourage companies to artificially shift profits there, leading to serious revenue losses for other countries. Also, tax rulings may create loopholes between tax systems of different jurisdictions (e.g. where two countries independently grant a tax

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[37] According to the OECD's Comparative Information Series (OECD, 2015, p. 289) which provides an overview of the tax administrations in OECD and selected non-OECD countries ATRs are popular and widely available instrument across the globe.

deduction to a company on the same income), which aggressive tax planners can exploit to minimise their overall tax bill.

4.2 International level: G20-OECD

After the financial crisis, an ambitious agenda on tax co-operation has been advanced at the international level with many important achievements: a plan to fight Base Erosion and Profit Shifting (BEPS) has been launched; progresses have been made in the field of transparency moving forward with the exchange of information.

The G20-OECD BEPS Project aims at promoting a coordinated approach at the global level in the fight against international tax avoidance. The BEPS Action Plan - endorsed in September 2013 by the G20 - includes fifteen actions aimed at tackling tax planning practices exploiting gaps and mismatches in tax rules of different tax systems that result in an artificial reduction of taxable income or in shifting profits to low-tax jurisdictions[38]. Since its launch in 2013, the BEPS Project has been involving over time more and more non-G20 countries, in particular developing countries (DCs) via the Inclusive Framework (IF)[39]. Among other things, the IF will monitor the minimum standards across countries for harmful tax practices, tax treaty abuse, country-by-country reporting and dispute resolution mechanisms. The effective implementation of the BEPS actions will crucially depend on the development of the multilateral legal instrument which is intended to deliver a simultaneous renegotiation of about 3,000 bilateral tax treaties (Action 15), as well on the progresses in the Country-by-Country Reporting (CbCR), that requires multinationals to report yearly and for each jurisdiction where they operate both tax and more general business information[40].

A core element of the envisaged international tax system is the automatic exchange of information. After a first breakthrough in 2009 with the exchange of information on request becoming the international standard, following the political commitment by the G20 Leaders in

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[38] The BEPS Action Plan includes 15 actions: <u>Action 1</u> "Addressing the tax challenges of the digital economy"; <u>Action 2</u> "Neutralizing the effects of hybrid mismatch arrangements"; <u>Action 3</u> "Designing effective Controlled Foreign Country (CFC) rules"; <u>Action 4</u> "Limiting base erosion via interest deductions and other financial payments"; <u>Action 5</u> "Countering harmful tax practices more effectively, taking into account transparency and substance"; <u>Action 6</u> "Preventing the granting of treaty benefits in inappropriate circumstances"; <u>Action 7</u> "Preventing the artificial avoidance of PE status"; <u>Actions 8, 9, 10</u> "Aligning transfer pricing outcomes with value creation"; <u>Action 11</u> "Measuring and monitoring BEPS"; <u>Action 12</u> "Mandatory disclosure rules"; <u>Action 13</u> "Transfer pricing documentation and Country-by-Country (CbC) reporting"; <u>Action 14</u> "Making dispute resolution mechanisms more effective"; <u>Action 15</u> "Developing a multilateral instrument to modify bilateral tax treaties". For more details, see OECD (2013b) (http://www.oecd.org/tax/beps/beps-actions.htm).

[39] As of 5 January 2017, 94 jurisdictions participate to the inclusive framework.

[40] As of 26 January 2017, 57 countries have signed the Multilateral Competent Authority Agreement on the Exchange of Information of Country-by-Country Reports.

June 2013 the automatic exchange of financial account information (AEoI) in tax matters has become the new international standard[41]. More than one hundred jurisdictions have committed to the OECD Common Reporting Standard for AEoI; around 50 jurisdictions are working in order to ensure their first information exchanges by September 2017, and many more will follow in 2018[42]. The standard requires financial institutions to report to their tax administration the relevant financial information (account balances, interest, dividends, and sale proceeds from financial assets) on accounts held by non-resident individuals and entities, including trusts and other arrangements (look-through approach). The tax administration will transmit the information to the account holders' countries of residence annually.

In the long-run, the BEPS Action Plan and the new international standards on the automatic exchange of information will improve the international tax landscape and increase tax certainty.[43] By promoting a coordinated approach in tax matters, these initiatives should reduce the fragmentation of the international tax system stemming from unilateral actions and the uncertainty that can be associated to it. Even more importantly, greater coordination may have indirect positive effects on tax certainty in the long-run. We will elaborate more on the relationship between coordination and tax certainty when we will, discuss about the EU initiatives.

The G20 put recently an explicit focus on tax uncertainty as an element to consider in the evaluation of reforms. During the Chinese Presidency in 2016, the G20 discussed tax uncertainty and its likely negative consequences for trade and investment[44]. The importance of a globally consistent application of international tax rules to enhance certainty was stressed in the discussions. The reason for this new interest in tax certainty is that during the transition period towards the reformed international tax system, tax uncertainty may indeed temporarily increase. The topic has been taken over by the German Presidency in 2017. Following the endorsement from G20 Leaders and Finance Ministers in September 2016, the OECD and the IMF have carried out work on this issue and have prepared a joint report on tax certainty (IMF-OECD, 2017). The report highlights that the effects of tax uncertainty are ambiguous in theory, but the empirical evidence – while sparse – suggests negative effects on trade and investment. It discusses initiatives for enhancing tax certainty at the domestic and international level. At the domestic level, a country should simplify

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[41] See OECD (2016b).
[42] For details, see http://www.oecd.org/tax/transparency/automaticexchangeofinformation.htm.
[43] This paper does not discuss whether BEPS is sufficient to address the shortcomings of the current international tax system in general. There is an on-going debate about whether more fundamental reforms of the international tax arrangements are necessary to deal with the challenges of digitalization and globalization in corporate taxes. A recent example is the policy debate of moving to destination-based cash flow taxes. This discussion is outside the scope of this paper.
[44] See https://www.oecd.org/tax/oecd-secretary-general-tax-report-g20-leaders-september-2016.pdf.

and rationalize the tax rules of its own system, improve the drafting of the legislation and more generally the tax law design, making and monitoring process, increase the predictability and consistency of its tax administration, and enhance the relationship between taxpayers and tax authority, for instance with cooperative compliance programs. At the international level, according to the report it is crucial to achieve a better coordination of tax rules and tax administrations. Dispute prevention and early issue resolution programs, as well as effective dispute resolution procedures, are considered of particular relevance to enhance tax certainty in the international context. With a focus on developing countries, the report also suggest devices by which governments can tie their hands in tax matters and provide greater certainty to taxpayers, such as the fiscal stability agreements (common in the extractive industries) and regional agreements.

5. The EU tax initiatives for businesses and tax certainty

Several initiatives have been launched at the European level over the last years, both in the field of direct and indirect taxation, with potentially important effects on tax certainty. In what follows, we briefly describe the main initiatives and discuss their implications for tax certainty.

5.1 Direct taxation

Corporate income is taxed at national level, but the economic environment has become more globalised, mobile and digital. In this context, the current rules for corporate taxation seem no longer fit for purpose. Business models and corporate structures are more complex, making it easier to shift profits. Furthermore, the divergence of national corporate tax systems has allowed aggressive tax planning to flourish over the last decade. Thus, when national rules are drafted without considering the cross-border dimension of business activities, mismatches are likely to arise in the interaction between different national corporate tax regimes. Such mismatches create risks of double taxation and double non-taxation and thereby distort the functioning of the single market. In these circumstances, governments might find it increasingly difficult to fight aggressive tax planning practices effectively through unilateral action to protect their national tax bases. Smaller businesses are put at a competitive disadvantage and citizens perceive tax systems as unfair since some corporate taxpayers might be able to avoid taxation by exploiting tax planning strategies. This perceived lack of fairness threatens the social contract between governments and their citizens and may impact overall tax compliance.

More generally, the international tax rules suffer from inefficiencies, lack of transparency and stability. Indeed, these matters may only be dealt with by laying down legislation at the level of the Union, since they are of a primarily cross-border nature. Unilateral initiatives by Member States

would only perpetuate, or even exacerbate, the current situation, as taxpayers would still need to deal with 28 different and sometimes conflicting tax systems.

Against this background, the Commission has advanced an ambitious agenda to make the EU corporate tax system more transparent, robust to tax avoidance and growth-friendly[45]. In March 2015 the Commission presented the tax transparency package with proposals to increase tax transparency as a crucial element to combat tax avoidance. A core element of the package was the proposal to introduce the automatic exchange of information between Member States on their tax rulings[46]. The Council adopted the proposed directive already in December 2015. Based on the new rules, applying from 1 January 2017, Member States are required to exchange information automatically on advance cross-border tax rulings, as well as advance pricing arrangements. Thanks to these developments, every Member State would know what cross-border tax rulings apply across the EU, and would be able to assess for itself whether a tax ruling of another Member State has an impact on itself. In June 2015 the Commission presented an action plan for effective and fair taxation to deal with the most pressing issues of aggressive tax planning[47]. The action plan reviewed existing corporate tax policies in the Union and set out the aim of establishing a system of corporate taxation in the EU whereby business profits are taxed in the jurisdiction where value is created. The intention of the actions is to ensure that companies pay the same taxes wherever they make their profits in the EU. The plan also aims at ensuring a coordinated EU implementation of many BEPS measures. In this regard, the Anti-Tax Avoidance Package was adopted in January 2016[48]. It includes measures to prevent aggressive tax planning, improve tax transparency and

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[45]   See European Commission (2016), *Building a fair, competitive and stable corporate tax system for the EU*, COM(2016) 862 final.

[46]   Following a previous political endorsement at the G20 level (June 2013), as well as the technical work undertaken by the OECD level and by Germany, Italy, Spain and the UK for the implementation of their FATCA agreements with the US, in October 2014 EU Member States reached a political agreement to amend the Directive 2011/16/EU and implement the automatic exchange of information on tax matters. The agreement was then formalized in December with the adoption of the amended Directive by the ECOFIN Council (Council Directive 2014/107/EU).

[47]   European Commission (2015), *A Fair and Efficient Corporate Tax System in the European Union: 5 Key Areas for Action*, COM(2015) 302 final.

[48]   European Commission (2016b), *Anti-Tax Avoidance Package: Next steps towards delivering effective taxation and greater tax transparency in the EU*, COM(2016) 23 final. The package contains: i) a proposal for an anti-avoidance Directive with six legally-binding anti-abuse measures, which all Member States should apply against common forms of aggressive tax planning; ii) a proposal for a revision of the Administrative Cooperation Directive, with the country-by-country reporting between Member States' tax authorities on key tax-related information on multinationals operating in the EU; iii) a Recommendation on Tax Treaties, advising Member States on how to reinforce their tax treaties against abuse by aggressive tax planners, in an EU-law compliant way; iv) a Communication on an External Strategy for Effective Taxation for a stronger and more coherent EU approach to working with third countries on tax good governance matters; and v) a Study on Aggressive Tax Planning looking at Member States' corporate tax rules (or lack thereof) that can facilitate aggressive tax planning and key structures used by companies to avoid taxation.

create a level playing field for all businesses in the EU[49]. It complements existing initiatives and forums to ensure effective taxation, such as the Code of Conduct and the Joint Transfer Pricing Forum. Despite the fact that decisions on taxation have to be taken by unanimity in the European Council, several proposals have been already adopted: the proposals for the automatic exchange of information on tax rulings and country-by-country reporting for multinationals of tax-related information in the area of transparency, and the Anti-Tax Avoidance directives (ATAD and ATAD2) - in <u>July 2016</u> and <u>February 2017</u>, respectively - in the fight against aggressive tax planning.[50] These actions implement most of the BEPS actions in the EU in a harmonized way.

Following the transparency package and the June 2015 Action Plan, the Commission tabled in October 2016 a comprehensive corporate tax reform package. According to the Commission the package "provides three new proposals to provide for a more modern and fairer tax system for business, to close loopholes between EU countries and non-EU countries and to provide new dispute resolution rules to relieve problems with double taxation for businesses". More precisely, the package included the re-launch of the CCCTB, a proposal for a Directive on hybrid mismatches involving third countries (ATAD2) and a Directive on dispute settlement.

The key element of the EU reform proposals is the Common Consolidated Corporate Tax Base (CCCTB). It would allow companies to treat the Union as a single market for the purpose of corporate taxation, and thereby facilitate their cross-border activity and promote trade and investment. The CCCTB is a single set of rules that companies operating within the EU could use to calculate their taxable profits. In other words, a company would have to comply with just one common EU system for computing its taxable income, rather than with different rules in each Member State in which it operates. Compared to more short-term measures as presented in the ATAD directives, the CCCTB offers a more fundamental solution by tackling important root causes of the tax avoidance problems and improving the growth-friendliness of the corporate tax system. For instance, mismatches in the legal qualification of entities or payments, leading to double taxation or double non-taxation, would be eradicated between companies applying the common corporate tax rules. The CCCTB includes some new features in comparison to the original 2011 proposal. An allowance for growth and investment (AGI) with well-designed anti-avoidance

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[49] More specifically, the legislative package covers interest limitation rule, exit taxation, general anti-abuse rule, controlled foreign company rules, rules on hybrid mismatches and switch-over rules to ensure the taxation of dividends in the EU if they have not been properly taxed in a non-EU country

[50] The ATAD directive dealt among others with mismatches between Member States. The ATAD2 proposal deals with the hybrid mismatches involving EU and non EU-countries. Hybrid mismatch arrangements exploit differences in the tax treatment of an entity or instrument under the laws of two or more tax jurisdictions to achieve double non-taxation. These types of arrangements are widespread and result in a substantial erosion of the taxable bases of corporate taxpayers in the EU.

measures was added as well as all costs related to research and development will be deductible from the tax base. These provisions will incentivize companies to continue investing in research and development and relying on more stable sources of financing. Very importantly in terms of simplification, the CCCTB proposal also stipulates how Member States should administer the CCCTB under a 'one-stop-shop' approach that would allow a EU company to file only one tax return for all its EU activities. Indeed, whilst under rules on only the common base, companies may continue to apply, as a matter of principle, their national rules for administering their tax liabilities, the CCCTB would require a special administrative framework in order to accommodate the structures of cross-border groups. Recognising the likely difficulties to adopt the CCCTB in a single step, the Commission proposed to introduce the new system in two steps. In the first step, the provisions for a Common Corporate Tax Base (CCTB) would be laid down. The first step would also allow for a cross-border loss offset. In the so-called 'second step' Member States should agree on the more complex consolidation aspects, as the conditions for being in a group, the possible forms that a group can take and all the technicalities of consolidation[51]. The full CCCTB has been proposed to mandatorily apply only to large multinational groups (with a turnover of more than EUR 750 million). Instead, for groups below the threshold the CCCTB would be optional.

The Commission has also proposed to amend the current system to resolve double taxation disputes within the EU. Double taxation results from the imposition of comparable taxes by two or more jurisdictions on the same income or capital. This is a major obstacle for businesses, creating uncertainty, unnecessary costs and cash-flow problems. Double Taxation Conventions (DTCs) have been developed over time to deal with this issue and mechanisms have been set in place to resolve disputes arising between countries by the existence of different interpretation of DTCs. Unfortunately, these mechanisms do not always work properly. At the EU level, lack of enforceability, inefficient procedures and the absence of a mandatory binding dispute resolution have been identified as the main problems of the existing Double Taxation Dispute Resolution Mechanisms (DTDRM) by a 2016 public consultation conducted by the European Commission. Given these problems, the European Commission has proposed to adjust the current dispute resolution mechanisms to better meet the needs of businesses. In particular, a wider range of cases will be covered and Member States will have clear deadlines to agree on binding solutions for cases

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[51] In addition to providing for the necessary adjustments when entering and leaving the group, the text of the Directive on consolidation and formula apportionment deals with business reorganisations, focussing on cross-border groups and, more precisely, with the treatment of losses and unrealised capital gains. There are also provisions on the dealings between the group and other entities, relating to the treatment of withholding taxes and credit relief for double taxation. One of the principal elements of the proposal is the formulary apportionment, i.e. the mechanism of weights used for allocating the consolidated tax base of the group to the eligible Member States.

of double taxation. This initiative to improve the DTDRM is an important supplement to the CCCTB proposal in order to deepen the Single Market by making simpler and cheaper for companies to operate cross border. Indeed, while in the long-run, in the envisaged EU corporate tax system instances of double taxation should be significantly reduced given the existence of a common consolidated tax base for the EU companies, in the first step (developing a set a rules for the determination of a common tax base) tax disputes will not disappear. Therefore, a reformed and more effective DTDRM will play a crucial role. Moreover, for groups for which the CCCTB will not be mandatory, the rules to resolve the disputes will continue to apply.

5.2 Indirect taxation

The simplification and modernization of the VAT regime are also core elements of recent Commission initiatives. The current VAT system, that was supposed to be a transitional system, is fragmented and has become more and more complex, given the growing number of businesses operating cross-border. This results in very high compliance costs for businesses, estimated between 2% and 8% of VAT collection[52]. The complexity and the fragmentation open the door to fraud, with substantial revenue losses estimated for cross-border frauds alone to be EUR 50 billion per year[53]. The current system has also not kept pace with the innovative business models and technological progress in today's digital era. In 2011, in its "Communication on the Future of VAT", the Commission set out the fundamental features of the future reformed VAT regime that should be simple, efficient, neutral, robust and fraud-proof. Very importantly, based on the fact that there was no political support for keeping the origin system of taxation as a target, the Commission came to the conclusion that efforts should have been rather devoted to devise a properly functioning destination-based EU VAT system.[54] Since 2011, the agenda set out in the Communication has advanced along several directions.[55]

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[52] See Institute for Fiscal Studies (2011).

[53] See Ernst & Young (2015).

[54] European Commission (2011), Communication from the Commission to The European Parliament, The Council and The European Economic and Social Committee on the future of VAT, COM(2011)851.

[55] The most important achievements are the following: the EU VAT Forum was set up in 2012, to help all the stakeholders meeting and trying to improve as the VAT works in practice; in 2013 the Council adopted two directives that allow Member States to better combat VAT fraud, by providing the legal basis to take immediate temporary national measures to stop promptly certain fraudulent practises; in October 2013 the Commission published practical guidelines to ensure a smooth introduction of the One-Stop-Shop for EU providers of telecommunications, broadcasting, and electronic services, that will allow EU providers to register only in their country of establishment and not also in each Member State in which they supplies services to their customers; in October 2014, the Commission put forward the feasible options to move towards the "definitive" destination-based EU VAT system. There have also been stalls on some simplification files. In 2013 the Commission proposed a new standard EU VAT return with the aims of slashing red-tape for businesses (with a reduction of compliance costs estimated at EUR 15 billion per year), improving tax compliance and increasing the tax administrations' efficiency.

In April 2016 the Commission tabled an Action Plan on VAT which designs the way forward to achieve a single EU VAT area. The key actions regard: removing the VAT obstacles to the e-commerce in the Single market; a simplification SMEs package to be presented by the end of 2017; measures to tackle the VAT gap by improving cooperation within the EU and with non-EU countries and tax collection, and by stimulating voluntary compliance; a legislative proposal for the definitive VAT system for cross-border trade to be tabled by the end of 2017. Following the publication of the Plan, in December 2106 the Commission did present a proposal for a Directive aimed at allowing Member States in some cases to derogate from the common VAT system and to collect instead VAT with an alternative method which is more robust to fraud. The Commission has also tabled the VAT Digital Single Market Package. It contains legislative proposals to modernize the VAT regime for cross-border e-commerce[56].

5.3 The effects of EU initiatives on tax certainty

The new envisaged EU corporate tax system is expected to be simpler and more stable, improving in this way tax certainty. In the current system companies active in several Member States have to deal with up to 28 different tax systems, as well as with international rules set by bilateral tax treaties between Member States. Moreover, they are faced with complicated transfer pricing systems for determining how intra-group transactions should be taxed and they may have to deal with audits in several Member States. This complex taxation system results in a very high number of cases pending in the EU under the EU Arbitration Convention and the Double Taxation Conventions (over 900 cases at the end of 2014).[57] Ultimately, this system generates tax uncertainty and consequently high compliance costs. In the EU, compliance costs are estimated for large companies to be about 2% of taxes paid and 30% for small and medium sized enterprises (SMEs).[58] High legal tax uncertainty is also reflected in an increasing number of pending double taxation disputes under the EU arbitration convention. The new EU corporate tax system – that should have as its core the CCCTB – is expected to reduce tax uncertainty and consequently compliance and administrative costs. Multinational companies under the scope of the CCCTB would only file one

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But, the proposal was withdrawn in 2016 since the negotiations resulted in a draft compromise text that had fundamentally changed the substance of the initial proposal.

[56] The derogation is called "generalized reverse charge mechanism" and it implies that the tax due in the business-to-business transactions will not be collected with partial payments (as in the standard VAT collection scheme), but rather in a unique solution at the final stage of the supply chain. Notice that this derogation is already possible, but only in some specific circumstances and in some sectors.

[57] European Commission (2016c), Proposal for a Council Directive on Double taxation Resolution Mechanism in the European Union, Impact Assessment, SWD(2016) 343 final.

[58] See European Commission (2011). See also the survey of empirical estimates for the period between 1984 and 2014 by Eichfelder and Vaillancourt (2014).

tax declaration in the EU and – under the one-stop-shop approach - would only have to deal with one tax administration. Crucially, no more transfer pricing documentation would be necessary for EU investments. Compliance costs would then clearly decline for cross-border investments, but also domestically since the CCCTB would be more streamlined than national systems. Quantitatively, the CCCTB could bring about a reduction of 8% of the time spent on corporate income tax compliance activities for existing multinationals. As regards additional cross-border investments, by experts assessment it is estimated that the elimination or reduction of transfer pricing compliance tasks and of tasks related to the contact with tax authorities could reduce total compliance time by 70%. Arguably, only a part of the previous figures on the effects of CCCTB on compliance costs and time can be attributed to the reduction of tax uncertainty. However, the figures likely underestimate the overall benefits of less tax uncertainty in the corporate tax environment on compliance and administrative costs both because they only consider the introduction of the CCCTB - without taking into account all the other achievements and proposals at the EU level in the taxation of corporations – and especially because the figures do not consider the indirect dynamic positive effects on tax certainty stemming from the structural change of the playing field and of the rules of the game for corporations and Member States.

By being more robust to tax planning, the new EU corporate tax system will additionally increase tax certainty over time. If there exists the possibility to avoid taxes by exploiting unclear or ambiguous laws and differences and mismatches between national systems, corporations will likely take these opportunities. By doing so, they may end up generating additional uncertainty, for instance by setting up complicated legal structures mainly with the aim of enjoying immediately lower taxes[59]. The recent EU achievements on transparency, exchange of information, as well as on common binding EU anti-abuse measures are already dramatically reducing the scope for multinationals to engage in aggressive tax planning. This will be all the more true in the future if the agenda on EU corporate taxation will further advance, for instance on a new EU common list of non-EU non-cooperative jurisdictions and, more importantly, with the CCCTB that will remove the need for complex transfer pricing for EU investments and will address the debt bias with the AGI strengthened with a strong anti-avoidance framework to avoid abuses. All in all, over time, a more robust EU corporate tax system should therefore increase tax certainty since multinationals operating in a clearer tax environment will have less incentive to complicate their business structures in their attempt to reap tax benefits.

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[59] See Blouin et al. (2012).

By promoting an harmonized approach in taxing multinationals and in tackling aggressive tax planning, there should be less incentives for harmful tax competition and unilateral protective actions by Member States, with positive consequences in terms of simplicity and tax certainty. The interplay between current international practices for the taxation of profits and increasing capital mobility over the last decades has created incentives for governments to engage in harmful tax competition for accounting profits, as well as for income related to intangible assets. This process of tax competition has traditionally shown itself with the reduction of the statutory tax rates and the broadening of the tax bases. More recently, governments have also implemented specific regimes to attract highly mobile tax bases such as royalty and license payments, opening up new tax planning opportunities for multinationals that generate opacity in the tax system. At the same time, governments have been trying to protect domestic tax bases through anti-avoidance rules. While this may be a useful approach from a single country viewpoint and in the short-run, the lack of coordination of such measures complicates the EU tax system, it may exacerbate the tax avoidance problem creating new tax mismatches and loopholes and it tends to increase tax uncertainty, with negative repercussions on compliance costs and investment. The new EU corporate tax framework described above is expected to: i) reduce tax rate competition, since under the CCCTB regime a country that decides to reduce the tax rate to be applied to the common tax base will face the risk of losing more and more revenues since companies initially outside the scope of the regime may opt in; ii) curb harmful tax competition, given – among others – the new transparency rules for tax rulings and reports on multinationals' tax related activities and the stricter enforcement of the state aid rules; iii) reduce the scope for unilateral measures to protect the domestic tax bases, given the adoption of legally-binding anti-abuse rules for the entire EU with the Anti-Tax Avoidance Directive as well as the inclusion of anti-abuse rules in the proposed CCCTB Directives. All in all, by promoting common and coordinated measures in corporate taxation and by being more robust to harmful tax competition, the new framework should increase over time tax certainty stabilizing the corporate tax environment.

The future EU VAT system is also expected to deliver more tax certainty by being simpler and more robust to tax evasion and fraud. As regards simplification, the VAT Digital Single Market Package presented in December 2016, as well as the SMEs package announced by the end of 2017, will dramatically simplify the VAT environment in the EU, cut complexity and tax uncertainty and ultimately reduce compliance costs. For instance, the new envisaged VAT system for on-line sales, by simplifying compliance activities, should reduce administrative burdens for companies selling on-line by 95%, with an overall saving estimated equal to EUR 2.3 billion. The proposed simplified VAT regime for small businesses based on a threshold for online sales is

estimated to make complying with VAT rules easier for 430,000 companies across the EU which represent 97% of all micro-business trading cross-border. When it comes to VAT tax evasion and tax fraud, the new EU initiatives for VAT described above, coupled with initiatives taken over the last decade[60], will make the EU VAT system more robust. As we have already argued for corporate taxation, a more robust system implies more legal and regulatory stability. Indeed, Member States will need less than in the past to run after fraudsters and evaders through unilateral measures to protect their VAT revenues, avoiding feed in this way legal fragmentation, complexity and tax uncertainty.

6. Conclusions

In this paper, we have discussed the main sources of tax uncertainty, reviewed the economic literature on the effects of tax uncertainty, and described the main initiatives at the international and European level, analysing their implications in terms of tax certainty. The main findings are the following.

The economic literature shows that the effects of tax uncertainty depends on many factors and in some cases there could even be counterintuitive effects of tax uncertainty on economic outcomes, running against the common sense. However, our reading of the economic literature is that under more realistic model assumptions – like that of investment irreversibility or in general equilibrium settings – and for very relevant cases for economic growth – like innovative investments and start-ups – uncertainty is very likely to have negative effects on investment and therefore on growth. And actually this is in line with the empirical evidence, even though it is still very limited.

Tax uncertainty can derive from several sources. An important part of it can be attributed to weaknesses of the institutional framework of tax policy, at domestic and international level.

At the domestic level, tinkering yearly with the tax code – often to change tax expenditures – clearly generates tax uncertainty. This is a very widespread behavior by governments. Another source of domestic tax uncertainty stems from the overall process of a tax reform, from the announcement and the preparation, to the implementation and the following fine-tuning. Uncertainty derives - among others - from the information asymmetry between policy makers and taxpayers about the precise content, direction, extension and timing of the reform. The effects of a tax reform on tax uncertainty are basically never considered in the cost-benefit analysis of a reform,

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[60] The reference is to Anti-Fraud Strategy launched in 2006 and the following legislative initiatives that have resulted in the creation of Eurofisc and more automated exchange of information (see COM(2006) 254, COM(2007) 758, COM(2008) 870, Council Regulation (EU) No 904/2010).

but indirectly through the relationship between compliance costs and tax uncertainty. However, these costs could be relevant, especially if the changes in important elements of the corporate tax system occur frequently, because CIT rules may become a sort of permanent work in progress, with compliance costs and tax uncertainty remaining higher than normal for a long time.

At the international level, the existence of different tax systems unavoidably generates uncertainty for cross-border investments. Here, there is both a static and a dynamic dimension to consider. At the static level, for a firm active in several countries, dealing with different tax systems is clearly a source of uncertainty regarding the final tax treatment of a specific investment. But there is a much important dynamic dimension in the relationship between tax uncertainty and international tax system, and that it has to do with the incentives that the international tax system may provide to governments and corporations to make choices that further complicate the system, increasing in this way tax uncertainty. With regard to governments, tax competition between countries can increase tax uncertainty along two channels, active and passive. The active channel is about countries that may try to attract capital, profits and corporations by introducing specific regimes mainly targeted to cross-border investments. These regimes introduce discontinuities in tax treatment of investment and they may ultimately generate tax uncertainty, not least because they basically amount to an *additional* tax regime only for some types of investments, structures, companies, profits and so on. The passive channel is instead about countries – usually high-tax countries – trying to protect their domestic tax revenues in the process of tax competition. In particular, governments may implement domestic anti-avoidance measures and the final result could be a patchwork of domestic protective measures, complicating further the international tax environment. As regards the corporations, a complex international tax system with loopholes may clearly provide occasions for minimizing the final tax bill, by choosing specific structures for cross-border investments. These structures may be complex and obfuscatory only to minimize the tax burden and complex structures may be associated with increased tax uncertainty.

Coming to the policy responses to improve tax certainty, changes in the taxation institutional framework should be promoted. More specifically, one may again distinguish the domestic and the international level. At the domestic level it would be – for instance – worthwhile to implement changes of the tax law generating process making more difficult too many frequent changes of the tax code, playing around with tax expenditures. More generally, a more methodical approach in the maintenance of the existing tax law should be encouraged. With regard the tax uncertainty linked to the tax reform process, policy makers should focus their attention on planning tax reforms properly, with pre-announcement consultations, clearly communicating their content and timing, and more

generally establishing a structured approach in managing the reform process. With respect to the kind of tax uncertainty related to international tax system, the best policy answer is boosting *broadly* the cooperation on tax matters, which means - not only exchange of information - but also common approaches in fighting aggressive tax planning, as well as agreeing on a fair distribution of the tax revenues for cross-border investment and more generally on a transparent and fair tax competition game. Indeed, this agenda would dramatically improve tax certainty, especially dynamically, over time.

Based on the previous considerations, the recent initiatives in the field of international corporate taxation are going in the right direction. Indeed, the BEPS initiative and the European agenda on aggressive tax planning are promoting more coordination among governments. This should result over time in an improved tax certainty, both because the corporations will have less scope for tax avoidance by complicating their business structures, and because the same governments will have less need to unilaterally protect themselves against aggressive tax planning. A more transparent international corporate tax system will also likely mean a more transparent tax competition game through the tax rate, with probably less scope for the governments to complicate their tax system to attract profits, corporations and capital. Other initiatives at the European level also promise to have positive effects on tax certainty, like those explicitly aiming at simplifying the taxation system for businesses, both in the field of direct taxation (e.g. with the CCCTB proposal) and in the field of indirect taxation (e.g. with the Action Plan on VAT).

In perspective, more empirical research would be welcomed in order to shed light on the effects of tax uncertainty on economic outcomes. This research would also be useful to identify measures of tax (un)certainty to be used in the tax policy evaluation process. More research on the institutional frameworks and arrangements to promote clearness and stability of the tax law generating process would also be welcome.

Annex 1. Early work on tax uncertainty: the impact on individual taxpayers

An earlier economic literature has analysed the effects of tax uncertainty on welfare highlighting a "precautionary savings" channel.[61] The basic premise underlying these earlier studies is that tax uncertainty might be expected to be detrimental to welfare because individuals tend to be risk adverse. Consumers want to smooth consumption over time to maximize their utiliy. Random taxation makes smoothing more costly since it leads to more adjustments in behaviour.[62] Results in this vein are provided by Alm (1988) and Bizer and Judd (1989).

Interestingly, these earlier studies also suggest that the efficiency costs related to tax uncertainty depend on the type of the tax instrument. Alm (1988) analyses the effects higher uncertainty about personal income taxes on tax sheltering choices, tax evasion, labour supply and savings. He finds that an increase of tax *base* uncertainty often leads to an increase of the tax base, while an increase of tax *rate* uncertainty has the opposite effect on the tax base. This observation holds when tax payers are very prudent and risk averse.[63] To illustrate this result, take the choice of the tax payer to allocate a fixed amount of income between tax sheltered income and non-sheltered income, and consider that a random part of sheltered income will be subject to taxation. When risk (the uncertainty) that the sheltered income will be taxed increases, two offsetting effects on the taxpayer's choice can be observed. On the one hand, the risk-adverse taxpayer will find that sheltered income is less attractive, and she will move to more non-sheltered income: this is the *substitution effect*. On the other hand, to maintain a given level of income, she would need to increase sheltered income: this is the *income effect*. When the substitution effect of greater risk (uncertainty) is larger than the income effect, namely when the taxpayer displays a prudent behavior, the tax base will increase with greater tax base risk. In Alm's analysis, the condition under which tax uncertainty increase or decrease welfare is the same as the condition under which tax uncertainty increase or decrease the tax base. Therefore, the sign of the response of welfare to additional uncertainty depends in theoretical contributions heavily on the assumptions about the risk profile of tax payers as expressed by the utility function. For prudent taxpayers, tax base risk may also increase welfare if the additional revenues generated by the increase of the tax base are used by

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[61] Literature has also dealt with the issue of the relationship between tax uncertainty and compliance without reaching conclusive results (Beck and Jung 1989; Alm et al. 1992).

[62] This result is intrinsically related to the curvature of the utility function. Under standard assumption the form of the utility function will lead to risk averse behaviour.

[63] This result is based on some restrictions on the utility function which lead to a substitution effect of greater risk which is larger than the income effect.

the government to reduce the tax rate[64]. Bizer and Judd (1989) develop and solve numerically a dynamic general equilibrium model, assuming a stochastic tax rate and a stochastic investment tax credit. They confirm in a more complex framework compared to Alm's that in general random taxation lowers welfare. More precisely, in their model this happens because it generates fluctuations in investment that are undesirable given the concavity of both the utility and the production function[65]. They maintain that this is especially true when randomness is referred to the investment tax credit, because, this is a much more precisely targeted instrument and therefore it has larger incentive effects.

Coherently with the theoretical results, early empirical evidence suggests that removing uncertainty about future tax policies may lead to significant welfare gains. Skinner (1988) estimates a large welfare loss due the uncertainty deriving from tax policy in the US in the period 1929-1975 equal to 0.40 per cent of national income. The loss would have been generated by the negative correlation between (shocks to) capital income and taxes on this type of income. This estimate is in line with Chun (2001) who - with a calibrated overlapping generation's model - finds that the welfare loss induced by random taxation (modelled with a stochastic tax rate) is about 0.53% of national income. He also finds that the welfare cost for low-income households is higher than for high-income households, because the latter would have more possibilities to absorb the tax shocks by reallocating efficiently resources within the household.

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[64] The result that an uncertain tax policy can be optimal for a benevolent government that seeks to maximize social welfare was first noted by Weiss (1976) and Stiglitz (1982). Similar results can be found, for instance, in Balcer and Sadka (1982) and Chang and Wildasin (1986). Also in Bizer and Judd (1989) there is a discussion of such result. In general, this result is derived assuming that marginal utility is a strongly convex function of consumption, namely that the third derivative of the utility function is positive and large. In these cases, the taxpayer displays a very *prudent* behaviour and reacts to an increase in uncertainty by working and saving more (see, for instance, Weiss, 1976, p. 1349). The basis of the results is the same as the precautionary saving motive of consumption theory (see, for instance, Bagliano and Bertola, 2004, pp. 22-29).

[65] However, they argue that this welfare cost may be not so large and, therefore, that there could not be a strong case for reforms that insulate the tax code from tax uncertainty.

Annex 2. Neoclassical vs modern theory of investment and the effects of uncertainty

The modern theory of investment can be compared with the neoclassical theory in order to get hints about the effects of (tax) uncertainty on investment.

The neoclassical theory is implicitly based on the net present value (NPV) rule: investment is undertaken when the present value of the expected revenues of a project is larger than the present value of the stream of expenditures. This is the basis of both the user cost of capital approach à la Jorgenson and Tobin's q-theory.

The NPV rule is the basis for the – somehow counterintuitive – Oi-Abel-Hartman effect, according to which greater uncertainty may increase the level of capital stock. Oi (1961), Hartman (1972) and Abel (1983, 1984 and 1985) showed that with symmetric adjustment costs mean-preserving increases of output price uncertainty – namely, changes in the volatility of the output price, with an unaffected expected value – raise investment by a competitive firm if the marginal product of capital is a strictly convex function of the output price (in words, a function is strictly convex when it lies below any line connecting any couple of its points)[66]. The same result holds in case of uncertain input costs. Convexity of the marginal product of capital derives from the combined assumptions of constant return to scale and substitutability of capital with other factors. As pointed out by Pindyck (1993), convexity can even result from fixed proportions between capital and labor, as long as the firm can vary the output, to avoid using the marginal unit of capital when the output price is low and/or input prices are high (for instance, with capital fixed in the short-run, it could also derive from the possibility to vary the utilization of capital; see Born and Pfeifer, 2014). Consider for instance an increase of output price. This will have the positive effect to increase profits, given the amount produced. But the firm could choose to increase labour with the aim of producing and selling more; this is an indirect effect that will increase the marginal product of capital and trigger an investment response.

The Oi-Abel-Hartman effect is derived under two implicit crucial assumptions, typical of the traditional theory of investment. First, the investment is totally reversible; this implies that it is possible to recover the initial expense if something turns out to be different and worse than expected; in other words, the opportunity cost of investing now is zero. Second, even if the investment is irreversible, it is a *now-or-never* type: if the firm does not invest now, it will not be

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[66] The Oi-Abel-Hartman effect ultimately derives from the Jensen's inequality: given a convex function f(x), according to the Jensen's inequality, $E[f(x)] > f[E(x)]$, where E(x) is the expected value function. In the case we are considering, x is the price of the output and f(x) is the marginal product of capital (for a textbook analysis of the Oi-Hartman-Abel effect, see for instance Bagliano and Bertola 2004).

able to do it in the future. Although there are investments for which the previous two assumptions are true, there are also other investments that do not satisfy them.

As to the reversibility assumption, it is clearly (at least partly) violated, for instance, when the investment costs are firm specific, as in the case of marketing and advertising costs; but also when these costs are industry specific, since it will be difficult to sell, say, a plant to other firms of the same industry if that plant is judged as unprofitable by the selling firm. The assumption is violated also for "investments" in new workers, given the hiring and training costs. More importantly, it is in general violated for investments made in foreign countries, given the fixed costs that these kinds of investments involve and the likely difficulties to "reverse" them.

In the irreversible investment literature, which uses option pricing techniques to analyse optimal investment choices, the firm has to take into account future costs and opportunities because capital expenditures are at least partly sunk. This literature shows that the timing flexibility undermines the traditional net present value approach, by stressing the similarity between the opportunity to invest and disinvest and financial call and put options, respectively (Dixit and Pindyck, 1994). More precisely, a firm has often the opportunity but not the obligation to invest, namely the investment can be a *now-or-later* type. This implies that when a firm exercises the option to invest – it "kills" the option – it gives up the possibility to wait, to see what happens in the future and to decide not to invest if the market conditions changed adversely. Therefore, the option has a value and exercising it is equivalent to incur a cost. The latter cost has to be balanced with the foregone profits if the firm decides to wait. Moreover, when the investment is partially irreversible, the decision to install capital gives the firm a *put option* to resell the capital in the future, if some conditions are met. This is a positive effect that derives from investing now, not recognized in the orthodox theory.

Overall, the traditional NPV rule has to be modified: the investment will not be undertaken when the value of capital is at least as high as all the purchase and installation costs, but when the value of capital exceeds these costs by an amount equal to the value of option to invest minus the value of the option to sell the capital in the future. Notice that the values of both the options increase with uncertainty: the more the future is uncertain, the more valuable is the possibility to wait and see what will happen, for the call option, and the possibility to sell the capital for the put option. The fact that the values of both the options increase with uncertainty and that they have opposing effects on the incentive to invest implies that the effect of uncertainty on investment is in general ambiguous since it will depend on the interaction between the two options (Abel et al., 1996). However, when the investment is even partially irreversible, the put option value is less important, and it is more likely that the overall effect of uncertainty on investment is negative. As the investment becomes totally irreversible, it is possible to get rid of the put option value altogether; in

this case, uncertainty affects negatively investment under very general assumptions, and since the call option effect tends to be higher than the Oi-Abel-Hartman's. This latter result was first derived by Pindyck (1988) and Bertola (1988). Originally, it was thought that the difference with respect to Oi, Abel and Hartman's models was due to the different investment structure, and precisely to the irreversibility assumption. Then, Caballero (1991) showed that the latter assumption is not sufficient to justify the different results, but it is also necessary to assume either imperfect competition or decreasing return to scale (or both). In Caballero's model, a firm faces a stochastically shifting demand curve and, as the elasticity of demand tends to infinity and returns to scale become constant, the opportunity cost of investing now goes to zero, and the Oi-Abel-Hartman result is re-established. However, as clarified by Pindyck (1993), when the uncertainty in Caballero's model is referred to the demand at the industry's level, the positive opportunity cost of investing now is restored, even if the firms operate in a competitive environment and the returns to scale are constant. Therefore, the possibility of negative effects of uncertainty on investment is restored even in more general set-ups.

Annex 3. How high should tax uncertainty be for investment to be negatively affected?

In the economic literature on tax uncertainty, in some models the sign of the response of investment to additional tax uncertainty depends on the model's parameters. It is interesting to elaborate on this point in order to derive some quantitative indications of the conditions that have to be satisfied in these models in order to get results in line with the common sense that uncertainty affects negatively investment. Let's consider Niemann's model (Niemann, 2011). Niemann finds that the effects of tax uncertainty on investment depend on the relative volatility of the pre-tax cash flow and the tax payment, as well as on the correlation between the two processes. The partial derivative of the investment threshold – the hurdle net cash flow, $\pi *$ - with respect to the volatility of the tax payment - σ_τ - measures the impact of larger tax volatility on the minimum post-tax cash flow. In his paper, this partial derivative is equal to a ratio with a denominator always positive, that we define Θ^+, and a numerator equal to the difference between the volatility parameter of the tax payment and the product of the correlation coefficient between the pre-tax cash flow process and the tax payment process - ρ - and the volatility of the pre-tax cash flow process σ_π (Niemann, 2011, p.9, formula 19). Formally:

$$\frac{\partial \pi *}{\partial \sigma_\tau} = \frac{\partial \pi *}{\underbrace{\partial \sigma}_{+}} \frac{\partial \sigma}{\partial \sigma_\tau} = \frac{\sigma_\tau - \rho \sigma_\pi}{\Theta^+}$$

The first equality makes clear that the sign of the partial derivative depends only on the sign of the change of the overall volatility of the cash flow process, σ, with respect to the change in the volatility of the tax payment. In the case of a stochastic tax payment either uncorrelated or negatively correlated with the pre-tax cash flow, tax uncertainty would have a negative effect on investment, even if the firm is risk neutral. The first case refers to a purely erratic tax policy/tax payment. Less likely is the second case, a tax payment negatively correlated with the pre-tax cash flow. As a matter of fact, the overall tax payment is likely to be positively correlated with the pre-tax cash flow, and so the effects of overall tax uncertainty are ambiguous. Indeed, increased tax uncertainty does not necessarily delay investment, as in the traditional theory of investment. The relationship between the pre-tax cash flow and the tax payment in Niemann's model could be further explored in order to have an idea about how high the volatility of the tax payment has to be in order to get a positive sign for the numerator of the equation [1] in the main text. With no loss of generality, let us assume that the tax payment is equal to the product of a tax rate and the pre-cash flow plus a pure random component. The latter is distributed as a normal distribution with mean zero and variance σ_ε^2, and is uncorrelated with the pre-tax cash flow. Formally:

$$T = \tau\,\Pi + \varepsilon$$

By the properties of variance and covariance, it can be shown that the variance of the tax payment is the following:

$$\sigma_\tau^2 = \tau^2\,\sigma_\pi^2 + \sigma_\varepsilon^2$$

and that the covariance between the pre-tax cash flow and the tax payment is equal to:

$$Cov(\Pi,T) = \tau\,\sigma_\pi^2$$

Therefore, the correlation between the two processes is:

$$Corr(\Pi,T) = \frac{Cov(\Pi,T)}{\sqrt{Var(\Pi)}\sqrt{Var(T)}} = \frac{\tau\,Var(\Pi)}{\sqrt{Var(\Pi)}\sqrt{\tau^2\,Var(\Pi) + Var(\varepsilon)}}$$

Then, the numerator of the expression [1] can be written as follows:

$$\sigma_\tau - \rho\sigma = \sqrt{\tau^2\,Var(\Pi) + Var(\varepsilon)} - \frac{\tau\,Var(\Pi)}{\sqrt{Var(\Pi)}\sqrt{\tau^2\,Var(\Pi) + Var(\varepsilon)}}\sqrt{Var(\Pi)}$$

The previous expression is positive when:

$$\tau^2\,Var(\Pi) + Var(\varepsilon) - \tau\,Var(\Pi) > 0 \Leftrightarrow Var(\varepsilon) > \tau(1-\tau)Var(\Pi) \Leftrightarrow \sigma_\varepsilon > \sqrt{\tau(1-\tau)}\,\sigma_\pi$$

If we consider an initial (time 0) tax rate equal to 30 per cent and a standard deviation for the gross cash flow equal to 0.2[67], the conclusion is that tax uncertainty would affect negatively investment if the tax payment process has a standard deviation at least equal to (approximately) 10 per cent around its mean: with a pre-tax profit equal to 100 Euro, and a tax rate of 30 per cent, the standard deviation of the tax payment should be approximately 3 Euro. It is difficult to say if this condition is likely to be satisfied in the current tax systems. Probably, it depends on the historical periods and it may be firm specific. Notice that in principle the random component includes everything: innovations to tax rate and tax base, uncertainty about investment tax credits and about auditing, and so on; thus, it may well be that the previous figure number is not that high. However, only with a well specified empirical model that allows identifying the innovations (i.e. the "shocks") to the tax payment process, it would be possible to get more information about the dimension of this crucial volatility parameter.

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[67] See Dixit and Pindyck (1994). Dixit and Pindyck use a value equal to 0.2 for the volatility parameter of the cash flow, on the basis of the historical volatility of the stock market. Note that Dixit and Pindyck consider a stochastic process for the percentage change of the cash flow, assuming that it is distributed as a normal variable (Dixit and Pindyck, 1994, p. 153). Instead, Niemann (2011) develops a model for the (pre and post-tax) cash flow. If the percentage change of a variable is distributed as a normal, the absolute change is distributed as a log-normal (Dixit and Pindyck, 1994, p. 65). Therefore, the mean and volatility parameters have to be adjusted accordingly. However, it can be shown that the adjustment of the variance is small.

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