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Abstract

Formulary apportionment is an intensively debated mechanism for allocating tax base within multinational groups. Systems under which the formula is identical in all jurisdictions and systems under which jurisdictions can determine the weights on the formula factors individually can be observed. The latter systems produce uncertainty about the overall tax-liable share of the future group tax base. Counter-intuitively, I identify scenarios under which increased uncertainty leads to higher expected future group income. My results provide helpful insights for firms and policy makers debating the specific design of a formulary apportionment system.

Keywords: CCCTB, factor weights, formulary apportionment, tax uncertainty

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1 Introduction

The allocation of the corporate tax base between entities of multijurisdictional groups (MJGs) is gaining importance in a globalized world. Current statistics confirm that companies operate more and more internationally. According to the OECD International Direct Investment Statistics 2013, the global FDI inward and outward positions increased strongly over the last decades. Moreover, as forecasted by the World Investment Report 2013 of the UNCTAD, global foreign direct investment is expected to further increase over the next years (cf. UNCTAD, 2013, p. 18).[1]

Jurisdictions increasingly have to deal with how and especially where to tax the profits from such multijurisdictional activities. When it comes to taxation, the coordination between jurisdictions is very difficult. Allocating tax revenues via double tax treaties results frequently in over- or undertaxation of MJGs. An alternative method is a common tax system between the jurisdictions that is based on formulary apportionment. Unexpected at first sight, depending on the degree of coordination in the allocation process, formulary apportionment may also cause cases of over- or undertaxation, which need to be investigated in detail.

Under formulary apportionment the overall tax base of a MJG is allocated to each group entity by using a formula that is supposed to determine the share of economic activity of each entity. This approach is already used on the subnational level in several countries; e.g. the US, Canada, Switzerland and Germany.[2] Formulary apportionment is a hot topic that is currently being discussed by the OECD with reference to the tax base allocation of MJGs on a global level (cf. Center for Tax Policy and Administration, OECD, 2010, pp. 8-9), as well as by the European Commission (EC) in connection with the implementation of a Common Consolidated Corporate Tax Base (CCCTB) between EU Member States.

[1] The internationalization of transnational companies grew in 2012, with foreign affiliates' value added and exports rising moderately, cf. UNCTAD 2013, p. 23, Kelly 2001, p. 539.

[2] In Canada, Switzerland and the US, formulary apportionment is used to allocate the corporate income tax. In Canada, it is applied on the level of the provinces, in Switzerland on the level of the cantons and in the US on the state level. In Germany, formulary apportionment is used to allocate the local business tax between the municipalities.

In March 2011, the EC submitted a proposal for a Council Directive on a CCCTB (cf. European Commission, 2011). Under the proposed system, the apportionment formula will consist of the three equally weighted factors of assets, labor and sales. However, whether this proposed system will come into force is far from clear. The Member States face enormous difficulties in agreeing on a common system, as they fear losing too much of their tax sovereignty (cf. European Economic and Social Committee, 2011, para. 3.6). A possible way of assigning more sovereignty to the Member States would be to entitle them to determine the weights of apportionment factors on their own instead of applying uniform formulas in all jurisdictions. In line therewith, Michel Aujean, the former director of the tax policy department at the European Commission, recommended leaving the decision on how to weight each of the apportionment factors to the Member States (cf. Aujean cited by Weiner, 2008b). Furthermore, Anand and Sansing (2000) suggest that "a move towards a system of formulary apportionment in which formulary weights are equalized across countries is likely to be fragile". They justify this claim with different underlying economic characteristics of the jurisdictions that incentivize the jurisdictions to deviate from a uniform formula. Anand and Sansing's study focuses on US states, which are likely to be more homogenous in their economic makeup than EU Member States. Thus, they expect that incentives to deviate from a uniform system will be even stronger within EU Member States.

Nevertheless, in the end, the idea of individually-determined factor weights was not included in the current CCCTB proposal. The CCCTB Working Group stated that it "[…] is extremely important that the formula is uniform across all M[ember] S[tates], i.e., that M[ember] S[tates] should not be allowed to apply domestic variations to the formula by attributing different weights to the formula" (CCCTB Working Group, 2007, p. 6). However, as long as the Member States cannot agree on a common formula, it is likely that the idea of individually-determined factor weights will continue to be debated in the EU tax reform discussion.

In the following, I refer to a system under which all jurisdictions are bound to use the exact same formula as the "common system". If each jurisdiction is allowed to determine the weights on the factors individually ("individual system"), then the share of the group tax base that is subject to taxation depends on two conditions: the factor weights and the share of each factor prevalent in each jurisdiction. Under a system of individually-determined factor weights per jurisdiction, more or less than 100% of the overall group tax base can be subject to taxation. Thus, depending on the factor weights and the allocation of factors among the jurisdictions, MJGs can be advantaged or disadvantaged by the individual system, since they may have to pay either more or less taxes than under the common system. Since the jurisdictions are free to change the factor weights under the individual system at any time and thereby determine the tax-liable share of the group tax base, the individual system results in tax base uncertainty. By contrast, the common system does not produce tax base uncertainty since all jurisdictions are bound to apply exactly the same formula. Hence, even if jurisdictions agree on changing their common apportionment formula, it is still guaranteed that exactly 100% of the overall group tax base is tax-liable. MJGs have to consider the uncertainty implied by the individual system for their future tax and financial planning.

In this paper I examine how the uncertainty in the design of apportionment formulas impacts the tax-liable share of the tax base and consequently the expected after-tax income of a MJG. As a consequence of this uncertainty, future factor weights are likely to develop as a random walk with up- and downward movements. By assuming equal tax rates in all jurisdictions, I focus on the share of the overall group tax base that is subject to taxation. I compare the (expected) after-tax income of MJGs under the individual and the common system, using the results under the common system as a benchmark. I model a two-jurisdictions-two-group-entities setting and refer to the (expected) after-tax future value as the criterion representing the expected future income of the group.

I find that uncertainty ambiguously affects MJGs income expectations and is likely to prevent efficient tax planning. Uncertainty increases the expectations about the after-tax income under the individual system for a profit-making MJG. In such a case the expected future values increase with increasing factor weight uncertainty. These results contradict the rather popular view that tax uncertainty generally dampens future income expectations (cf. for example, Bloom et al., 2013, IHK, 2013, Misik, 2012). The surprising outcomes are driven by interest effects in multiperiodical settings.

The results may be helpful for policy makers debating the design of a formulary apportionment system, and also for MJGs that are located in jurisdictions considering the implementation of such a system. Since EU Member States have not yet been willing to agree on the CCCTB as proposed by the EC, the idea of an individual formula design by each Member State may merit further discussion. From the analysis some conclusions about potential responses of MJGs to such a system can be derived. Furthermore, the results may promote discussions about the formula design in countries, that already apply formulary apportionment systems, i.e. Switzerland, Canada, the US and Germany.

After providing an overview of the relevant literature in the following section, I explain the model in Section 3. First, I introduce a model to determine the future value under the common system; and then for the expected future value under the individual system. Subsequently, in Section 4, I present the results on the impact of uncertainty on the expected future value of MJGs. Section 5 summarizes and interprets the findings.

2 Literature

There are two streams of literature to which this study contributes: on the one hand, literature that focuses on the impact of tax uncertainty on investment decisions; on the other, literature related to the design of apportionment formulas for allocating group tax bases within jurisdictions.

There is a vast body of analytical and empirical literature concerned with tax uncertainty[3] yet to my knowledge there is no paper that addresses uncertainty resulting from the uncoordinated tax allocation between jurisdictions. From a practical point of view, formulary apportionment is becoming increasingly important as a mechanism for tax base allocation but has not yet been thoroughly investigated analytically. It is therefore crucial to develop a suitable theoretical framework to study the effects that arise from tax allocation uncertainty.

Much of this literature explores the effects of tax rate or tax base uncertainty on investment behavior. Niemann (2004) analyzes the impact of uncertainty in tax rates on individual investment behavior. In

[3] For a brief overview on analytical research on the interplay of uncertainty and taxes see, for example, Alvarez and Koskela, 2008. Cf. further, MacKie-Mason, 1990, Alvarez et al., 1998, Sureth, 2002, Niemann/Sureth, 2004, Gries et al., 2012. An overview about the empirical literature provide, for example, Blouin et al., 2012, Stomberg, 2013, Edmiston, 2004.

line with my approach, he uses a binomial process to capture uncertainty. He compares expected after-tax future values of a real and a financial investment project under uncertain future tax rates. The outcome of the analysis is ambiguous: depending on the cash flow and depreciation streams, real investment may be encouraged or discouraged. Congruent with my results, he finds that the impact of the tax rate uncertainty on the expected future value is positive for a positive tax base. Taking irreversibility into account, Niemann (2011) probes the effects of tax uncertainty on investment behavior. Tax rate and tax base uncertainty is represented by tax payments that follow an arithmetic Brownian motion. Furthermore, stochastic cash flows are also assumed to follow an arithmetic Brownian motion. He finds that increased tax rate uncertainty does not necessarily delay investment. Auerbach and Hines (1988) examine historical patterns of corporate investment incentives in the US and find that expectations about uncertain future tax changes significantly affect the investment incentives only if adjustment costs were low. In a broader setting, Agliardi (2001) and Panteghini and Scarpa (2003) focus on policy changes in general instead of tax changes in particular. They find that regulatory risk has ambiguous effects on investment decisions. Congruent with my results, they show that regulatory risk does not necessarily have negative consequences.[4]

Another stream of the literature on uncertainty focuses on the impact uncertainty in tax parameters has on welfare. This literature also plays an important role in the present analysis, as welfare and (expected) future income of MJGs are to some extent related. In this respect, Alm (1988) examines how individuals respond to greater uncertainty concerning individual income tax. He distinguishes between tax base and tax rate uncertainty and finds that simply altering the likelihood of possible changes in tax policy already has an effect on investment behavior, even if the changes are not made in the end. A greater tax base risk may increase the expected tax collections of the government. Skinner (1989) investigates the impact of uncertain tax policy on savings, labor supply, and welfare in the US. He finds that removing future tax policy uncertainty can result in an annual welfare gain of 0.4 percent of national income.

[4] For more literature on regulatory uncertainty see Pawlina/Kort, 2005 and Bloom et al., 2007. See also Gries et al., 2012.

The second literature stream pertinent to this study analyzes formulary apportionment and factor weights. Some studies investigate the externalities resulting from uncoordinated factor weights. While I focus on the consequences of the externalities for the after-tax income, the existing literature centers mostly on consequences for social welfare in a game theoretic framework.

In this regard, Anand and Sansing (2000) examine theoretically why jurisdictions choose different weights in the apportionment formula for corporate income tax purposes. They find that the aggregate social welfare is maximized when all states use exactly the same formula. However, since a state can increase its individual welfare by deviating from this formula, it has a unilateral incentive to do so. Furthermore, Anand and Sansing show that, depending on their industrial makeup, jurisdictions follow different strategies to set the factor weights.

Furthermore, Weiner (2008) and Edmiston (2002) give suggestions for the design of formulary apportionment systems based on the experiences gained in the US. Weiner (2008) recommends that EU Member States should attempt to agree on a coordinated formula; otherwise they may face prisoner’s dilemma where each Member State makes the others worse off by trying to reach its individual revenue goals. Weiner further states that side payments should be made between Member States for the sake of reaching a coordinated solution. Using US data, Edmiston (2002) examines how the factor choice of a state impacts choices of other states. Using an applied general equilibrium model, she finds that the best economic development strategy of a given state is to choose a single-factor sales formula. However, this beneficial effect is supposedly short-term since the other states may change their formulas as well. Therefore, Edmiston suggests that states would be better off had they not started to play the “strategic apportionment formula” game. While both Weiner and Edmiston suggest applying a common formulary apportionment system from a social welfare point of view, the results of my study indicate that their suggestions are not necessarily preferable from a firm level point of view.

3 Model

I consider a MJG that is conducting business in two different jurisdictions. One group entity is located in jurisdiction 1 and the other entity in jurisdiction 2. The MJG faces the hypothetical decision of whether to carry out a real investment under the common system or under the individual system. The investment is assumed to generate yearly cash flows and depreciation. Interest payments are taxed similarly to regular business income. Furthermore, I assume that surplus liquid funds are reinvested in the capital market. If the group is short on funds, it may borrow funds from the capital market to fill the gap. The pre-tax debit interest rate is assumed to be equal to the pre-tax credit interest rate.

It is postulated that both jurisdictions have agreed on allocating the overall group tax base to the respective entities by formulary apportionment. I assume the application of a three-factor apportionment formula, as implemented in the US or as proposed for the CCCTB project, with the factors sales (s), labor (l) and assets (a)[5]. The sum of these three factor weights amounts always to 100% per jurisdiction. Whereas the labor factor only consists of payrolls in the US, it consists under the proposed CCCTB of equal shares of payrolls and number of employees. However, since the labor factor l is exogenously given in my model, its particular makeup is not crucial for the analysis. The share of each factor that is apportioned to the entity located in jurisdiction 1 is determined as follows:

$$a = \frac{assets\ of\ entity\ 1}{assets\ of\ the\ entire\ group,} \tag{1a}$$

$$l = \frac{labor\ of\ entity\ 1}{labor\ of\ the\ entire\ group,} \tag{1b}$$

$$s = \frac{sales\ of\ entity\ 1}{sales\ of\ the\ entire\ group.} \tag{1c}$$

The factor shares a, l and s take on values between zero and one and are assumed to be constant over time. In fact, rational market actors are expected to make use of preferential tax effects and respond to changed factor weights by shifting labor and assets. However, the assumption of constant factor shares is, at least in the short-term perspectives, widely in line with empirical evidence[6] and rules out any

[5] On the US state level the factor is called “property”. The definitions of the asset factor under the CCCTB system and the property factor on the US state level are pretty much identical. I refer to this factor in line with the CCCTB wording as the asset factor. This is just an issue of wording and has no impact on the results.

[6] Several studies examine behavioral changes associated with changed factor weights on the US state level. While some studies find no significant behavioral responses, i.e., Weiner (1994) and Lightner (1999), others identify small reactions, i.e., Goolsbee and Maydew (2000) and Gupta and Hofmann (2000). In a cross-sectional study, Weiner finds no association between the apportionment formula design and investments in that state. In a further study from 1999 she finds an association yet the effects are tiny and only marginally significant. Moreover, Lightner (1999) examines the impact of the apportionment formula on employment growth yet also finds no significant association between them. However, Goolsbee and Maydew (2000) use a richer and more detailed panel data set than Lightner and find that reducing the weight of the labor factor from

kind of real activity shifting from the analysis. Disregarding real activity shifting allows for the separation of behavioral effects and uncertainty effects inherent in the individual system. Nonetheless, due to this assumption, my results may be biased towards the disadvantage of the individual system, as the expected after-tax future cash flows would be higher if the MJG could respond to changes in factor weights.

The share a becomes one if only the entity located in jurisdiction 1 has assets and the entity located in jurisdiction 2 has none. The share of each factor apportioned to entity 2 is obtained by subtracting the share of the respective factor in jurisdiction 1 from one. Thus, in the previously mentioned example the share of assets held by entity 2 is equal to zero. I assume that jurisdictions determine the weight γ on the sales factor and allocate the remaining weights equally on the asset and labor factor ($\frac{1-\gamma}{2}$). Thus, the weight of the sales factor determines the weights on the asset and labor factor as well. This approach is in line with the setting of factor weights in all states of the US and with the proposed CCCTB system in Europe. Consequently, taxes that have to be paid in jurisdiction 1 $(TP)_1$ are determined as follows:

$$TP_1 = \left(\gamma \cdot s + \frac{1-\gamma}{2}(l + a)\right) TB \cdot \tau \quad \text{with} \quad TB = CF - D, \tag{2}$$

where TB denotes the group tax base, CF the cash flows, D the depreciation and τ the tax rate.

Assuming equal tax rates[7] (cf. Anand/Sansing, 2000, p. 186.) in both jurisdictions allows me to focus on the share of the group tax base that is subject to taxation. Further ambiguous effects resulting from the interaction of tax rate differences and tax bases are thereby eliminated from the analysis. A time horizon of two periods is sufficient for the purpose of this paper, as the results are systematically similar for broader time horizons.

one third to one fourth significantly increases manufacturing employment in an average state by 1.1%. Furthermore, Gupta and Hofmann (2000) find that the elasticity of corporations' new capital expenditures in the manufacturing sector ranges between 0.05 to 0.35 depending on the income tax burden on property (measured as the product of the property factor weight and the statutory tax rate). Even in the studies that find behavioral adjustments of companies to changed apportionment factors, the effects are rather small. Thus, in line with the empirical literature, I believe it is justifiable to neglect them in this analysis.

[7] As a starting point, this simplifying assumption is also made by Nielsen et al., 2010, p. 131.

In the following, I assume risk neutral decisions-makers.[8] Even though the examination of risk-averse decision-makers would be desirable, I assume risk neutral ones here for the following reason. As I compare a system that results in a tax base risk (individual system) with a system that is fully certain with respect to the tax-liable share of the tax base (common system), the direction of impact of risk aversion is clear and unambiguous: higher risk aversion makes the individual system relatively less attractive compared to the common system. Therefore, accounting for risk-averse decision makers would not bring any valuable insights but would rather add a lot of complexity to the model. In order to focus on the inherent effects of the individual system and to keep the model as simple as possible I assume risk neutral decision-makers. However, due to this assumption my results may be biased in favor of the individual system.

3.1 Common system

Assuming that both jurisdictions have agreed on a common formula, the after-tax net cash flow of the group in each period t is determined as follows:

$$\begin{aligned} NCF_t &= CF_t - TB_t \cdot \tau \underbrace{\left(\gamma \cdot s + \tfrac{1-\gamma}{2}(a+l) + \gamma\,(1-s) + \tfrac{1-\gamma}{2}\,(1-a+1-l\right)}_{\text{tax base factor} = 1} \\ &= CF_t - TB_t \cdot \tau. \end{aligned} \quad (3)$$

The net cash flow NCF is reflected by the gross cash flow CF minus the tax payment. The tax payment is calculated by the tax base multiplied with the corporate tax rate τ and the tax base factor, which determines the tax-liable share of the group tax base. This share is, in case of a common formula, always equal to one.

In a two-period setting, I obtain the following future value of the net cash flows:

$$FV_2^{com} = \sum_{t=1}^{2} (CF_t - TB_t \cdot \tau) \cdot (1 + i(1-\tau))^{2-t}. \quad (4)$$

[8] This assumption is widely used in public economics. Cf. Niemann/Sureth, 2002, p. 1. For a study of tax effects on investment decisions under risk aversion and the involved methodological limitations see, for example, Niemann/Sureth, 2004, 2005.

The future value measures the nominal future sum of money that today`s net cash flow is worth at a specified time in the future assuming that it will be invested in the capital market at the pre-tax interest rate i.

3.2 Individual system

Under the individual system, under which both jurisdictions can set the factor weights individually, the share of the overall group tax base that is subject to taxation depends on the factor weights in each jurisdiction and the allocation of the factors among the group entities. The following example clarifies how the variation in factor weights and the allocation of the factors among the entities determine the share of the tax-liable group tax base. I assume exemplarily that jurisdiction 1 applies a single-factor formula consisting only of the sales factor ($\gamma = 1$) and jurisdiction 2 the Massachusetts Formula ($\gamma = 1/3$).

	jurisdiction 1		jurisdiction 2	
Factor	**Weight**	**Share**	**Weight**	**Share**
Assets	0	0.7	1/3	0.3
Labor	0	0.3	1/3	0.7
Sales	1	0.8	1/3	0.2
Share subject to taxation	80%		40%	
Sum	120%			

Table 1: Example on how the interplay of factor weights and the allocation of the factors within the MJG determine the share of the tax-liable group tax base

In this example 120% of the group tax base is subject to taxation. Thus, the MJG has to pay more taxes under the individual system than under the common system. However, if the share of the sales factor amounts to 20% (instead of 80%) in jurisdiction 1 and to 80% (instead of 20%) in jurisdiction 2, then only 80% (instead of 120%) of the group tax base will be tax-liable. If, in the example as displayed in Tab. 1, jurisdiction 1 uses a single-factor formula consisting of labor instead of sales, then only 70% of the group tax base will be subject to taxation. In tendency, more than 100% of the group tax base is tax-liable if a major share of a factor is located in a jurisdiction that heavily weights this factor.

Experience gained in the US has shown that if jurisdictions deviate from the equally weighted Massachusetts Formula, they increase the weight of the sales factor and lower the weight of the remaining factors. Jurisdictions do so in order to promote economic development in their respective state. By increasing the weight of the sales factor and decreasing the weights of the labor and asset factor, the MJG is not “penalized” for investing in assets or hiring employees (cf. KPMG, 2012, p. 1, Multistate Tax Commission, 2003, p. 25). Many US states use the so called double-weighted sales formula, which weights the sales factor with 50% and the remaining two factors each with 25%. Other states weight the sales factor even higher and some states use it as the only determinant in a single-factor formula. In all US states the weight of the factor asset is equal to that of the labor factor.

Whereas on average the sales factor has the highest weight of the three formula factors in the US, it is not even part of the formula used in Germany to apportion the tax base of the trade tax. The German trade tax is apportioned according to a single-factor formula consisting of labor. In Canada a common formula consisting of the two factors labor and sales is applied. Both factors are weighted equally. In Switzerland, moreover, industry-specific formulas are used. Whereas, e.g. the formula for the manufacturing sector consists only of the factors capital and labor, the formula for the commerce sector contains only the sales factor. Thus, overall, it is apparent that, contrary to experience gained in the US, the sales factor is not the main driver for the tax base allocation under all worldwide existing formulary apportionment systems. Under formula apportionment systems in other countries the sales factor plays a rather minor or no role for the tax base allocation.

Since jurisdictions may change the factor weights, the weights are uncertain for future periods in both jurisdictions under the individual system. As a consequence of the uncertainty, future factor weights are likely to develop as a random walk with up- and downward movements. However, even if each jurisdiction can potentially change its factor weights in each period by any amount a fundamental change is rather unlikely. Experiences gained in the US show that the states have changed their factor weights in the past by increment. Arizona is an example of a state that slowly increased the weight on the sales factor. Originally, Arizona applied the equally-weighted Massachusetts-Formula. In 2009 it introduced a double-weighted sales formula and simultaneously offered an alternative formula consisting of a sales factor weighted by 80% and an asset and labor factors weighted by 10% each. Finally, in 2014, Arizona implemented a single-sales formula (cf. Tax Management BNA, 2014a, p.

8). The development of statutory tax rates in European countries suggests the same jurisdictional reform strategy as on the US state level. The European countries frequently adjust their statutory tax rates. Nevertheless, they adjust their rates only in small steps (cf. European Union, 2014, p. 37). Germany, e.g. in 1998, had a statutory tax rate on corporate proftis of 56%, which was decreased by about 4 percentage points in 1999 (cf. European Union, 2014, p. 37). In 2001 the rate was decreased further to a level of about 38%. Since the tax reform act in 2008 corporate profits are subject to an overall profit tax at a rate of about 30%. These US and European examples show that jurisdictions tend to implement rather small changes in tax systems. In line with this evidence, I assume small changes in the factor weights. These changes are captured by the constant Δ, which represents the average change in factor weights in both jurisdictions.

Factor weights are assumed to undergo discrete jumps in discrete time with a discrete state space. The annual upward or downward movement of the state variable sales factor weight γ by the constant Δ is characteristic of a binomial process. Thus, an additive binomial process seems to be adequate to catch uncertainty.[9] The factor weight at time $t = 1$ is

$\gamma + \Delta$ with probability p and

$\gamma - \Delta$ with probability $1 - p$.

To ensure that the factor weights vary only between zero and one the following condition must hold:

$$\gamma - T \cdot \Delta \geq 0 \;\; \wedge \;\; \gamma + T \cdot \Delta \leq 1.$$

T denotes the MJG's time horizon. For reasons of simplicity an immediate full loss offset is assumed. In my analysis, I distinguish between two different scenarios. In the first scenario, I assume that both jurisdictions set factor weights completely independent of each other. In the second scenario, it is assumed that the weights on the sales factor are perfectly negatively correlated between both jurisdictions. This implies that one jurisdiction decreases the weight of the sales factor if the other

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9 In principle, it would be also adequate to implement a multiplicative binomial process to generate the upward- and downward movement of the state variable. This approach would lead to similar results. However, in line with the approach used by Niemann (2004) and for reasons of comparison and a better intuitive understanding of the subject matter, I use an additive process.

jurisdiction increases it correspondingly. The object of research in this paper rules out an analysis of positively correlated factor weights as they preclude any tax base uncertainty. Disregarding perfectly positively correlated factor weights is supported by practical experience gained in the US: even decades after implementing the possibility to deviate from the Massachusetts Formula, the apportionment formulas still vary greatly between states (cf. Tax Management BNA, 2014, p. 8).

The deviations between factor weights within jurisdictions can be explained by game theory. In line with Anand and Sansing (2000), Weiner (2008a), and Mintz and Weiner (2008), jurisdictions' decisions on how to set factor weights can be interpreted as a game in which each jurisdiction tries to maximize its individual tax revenues. The literature stream examining game theory essentially provides two differing arguments explaining deviating factor weights between jurisdictions: the different industrial makeup of the states (cf. Anand and Sansing, 2000) and differing taxation goals, i.e., revenue maximizing or investment promoting strategies (cf. Weiner, 2008, p. 106).

First, against the trend in the last decades at the US state level, Anand and Sansing (2000) find that "the simple prediction that all states will have incentives to increase sales factor […] is generally wrong" since "states will […] have unilateral incentives to deviate from any […] coordinated solution". According to Anand and Sansing, the variation in different factor weights within jurisdictions results from unique underlying characteristics of the jurisdictions. They argue that the variations within factor weights in the US are explained by the different taxation objectives of the jurisdictions: some aim to tax immobile capital, such as natural resources and agriculture, while others prefer to tax mobile capital from manufacturing. The heterogeneity across states, with respect to natural resources, leads to different weighting strategies between the states: states exporting output from immobile capital tend to put less weight on the sales factor, while importing states tend to implement the opposite. Second, Lightner (1999) points out that jurisdictions have two conflicting goals when it comes to choosing factor weights. If the only aim of a jurisdiction is to increase tax revenues, it may increase the weights of the factors that are prevalent in that jurisdiction. Conversely, if a jurisdiction aims to attract new economic development it is well advised to reduce the weights on the decisive factors. Thus, each jurisdiction's differing economic aims and underlying physical characteristics may hinder them from aligning their factor weights

3.2.1 Uncorrelated factor weights between both jurisdictions

In the first scenario I assume that no jurisdiction takes the weighting decisions of the other jurisdiction into account. This assumption is in line with some empirical evidence found in the tax competition literature. A change in the weight of apportionment factors can be interpreted as a change in the effective corporate tax rate of the jurisdiction. Thus, allocation factor competition is a stylized form of tax competition. In an EU 15 setting, Ruiz and Gerard (2008) investigate the strategic interaction of the Member States with respect to effective tax rates. They find only limited evidence for strategic interactions. Furthermore, in a broader EU 27 setting, Overesch and Rincke (2011) cannot find evidence to support strategic interaction in effective tax rates. Both studies support the assumption that changes in factor weights, which represent a specific kind of changes in effective tax rates, do not affect factor weights in other jurisdictions.

Moreover, assuming uncorrelated factor weights is reasonable in specific industries, e.g. in the setting described previously by Anand and Sansing. In a two-jurisdiction setting, one jurisdiction is assumed to generate tax revenues mainly from taxing companies that process natural resources (e.g. agriculture, mining, forestry or fishery). Since companies that generate income by processing natural resources are highly unlikely to be able to shift their business to another more tax-advantageous jurisdiction, their home jurisdiction needs not fear that they will resettle; the other jurisdiction needs not to try to attract these companies. Thus, since behavioral adjustments of such companies can be practically ruled out, both jurisdictions are free to set the weight of the factors independently of each other.

In a one-period setting there are four possible combinations for the different developments of sales factor weights in each jurisdiction. Either the weights are raised in both jurisdictions by the constant Δ with the probability p, or they are reduced by both jurisdictions with the probability $(1-p)$, or they are raised by one jurisdiction and reduced by the other one. Here, the constant Δ can be interpreted as the magnitude of the factor weight uncertainty.

In a one period setting, the expected after-tax net cash flow under the individual system is – independent of the probability p – equal to the after-tax net cash flow under the common system. When calculating the expected after-tax net cash flow under the individual system, the four different combinations of factor weight developments add up to zero. In a two-period setting the combination of the binomial trees and the resulting possible future weight developments in jurisdiction 1 and 2 are exemplified for the sales factor in Fig. 1. Since in this scenario the jurisdictions set the factor weights independently of each other, there is no correlation between the binomial trees of jurisdiction 1 and 2. The binomial process of the factor weights in each jurisdiction begins with a sales factor weight of γ.

[Insert Figure 1 about here]

Since I consider changes in the factor weights in annual intervals and since the magnitude of the changes is constant (Δ), the branches of the binomial trees always recombine. Each binomial tree shows four different weighting developments that result in three final states. For my analysis the weighting developments are crucial. Thus, there are 4 x 4 (=16) different combinations of factor weighting developments in jurisdiction 1 and 2 in two periods.

In order to determine the expected future value for the weighting developments illustrated in Fig. 1 the future value of each branch has to be calculated by considering the probability p. For demonstration purposes the following model shows exemplarily the determination of the future value for a specific path, taking into account the probability p. The path is characterized by a raise in the sales factor weight in jurisdiction 1 and a reduction in jurisdiction 2 for the first period, followed by a reduction in both jurisdictions in the second period.

$$FV_2^{ind_{example}} = [CF_1 \tag{5}$$

$$\underbrace{-TB_1 \cdot \tau \left((\gamma + p\,\Delta)\, s + \left(\frac{1-\gamma}{2} - p\,\frac{\Delta}{2}\right)(a+l) + (\gamma - (1-p)\,\Delta)\,(1-s) + \left(\frac{1-\gamma}{2} + (1-p)\frac{\Delta}{2}\right)(1-a+1-l)\right)]}_{\text{tax payments in t=1}}$$

$$\underbrace{\cdot \left[1 + i\left(1 - \tau\left(\gamma \cdot\, s + \frac{1-\gamma}{2}\,(a+l) + (\gamma - 2\,(1-p)^2\,\Delta)\,(1-s) + \left(\frac{1-\gamma}{2} + (1-p)^2\,\Delta\right)(1-a+1-l)\right)\right)\right]}$$

after-tax interest rate in t=2

$$+CF_2 - TB_2 \cdot \tau \left(\gamma \cdot \ s + \frac{1-\gamma}{2}(a+l) + (\gamma - 2\,(1-p)^2\,\Delta)\,(1-s) + \left(\frac{1-\gamma}{2} + (1-p)^2\,\Delta\right)(1-a+1-l)\right).$$

after-tax cash flow in t=2

The first three lines of eq. (5) display the compounded first periods' net cash flow. It becomes clear that the factor weights of the second period also determine the share of the interest payment that is subject to taxation. The last line of eq. (5) displays the share of the group tax base that is tax-liable in the second period.

By transforming and summarizing the formulas for all 16 branches, I obtain the following equation for the expected future value under the individual system after two periods.

$$E\left[FV_2^{ind_{uncorr}}\right] = (CF_1 - TB_1 \cdot \tau)\left(1 + i(1-\tau)\right) + \underbrace{TB_1 \cdot \tau^2 \cdot \Delta^2 \cdot i \left(s - \frac{1}{2}\,(a+l)\right)^2 \cdot \left(\frac{1}{2} - p + p^2\right)}_{\text{uncertainty term}}$$

$$+CF_2 - TB_2 \cdot \tau. \qquad (6)$$

In eq. (6), the expected future value is a function of the factor weight uncertainty captured by the constant Δ. As becomes apparent in eq. (5), each of the 16 future values represented by the branches of the binomial tree is calculated by multiplying each net cash flow of the first period with the corresponding after-tax interest rates of the second period. The weighting developments of the second period also determine the after-tax interest rate, since interest payments are taxed similar to regular business income.

In the second period, some of the weighting developments cannot occur anymore, as they are already ruled out by the developments in the first period. Consequently, developments in the first period predetermine, to some extent, those of the second period. This implies that, for example, high first periods' after-tax net cash flows (due to low tax payments) tend to be multiplied with high after-tax interest rates in the second period. The opposite is true for low first periods' after-tax net cash flows. Thus, the interest effect increases the differences in the after-tax net cash flows of the first period to a different degree. Owing to this interplay between the low/high first period's after-tax cash flows and the low/high second period's after-tax interest rates, the net cash flows of the 16 weighting developments no longer completely cancel each other out. In essence, the high first period's after-tax cash flows multiplied with the high second period's after-tax interest rates overcompensate the low first period's after-tax cash flows multiplied with the low second period's after-tax interest rates and hence they do not add up to zero. In this two-jurisdiction, two-entity-setting, six out of 16 branches do not vanish, thus determine the uncertainty term. Without interest effects, the (expected) future value under the individual system would be similar to that under the common system.

The impact of the factor weight uncertainty depends on the tax rate τ, the interest rate i, the allocation of the factors a, l and s, the probability p and on the tax base TB_1 in the first period. Note that the impact of the factor weight uncertainty does not depend on the value of the (initial) weight of the sales factor γ. The particular design of the (initial) apportionment formula is not decisive in this setting as tax rate differentials have not been taken into account. For determining the expected tax-liable share of the group tax base under the individual system, it is only the potential deviations in the design of apportionment formulas between both jurisdictions which matter. Since the tax rate τ, the interest rate i and the probability p take on values between 0 and 1 these factors cannot negatively impact the uncertainty term. However, their magnitude determines the level of the impact of the factor weight uncertainty on the expected future value. The higher the tax and interest rates and the more the probability p deviates from 0.5, the higher the impact of the factor weight uncertainty on the expected future value.

In case of a positive/negative first periods' tax base the uncertainty impacts the expected future value positively/negatively. A positive (negative) tax base of the first period leads to a positive (negative) impact of the factor weight uncertainty on the expected future value. The impact of the factor weight uncertainty depends also on the allocation of the factors a, l and s between the two jurisdictions. The more unequal the share of the sales factor s on the one hand and the sum of the labor l and asset a factors on the other hand are distributed within each jurisdiction, the higher the impact of the factor weight uncertainty on the expected future value. Thus, the impact of the factor weight uncertainty is at its peak when the share of the sales factor s is one, and the sum of the factors asset a and labor l is zero in one of the two jurisdictions ($s = 1$ and $a + l = 0$ or $s = 0$ and $a + l = 1$). If the sum of the factors asset a and labor l is equal to the share of the sales factor s ($a + l = s$) in each jurisdiction, then the uncertainty term becomes zero and factor weight uncertainty does not affect the expected future value. In this case, the (expected) future value under the individual system is similar to that under the common system.

3.2.2 Negatively correlated factor weights between jurisdictions

In line with the argumentation of Lightner (1999), it is also conceivable that factor weights between jurisdictions are perfectly negatively correlated (factor -1). Jurisdictions that focus on generating tax revenues from the same kind of immobile capital, such as manufacturing, may have opposing weighting strategies. While one jurisdiction may aim to heavily tax the prevalent companies by setting high weights on the asset and labor factor, the other jurisdiction may want to attract new economic development by setting extra low weights on the asset and labor factor.[10] Furthermore, jurisdictions may want to differentiate from each other in order to exploit more exclusive taxing niches.

Another reason for negatively correlated factor weights can be found in the general tax competition literature. As a change in factor weights can be reinterpreted as a change in effective corporate tax rates (see Section 3.2.1), it is reasonable to refer to this literature stream. Gordon (1992), Bucovetsky (1991) and Wilson (1991) model tax competition between countries that are unequal in size. Bucovetsky and Wilson conclude that smaller countries set lower tax rates, while Gordon, in turn, concludes that large countries set higher tax rates. Both papers together support my assumption of negatively correlated effective tax rates between jurisdictions, as illustrated here by the example of large and small countries.

Fig. 2 shows the combination of the possible weighting developments for opposing weighting strategies of the jurisdictions. Since in this scenario the weighting decisions of both jurisdictions are correlated by the factor (-1), the factor weights in jurisdiction 2 are dependent on that in jurisdiction

[10] Goolsbee/Maydew, 2000, find that a reduction in the payroll factor weight from one third to one quarter increases manufacturing employment around 1,1%.

1 for each period. In order to indicate the relation between the weight setting developments of jurisdiction 1 and 2, I use different types of lines for the binomial trees in the following figure. The weighting developments in jurisdiction 2 must follow the same pattern of lines as the weighting developments in jurisdiction 1 over time. Because of the correlation between the weighting processes of both jurisdictions the number of possible combinations of future factor weight developments has decreased to four (compared to 16 in case of uncorrelated factor weights). The thin grey lines of the binomial trees in jurisdiction 2 indicate that these branches of the trees are irrelevant for the analysis in this section.

[Insert Figure 2 about here]

By transforming and summarizing the formulas for the future value of the four possible weighting developments, the following model for the expected after-tax future value is obtained:

$$E\left[FV_2^{ind_{corr:-1}}\right] = (CF_1 - TB_1 \cdot \tau) \cdot \left(1 + i(1-\tau)\right) + \underbrace{2\, TB_1 \cdot \tau^2 \cdot \Delta^2 \cdot i \left(s - \tfrac{1}{2} * (a+l)\right)^2 \cdot \left(\tfrac{1}{2} - p + p^2\right)}_{\text{uncertainty term}} + CF_2 - TB_2 \cdot \tau. \quad (7)$$

In line with the explanation given in Section 3.2.1, the uncertainty term results from some branches of the binomial tree that do not cancel each other out. Compared to non-correlated factor weights the number of different combinations for weighting developments decreases but the relative share of combinations that do not add up to zero anymore increases. Here, two out of four branches do not cancel each other out.

By comparing this model of perfectly negatively correlated factor weights with the model for non-correlated factor weights, it becomes apparent that both models are, to a large extent, identical. The only difference is that the uncertainty term in eq. (7) is multiplied by the factor of 2. Thus, the effects explained above hold also true for the model of perfectly negatively correlated factor weights, but the impact of the uncertainty on the expected future value of after-tax cash flows is twice as large.

4 Results

By assuming a risk neutral investment decision-maker of the MJG, I can directly compare the (expected) future values under both the individual and the common system (eq. (4) and eq. (6)/eq. (7)). The future value under the common system serves as a benchmark for the expected future values under the individual system.

The difference in the models for the (expected) future value under both systems (eq. (6)/eq. (7)) is the term containing the uncertainty. As described in Section 3.2, only the tax base of the first period determines whether the factor weight uncertainty has a positive or negative impact on the expected future value under the individual system. If the tax base has a positive (negative) sign, the expected future value under the individual system is higher (lower) than the future value under the individual system. Moreover, the absolute difference in (expected) future values under both systems increases with rising factor weight uncertainty Δ. These results contradict the rather popular view that tax uncertainty generally depresses MJG's expectations about future after-tax income. Under certain conditions, the analysis shows that the opposite is true: higher tax uncertainty may even increase expectations. The paradoxical tax effects result from the uncertainty itself, and not, as one may assume, purely from cases in which undertaxation occurs.[11]

Furthermore, the analysis reveals that the (expected) future values under the individual system are at least as high (low) as that under the common system in case of a positive (negative) tax base of the first period, irrespective of the allocation of the factors sales s, labor l and assets a between the group entities. However, the allocation of these factors within the MJG determines the degree of how much the (expected) future value under the individual system is higher/lower than that under the common system. In case the factors assets a, labor l and sales s are allocated among the group in a way that the following relation holds true $s = a = l$, the (expected) future values under both systems become equal. The difference in (expected) future values between both systems is maximized if either the sum of the asset and labor factors is equal to one ($a + l = 1$) and the sales factor s is equal to zero ($s = 0$) or vice versa.

[11] Paradoxical effects solely resulting from uncertainty are also found by Gries et al., 2012.

The distinction between uncorrelated and perfectly negatively correlated factor weights shows that the relation of weighting strategies between jurisdictions impacts the level by which the uncertainty affects the expected future income. If the factor weighting process between the jurisdictions is perfectly negatively correlated, then the impact of the uncertainty on the expected future value is twice as high as if the factor weights were uncorrelated. Thus, perfectly negatively correlated weighting strategies result in either higher positive or higher negative differences in (expected) future values between the common and the individual system.

The analysis shows that the positive/negative difference between the (expected) future values under the individual and the common system increase with an increasing corporate tax rate τ and interest rate i. Moreover, the analysis reveals that the impact of uncertainty on the expected future value increases if the probability p for an upward movement of the factor weight deviates more from 0.5. A practical example for jurisdictions that tend to have deviating probabilities from $p = 0.5$ are the states in the US: experience shows that US states tend to increase the weight of the sales factor over time. Thus, on average, the probability p for an increase in sales factor weights by US states is considerably larger than 0.5. The impact of the probability p on the uncertainty term is always positive. Consequently, the probability p cannot lead to a change in sign of the uncertainty term.

As already outlined in the analysis of the individual system, results are mainly driven by after-tax interest effects. The applicable after-tax interest rates that are used to compound the cash flows are path-dependent as the factor weights also drive the tax burden on interest income. As a consequence the after-tax net cash flows compounded to the second period for all possible weighting developments may not recombine. As a result of factor weights chosen in the underlying jurisdictions, some branches of the binomial tree do not cancel each other out when calculating the future value for each weighting development. In tendency, under the individual system, high/low after-tax cash flows are compounded with high/low after-tax interest rates. Thus, the assumption of constant weight changes over time drives my results to some extent since these weights determine the magnitude of the after-tax cash flows and the after-tax interest effects and create asymmetric outcomes in the second period.

Consequently, the question rises if the results hold also true in a setting with asymmetric binomial trees.

I checked the validity of my results in a robustness test. Therefore, the binomial trees are assumed to be skewed similarly in both jurisdictions. I skewed the random walks, e.g., by setting the highest possible factor weight on the sales factor up to $\gamma + 3\Delta$ (instead of $\gamma + 2\Delta$) in the second period leaving the downward movement unchanged. I find that my results still generally hold in this setting. The impact of the uncertainty on the expected after-tax future income under the individual system becomes even stronger the more skewed the decision trees are. This result holds regardless of whether the decision tree is skewed in a positive or negative direction. In a further robustness test, I assume that the factor weights may not necessarily change on a periodical basis but may also remain on their current level. Also in this setting, the basic results hold true but, however, the impact of the uncertainty on the expected after-tax cash flows is mitigated. All in all, the robustness tests clarify that the identified effects are not restricted to settings with symmetric binomial trees. Irrespective of the characteristics of the random walk I find that uncertainty impacts the expected after-tax income positively or negatively. However, the magnitude of the impact of uncertainty on the after-tax income increases with increased skewness of the binomial tree.

5 Conclusion

In this paper, I examine if the uncertainty implied by individually-set factor weights by jurisdictions decreases the expectations about future income of a MJG. I compare the (expected) after-tax future income of a MJG under a system where all jurisdictions are bound to use exactly the same formula (common system) with a system that allows each jurisdiction to determine the weights on the apportionment factors individually (individual system). Whereas under a common system always exact 100% of the group tax base is subject to taxation, it may be more or less than this under the individual system. The tax-liable share of the group tax base depends on the combination of factor weights in each jurisdiction and the allocation of the factors within the MJG. Since jurisdictions are free to change the factor weights at any time, the individual system contains uncertainty about the future tax-liable share of the group tax base and thus also about the future after-tax income.

I use a two-jurisdictions-two-entity setting and assume that the tax rates in both jurisdictions are equal. The results clarify that factor weight uncertainty affects MJGs expectations about the after-tax future income in an ambiguous manner. Counterintuitively, the results show that in case of a positive first period's tax base the (expected) after-tax income under the individual system is higher than that under the common system. In case of a negative first period's tax base the opposite is true. Thus, the factor weight uncertainty affects the expected future income negatively for companies that are likely to incur initial losses (as start-up firms typically do) and positively for economically successful, profit-making companies. Furthermore, I find that the expected future values increase under the individual system with increasing factor weight uncertainty in case of a positive first periods' tax base. Thus, the results are contrary to the popular view that uncertainty reduces expectations about future after-tax income. Moreover, the results show that regardless of how the factors assets, labor and sales are allocated between the group entities, they cannot influence the uncertainty term negatively. The same is true for the tax rate τ, the interest rate i and the probability p by which the sales factor weights are raised. However, they determine the degree by which the (expected) future values under both systems differ. Furthermore, the relation of the weighting strategies between the jurisdictions determines how strong the impact of the uncertainty is on the expected future income: the impact in case of perfectly negatively correlated weighting strategies is twice as high as that of uncorrelated strategies.

I contribute to the existing literature on regulatory risk and tax risk through a theoretical framework that deals with the effects arising from tax uncertainty in interjurisdictional settings. I identify two rather surprising results. First, tax base uncertainty (here implied by the application of the individual system) does not necessarily dampen MJGs' expectations about its future income and thus may not discourage investments. Second, more uncertainty may result in even higher expectations concerning future income.

The results are helpful for policy makers debating the concrete design of a formulary apportionment system as well as for MJGs in jurisdictions where the implementation of an individual system is being considered. It is demonstrated that uncertainty implied by an individual system may not dampen MJGs' expectations about future income and thus may not slow down the economy in jurisdictions.

Specifically, the results could be useful in a CCCTB context. If the Member States continue to fail to reach agreement on the implementation of a CCCTB, individually determined factor weights by each jurisdiction may re-enter the agenda.

The results of this analysis may also be helpful in assessing the consequences from other sources of tax base uncertainty, especially within a CCCTB context. Some research analyzes the effects of legal loopholes or questions regarding the interpretation and implementation of the proposed CCCTB system. However, contrary to my study, these studies use specific elements of tax base uncertainty to motivate their research question but do not investigate tax uncertainty in particular. Eberhartinger and Petutschnig (2014) focus on the unclear definition of the term “employee” which is a factor of the apportionment formula under the proposed CCCTB system. Kiesewetter et al. (2014), in their analysis, consider room for discretion concerning the apportionment factor “assets”. Both studies address a specific form of factor uncertainty. In this context my results could, to some extent, also be helpful for discussing implications of other sources of factor uncertainty.

When interpreting the results, one has to bear in mind the following two limitations. First, even if widely in line with empirical evidence (Weiner (1994), (1999), Lightner (1999)), behavioral adjustments by rational MJGs when faced with changing factor weights are excluded. The expected after-tax future value under the individual system would increase if behavioral adjustments were accounted for. Thus, the results are likely biased towards the disadvantage of the individual system. Second, I assume risk neutral decision-makers of MJGs. Assuming risk aversion would favor the common system, since the MJG decision-maker would demand an additional risk premium for applying the individual system.

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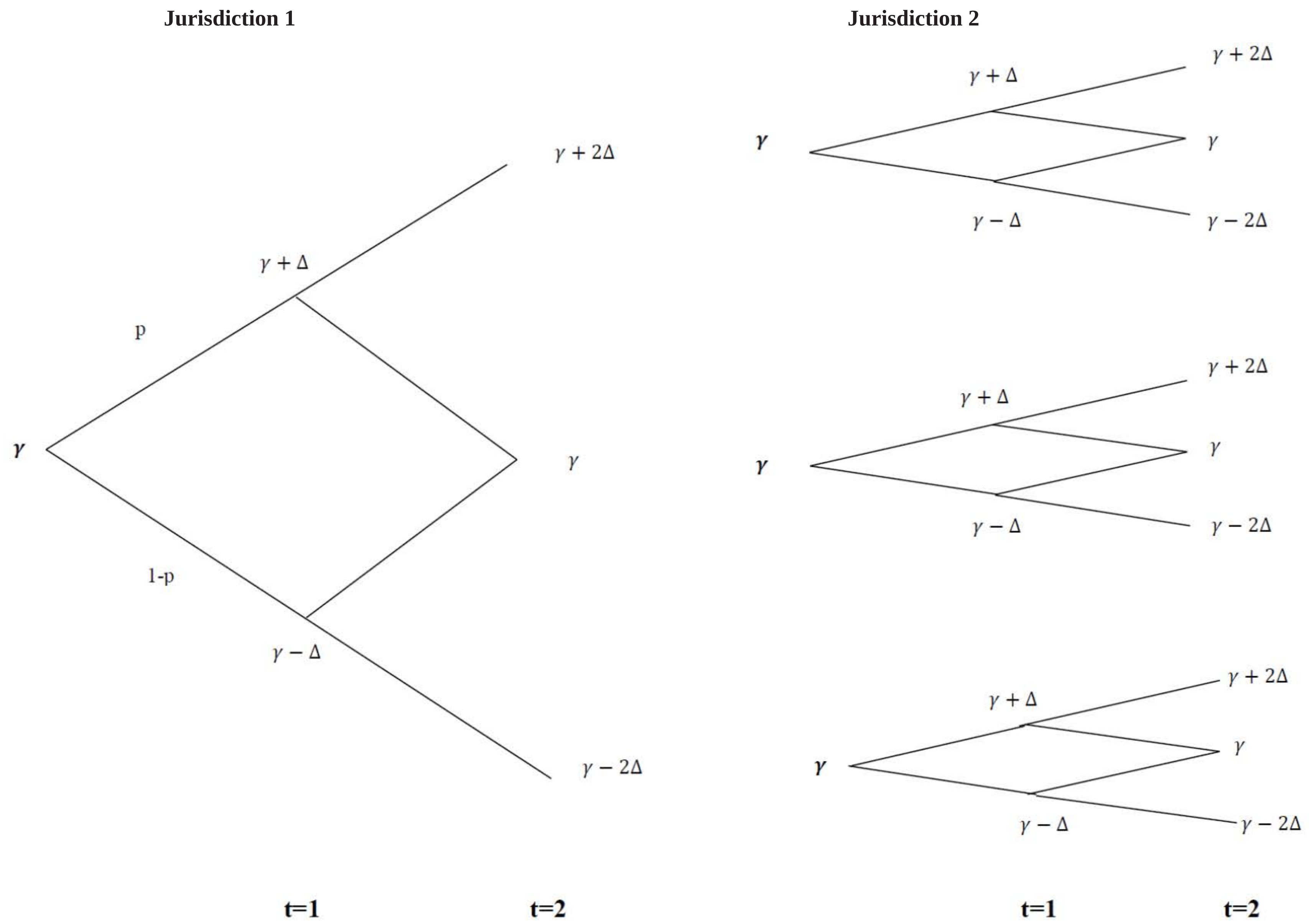
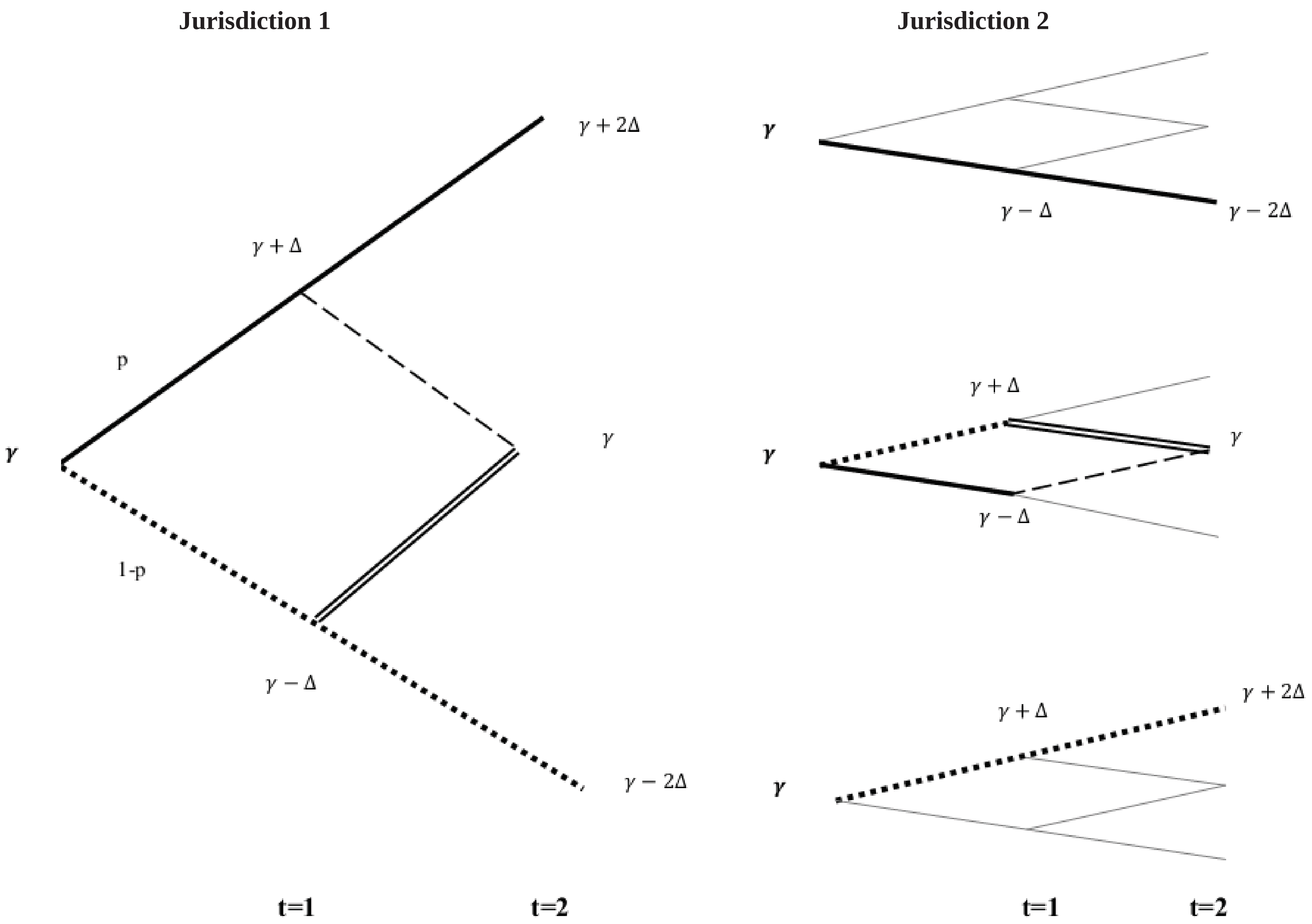


Fig. 1: Possible combinations of weighting developments in jurisdiction 1 and 2 for the sales factor weight (two-period setting, uncorrelated factor weights



Notes: Since the developments of factor weights in both jurisdictions are perfectly negatively correlated, the factor weight development in jurisdiction 2 is a function of the factor weights in jurisdiction 1. The different types of lines indicate the development of factor weights in jurisdiction 2 given the development in jurisdiction 1. The developments in both jurisdictions must follow the same patterns of lines. E.g., if the factor weights in jurisdiction 1 are chosen in line with the dotted line, the corresponding weights in jurisdiction 2 are illustrated by a dotted line, too. If the factor weights in jurisdiction 1 are chosen according to the path described by the solid line (first branch) and the dashed line (second branch) then the resulting weights in jurisdiction 2 are correspondingly illustrated by the solid and dashed branches.

Fig. 2: Possible combinations of weighting developments in jurisdiction 1 and 2 for the sales factor weight (two-period setting, perfectly negatively correlated factor weights)

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