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The better route to global tax coordination: Gradualism or multilateralism?

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Abstract. We compare the success probability of multilateral negotiations and sequential negotiations over international tax cooperation. To make this difference relevant, we introduce incomplete information as a friction that can lead to bargaining failure. We find plausible conditions for when multilateral negotiations are more likely to achieve full global tax coordination than a gradual/sequential approach. We also compare different routes of sequential bargaining. We ask whether negotiations should start with countries that are the most unpredictable candidates or the most difficult negotiation should be preserved for the final round. We find that sequencing along this dimension matters. Under plausible conditions, full cooperation is least likely to emerge if the negotiations with the most unpredictable country take place last.

Résumé. *Quelle approche pour une meilleure coordination fiscale internationale : gradualiste ou multilatéraliste?* En matière de coordination fiscale internationale, nous comparons les chances de réussite des négociations multilatérales par rapport aux négociations séquentielles. Pour illustrer la pertinence de cette différence, nous introduisons des informations incomplètes comme points de friction pouvant conduire à l'échec des négociations. Comparativement à une approche graduelle/séquentielle, et sous certaines conditions vraisemblables, nous constatons que les négociations multilatérales ont davantage de chances d'aboutir à une coordination fiscale internationale complète. Nous comparons également les différentes façons d'envisager les négociations séquentielles. Nous cherchons à savoir si les négociations doivent commencer avec les pays les plus imprévisibles, ou si les négociations les plus ardues doivent être réservées pour la phase finale. Dans cette optique, nous constatons qu'une approche séquencée prend toute son importance. Dans des conditions vraisemblables, si les négociations avec les pays imprévisibles se déroulent lors de la phase finale, alors il est très peu probable qu'une coopération totale n'émerge.

JEL classification: H25, H77, F52, F55

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1. Introduction

TO SOLVE TRANSNATIONAL taxation issues, organizations such as the OECD or the G20 often advocate multilateral solutions.¹ In contrast to this view, some policy-makers and their scientific advisors appeal to gradual approaches. One example is the discussion in France and Germany regarding a coalition of a subgroup of countries that are prepared to act jointly.² The hope among gradualists is that a first gradual step will unleash further dynamics towards global cooperation. Blum (2008), who diligently assesses bilateral treaties (BLTs) in comparison to multilateral treaties (MLTs), articulates this hope. She suggests the following: “In time, the accumulation of such BLTs could generate a customary norm or spark the negotiation of a multilateral treaty. Successful bilateral formulas could serve as useful precedents and foundations for future MLTs” (Blum 2008, p. 376). Imagine that the international community wishes to address the problems of base erosion and profit shifting. If the final goal is a global solution for problems of international tax cooperation, should one pursue a multilateral agreement and wait until such an arrangement is reached? Or does it make sense to start gradually, form a coalition of those prepared to act immediately and then hope that the momentum of this cooperation further enlarges the coalition until a broad international agreement is achieved?

1 In chapter 2 of *Action Plan on Base Erosion and Profit Shifting* (OECD 2013, p. 10), the OECD expressed its concerns regarding possible unilateral actions of some countries and advocated “a bold move by policy makers.” On page 11, this OECD report refers to the communiqué of the G20 Summit in Los Cabos in June 2012: “Despite the challenges we all face domestically, we have agreed that multilateralism is of even greater importance in the current climate, and remains our best asset to resolve the global economy’s difficulties” (G20 2012, paragraph 8). In chapter 15, the OECD sketches the idea of developing a multilateral instrument to amend bilateral tax treaties.

2 In a publication of the French *Conseil d’Analyse Économique*, Bénassy-Quéré et al. (2014a, p. 9) advocate for partial corporate tax coordination by a subgroup of countries within Europe. They suggest the following: “Therefore, we recommend adopting the CCCTB project or at least some part of it (e.g., base harmonization), possibly through enhanced cooperation (nine countries) or through an ad hoc initiative of willing countries.” They argue that “an ad hoc initiative could be a useful step in the path to further harmonization . . .” In a voxu.org feature, Bénassy-Quéré et al. (2014b) further elaborate on this argument suggesting that “. . . a group of possibly large countries speaking with one voice would have more weight to convince third countries (either EU members or not) to cooperate (see what the US has obtained from non-cooperative countries in recent months).”

We address these diverging views in an analytical framework, focusing on incomplete information as a salient reason for why a global agreement may not be reached. Several reasons for incomplete information come to mind in the context of international negotiations. First, negotiations are carried out by politicians rather than “countries.” The politicians’ preferences might diverge from the country’s costs and benefits, and these idiosyncratic preferences might be difficult to observe. Politicians may like or dislike accepting bargaining offers as such. Some politicians might regard an agreement as a weakness, while others may regard it as an indication of ability.³ Second, behavioural motives might play a crucial role. Experimental studies of the ultimatum offer game have revealed numerous behavioural payoff components in addition to material payoffs. The former include relative standing comparisons, fairness considerations and so forth.⁴ A responder might even be willing to forgo its own surplus for the benefit of global efficiency.⁵ Third, negotiators might learn about others’ preferences only in the long run, and a recent office change in one country might make the preferences of a new negotiator from this country less well known.⁶

The literature has explored the efficiency properties and the distributional impacts of cooperation on taxes among an exogenous subgroup of countries. Konrad and Schjelderup (1999) analyze a three-country model and study the static costs and benefits of partial cooperation by two countries for the members in this group and for a bystander third country. They conclude that both the members of the cooperating subgroup and the bystander country are likely to benefit if the countries’ choice variables are strategic complements.⁷ Soerensen (2004) offers simulation results that assess the size of these benefits for the cooperating subgroup and for the

3 As argued by Konrad and Thum (2014) in the context of climate conventions, politicians might have preferences of their own, or they might have to respect the preferences of powerful interest groups or of their political supporters.

4 See, e.g., the overview by van Damme et al. (2014).

5 For preferences for efficiency, see, e.g., Engelmann and Strobel (2004).

6 For a formal treatment of opacity in negotiations, see Konrad and Thum (2020). Their paper also shows that asymmetric information can be used strategically in negotiations and that there is an optimal degree of opacity about a negotiator’s type.

7 The advantage of the bystander is a very natural outcome and conforms with the intuition gained from the merger paradox in oligopoly theory, which holds for players’ actions that are strategic substitutes (as in Salant et al. 1983) or strategic complements (as in Deneckere and Davidson 1985).

bystander countries. He finds small benefits for the subgroup and large benefits for the bystanders.⁸

These analyses do not address the dynamics of negotiations, the endogeneity of coalition outcomes or the advantages and disadvantages of multilateral negotiations relative to the various gradual and sequential negotiation strategies. One conceptual contribution to this issue, framed in the context of regional trade agreements,⁹ is the seminal paper by Aghion et al. (2007). Choosing an abstract model with three countries, they compare the equilibrium outcome from multilateralism with that of gradual negotiations. Their own framework is prominent in the literature and provides a simple complete-information benchmark that is well suited to considering incomplete information between countries and studying its decisive role. They make strong assumptions, but the limitations of their approach are well understood.¹⁰ They award one leader country all bargaining power,¹¹ impose strong exogenous rules about the possible routes and terminal nodes of the negotiation process¹² and assume that coalitions, once formed, and arrangements about payments, once made, are irreversible and binding.

Burbidge et al. (1997) make an early and important contribution that highlights the sensitivity of dynamic games of coalition formation and

8 Overall, the issue of partial coordination has attracted considerable attention. There are several important examples in this literature. Haufler and Wooton (2006) identify possible gains from partial coordination that operate through investment incentives. Conconi et al. (2008) argue that moderate increases in tax rates due to partial coordination might be welcome in comparison to full cooperation if the global tax union suffers from the problem of time-consistent overtaxation of capital. Vrijburg and de Mooij (2016) raise some doubts about the common assumption of tax rates as strategic complements. Finally, Itaya et al. (2014) study the sustainability of partial cooperation in a repeated game setting. They identify the size of the group of cooperators and the overall number of countries in the global economy as the main determinants. See also Keen and Konrad (2013) for a discussion.

9 Whether a multilateral negotiation strategy is superior to a sequential strategy and whether regional free trade agreements tend to pave or block the way to global free trade is at the centre of a major controversy in the context of trade policy. A recent survey is provided by Maggi (2014).

10 Aghion et al. (2004) defend many of their assumptions and check their robustness in the working paper version of their published paper.

11 A concept with alternating offer bargaining might be a suitable alternative; in such a case, the leader role is allocated by a random process over a potentially infinite sequence of periods, as in Okada (2000).

12 For instance, direct negotiations between the non-leader countries are ruled out. In the multilateral bargaining case, negotiations fail irreversibly, even if one of the countries would like to cooperate with the leader country. Sen and Biswas (2015) show that some of these assumptions partially drive the results.

bargaining (in the contexts of trade agreements and tax cooperation) to the precise bargaining protocols and coalition stability concepts. Failure to achieve the grand coalition might occur, even if the grand coalition maximizes aggregate surplus.¹³ Caparrós and Péreau (2017) employ a variant of the Rubinstein alternating-offer game to allow for endogenous bargaining power of countries that is driven by the externalities. They show that the leader may prefer sequential negotiations because this might be the only way to reach a stable global agreement in this setting.¹⁴

Extensive research has systematically explored endogenous coalition formation under various constraints. Ray and Vohra (2015) survey a large part of this literature. They emphasize a number of dimensions that matter for the equilibrium outcome: farsighted versus myopic concepts of stability, cyclical patterns of coalition formation, a permanent or temporary nature of contractual agreements, the precise bargaining rules, feasibility of side payments and the payoff implications of a partial coalition for players who are not members of this partial coalition—i.e., the “externalities” that a subset of players imposes on bystanders when they form a subgroup coalition. This multiplicity of dimensions results in a large number of combinations of reasonable assumptions. Whether and under what conditions efficiency is reached depends on the combination of assumptions made. We take from this literature that there is no gold standard for the type of rules, the stability criterion or other aspects that should be adopted. An early contribution by Hart and Kurz (1983, pp. 1060) already alludes to the multiplicity of reasonable assumptions, for instance, about what defines coalitional stability. They ask, “What happens to those coalitions from which one or more players depart? Do they ‘fall apart,’ or do they still ‘stick together’? ... There is no universally correct answer to this problem.”

The framework of Aghion et al. (2007), hereafter AAH, uses one possible set of assumptions. For two reasons, this framework is compelling as a benchmark to study the role of incomplete information for the possible superiority of multilateralism or for the optimal route of sequential negotiations.

First, their framework leads to global cooperation both for sequential and multilateral negotiations whenever global cooperation is efficient. Therefore, if the implications of incomplete information for the probability of reaching a global agreement are not identical for the various bargaining settings, these differences can be attributed to differences in how incomplete information affect bargaining in the respective settings.

Second, studying incomplete information faces tractability limits in many alternatives to the AAH benchmark. With incomplete information, an

13 Burbidge et al. (1997) demonstrate that, with more than two players, the grand coalition cannot form because a single country might have the incentive to withdraw from the treaty and reap the benefits of being a bystander country.

14 Caparrós and Péreau (2017) also extend the game to more than three players and analyze the internal stability of agreements.

alternating bargaining-offer game or reversibility of subgroup coalition contracts induce non-trivial signalling/information extraction problems. This has implications for the equilibrium concept and typically might allow for a multiplicity of perfect Bayesian equilibria. Apart from the mere technical challenges of solving dynamic games with incomplete information, it becomes difficult to distinguish effects driven by technology and preference uncertainty as such from effects driven by belief formation, information processing and Bayesian updating. The AAH framework is sufficiently straightforward and simple as a workhorse model to avoid these problems.

Our findings compare three alternative bargaining approaches. We concentrate on the differences in the likelihood of a global agreement. We also touch upon the question of which negotiation route would be chosen by a powerful offer-maker. Based on the microfoundations of partial tax coordination when tax rates are strategic complements as in Konrad and Schjelderup (1999) and Soerensen (2004), we put particular emphasis to the case in which both bystanders and the partial coalition members benefit from partial tax cooperation. For this case, reaching a global agreement is most likely for multilateral bargaining, followed by negotiating first with the uncertain country and then followed by negotiating first with the less uncertain country.

Intuitively, the different routes generate different trade-offs for the offer-maker between asking for a larger share in the total benefits of collaboration and the increased risk of bargaining failure. Furthermore, gradual negotiations are more promising if they start with the most difficult parts. While derived within the specific framework, the unfavourable effect of postponing the most difficult negotiations to the end can offer a more general insight: it highlights a time-consistency problem that is more severe if difficult negotiations take place near the end of the negotiation process. As will be discussed, the ranking in success probabilities need not coincide with the sequencing preferences of the offer-maker. The offer-maker dislikes subgroup coalitions that make the bystander better off than in the non-cooperative equilibrium because this reduces the rent that the offer-maker can extract from making also the bystander join the coalition.

In the next section, we briefly sketch the AAH framework and reproduce Aghion et al.'s (2007) key results in the context of tax cooperation. Then, we turn to the main analysis and consider the role of incomplete information for a comparison between multilateralism and gradual negotiations as well as for the optimal route of gradual negotiations. We finish by offering some conclusions.

2. The AAH framework

In adapting the tariff competition/union model developed by Aghion et al. (2007) to tax competition and tax coordination, we consider a global economy with three ex ante symmetric countries, *A*, *B* and *C*. The countries' choice objects could be tax rates, as in most tax competition models, or stand for

more complex tax system choices. One of the countries is chosen at random to be the “leader” and is labelled country A . For reasons outside the model, this country is given an active role and strong commitment power in the negotiations as described below.

Three possible states of the global economy exist. One state is the status quo, which can be thought of as representing the unique outcome of a non-cooperative Nash equilibrium of national tax policies. The utility levels of countries in this state are denoted by (π^N, π^N, π^N) , and we normalize this utility level to $\pi^N = 0$. The normalization assumption is merely for notational convenience.

A second state represents the globally efficient outcome characterized by globally coordinated tax policies. We assume that this efficient system of taxation is unique and, in the absence of inter-country transfers, generates the same utilities for all three countries, denoted by the vector (π^O, π^O, π^O) .

Third, an intermediate situation may come about in which the leader and one of the other two countries coordinate their tax policies and maximize their joint utility. Here, the third country is a bystander; it replies to the anticipated actions of the cooperating countries in a unilaterally optimal way. We denote the resulting payoff vector in this partial coordination outcome as (π^P, π^P) for the two cooperators and the payoff π^T for the bystander country. Note that this assumes that countries’ payoffs depend only on their roles as a member or a non-member of a bilateral tax coordination.

Furthermore, following Aghion et al. (2007), let

$$3\pi^O > \max\{2\pi^P + \pi^T, 3\pi^N\}. \quad (1)$$

This states that aggregate welfare is highest if the countries agree on what is called global coordination.¹⁵ The partial coordination outcome differs from the global optimum because it typically internalizes the fiscal externalities between the cooperators but fails to internalize all externalities between the coordinating group and the bystander country.

Whereas π^O , π^N , π^P and π^T are genuine payoff values that emerge in the three possible states in the absence of direct transfers between countries, we follow Aghion et al. (2007) and allow for transferable utility, i.e., we allow for direct financial transfers as part of the negotiated contracts. In comparison to the genuine payoffs, the country payoffs that emerge after transfers are denoted as w_A , w_B and w_C .

2.1. Multilateral negotiations

In the multilateral negotiations game, the leader country A makes a simultaneous take-it-or-leave-it offer to B and C . The offer, if accepted by both,

15 These are mild assumptions. If $\pi^O < \pi^N$, then it does not make much sense to discuss coordination or cooperation. If $3\pi^O \leq 2\pi^P + \pi^T$, then partial coordination already reaps all the benefits that can be gained from coordination.

brings the global economy to the efficient state.¹⁶ The sum of payoffs here is $3\pi^O$. In a standard tax competition model, this is the tax regime that maximizes the global welfare in the world economy. If A , B or both reject, the game ends in $(w_A, w_B, w_C) = (0, 0, 0)$. In equilibrium, A offers B and C their payoffs in the non-cooperative Nash equilibrium and keeps the remainder, and B and C accept this offer. The resulting payoffs are $w_A = 3\pi^O$, $w_B = w_C = \pi^N = 0$.

2.2. Sequential bargaining

The alternative bargaining setup assumes that A first makes an offer w_B to B or w_C to C . If this stage 1 offer is rejected, then, following the assumptions in Aghion et al. (2007), this ends the game, and $(w_A, w_B, w_C) = (0, 0, 0)$. If the stage 1 offer is accepted, then A can make a further offer to the remaining country in stage 2. If this other country also accepts, then the economy ends in the same welfare optimum as in the multilateral game, i.e., the sum of all payoffs is $3\pi^O$. If the stage 1 negotiations are successful, but the stage 2 negotiations fail, then the economy ends in the outcome with partial tax cooperation that was negotiated between A and the country that first received an offer.

Given the ex ante symmetry between B and C , it does not make a difference whether the stage 1 negotiations are with country B or with country C . (Sequencing will matter with incomplete information and with asymmetry between B and C .) Suppose that the stage 1 offer goes to B . Then, B is offered some w_B . Country B 's reservation payoff is $\pi^N = 0$; hence, $w_B = 0$ is offered and accepted. Entering stage 2, the status quo utility for C is now equal to π^T . If A offers C its reservation utility π^T as a standalone player in the partial coalition outcome and C accepts this offer, then this yields the final equilibrium payoffs $w_A = 3\pi^O - \pi^T$, $w_B = 0$ and $w_C = \pi^T$, which makes use of $\pi^N = 0$.

2.3. Comparison in the absence of incomplete information

Compare the leader country's payoff in the multilateral bargaining and the sequential, bilateral negotiations:

$$w_A = \begin{cases} 3\pi^O & \text{in the multilateral game} \\ 3\pi^O - \pi^T & \text{in the sequential game.} \end{cases} \tag{2}$$

Under conditions of complete information, both multilateral and sequential gradual bargaining leads to efficiency in Aghion et al. (2007).¹⁷ The leader

¹⁶ Caparrós and Péreau (2017) note that, in many international negotiations, a single country plays the leader role and is the de facto proposer.

¹⁷ Aghion et al. (2007) also discuss stumbling bloc equilibria, where the grand coalition is not formed. However, in their framework this is the case only when grand coalition super-additivity does not hold, which is ruled out in our case due to condition (1). In section 8 of the working paper version of their paper (Aghion et al. 2004), they stress the role of the specific bargaining protocol chosen in their paper and discuss alternative bargaining protocols.

prefers multilateral bargaining if $\pi^T > 0$ and sequential negotiations if $\pi^T < 0$ and is indifferent in case $\pi^T = 0$.¹⁸ This completes the description of AAH model and the replication of its results framed in the context of international tax coordination.

As discussed in the previous section, the model makes strong assumptions about coalition stability, about which negotiation paths are permissible or not, and about the binding nature of contracts in coalitions, but these limitations are well understood in the literature. The fact that efficiency properties do not depend on the negotiation path in this model makes it an excellent starting point to compare the different negotiation paths in case of incomplete information.

3. Incomplete information

As the major departure from the benchmark framework in section 2, we assume that the reservation payoff of the responder country C is no longer common knowledge—in a way described in greater detail below. Only the responder country B has a reservation payoff $\pi^N = 0$ that is common knowledge, as in the benchmark case. We study this small deviation and ask whether global coordination is more likely to be reached under multilateral negotiations or under sequential negotiations. We also study how incomplete information affects the distribution of rents and allocates an information rent to the player who has private information. We also ask how the asymmetry in what is known about B and what is known about C affects the optimality of the route of sequential negotiations. When making sequential offers, the leader has to decide whether to negotiate first with the predictable counterparty B and delay the more difficult negotiation until later or whether A should first deal with the less predictable counterparty C . Our setup can address this question.

Several reasons for incomplete information about country C 's reservation payoff in the ultimatum offer game were discussed in the introduction. All these potential sources of ambiguity will be collapsed into a single random variable. Formally, we define a random variable γ that measures the deviation of the decision-maker in C from the country's material reservation payoff. A positive value of γ implies a political cost. We assume that the actual γ is drawn from a random distribution with a cumulative distribution function $F(y)$ that has a compact support and is continuously differentiable everywhere and fulfills the condition

$$\frac{\partial \frac{F'(\gamma)}{F(\gamma)}}{\partial \gamma} < 0. \quad (3)$$

18 There are good reasons to believe that $\pi^N < \pi^T$. In a standard tax competition framework, one might expect that $\pi^T > \pi^P > \pi^N$. See also the literature cited in the introduction.

The reversed hazard rate captures the probability of observing a political cost in a neighbourhood of γ , conditional on the outcome being no more than γ . The reversed hazard rate condition requires that the density does not increase too rapidly. The condition holds for many commonly considered probability distributions such as uniform, Weibull, gamma, lognormal and exponential distributions (Kayid et al. 2011).¹⁹ Furthermore, we assume that $E\gamma = 0$. This makes the results more comparable to the benchmark framework than if $E\gamma \neq 0$ and constitutes a one-step departure from the analysis under complete information. This method allows us to isolate the effect from incomplete information, rather than from country asymmetries in the first moments of their reservation payoffs. Country C might dislike reaching an agreement (i.e., $\gamma > 0$) or C might like reaching an agreement (i.e., $\gamma < 0$).

3.1. Multilateral negotiations with incomplete information

In the multilateral framework, the leader chooses simultaneous offers to B and C .²⁰ If the full tax union does not come about, then the economy remains in the fully non-cooperative equilibrium. In this case, A , B and C receive their reservation utility, which is equal to $\pi^N = 0$. The leader offers a total material benefit w_B to B and w_C to C if both B and C agree to the full tax union. These values might deviate from π^O , and the difference is a transfer between the leader and the responder country. Player B accepts A 's offer if $w_B \geq \pi^N = 0$. The equilibrium offer to B is $w_B = 0$. When solving for the optimal w_C , taking into account that country B is satisfied and will never block the formation of the global coordination, it is necessary to account for the incomplete information about country C 's reservation utility. Country A 's objective function for the offer to C is

$$w_A = F(w_C)(3\pi^O - w_C). \quad (4)$$

Note that $F(w_C)$ captures the probability that an offer that yields a total material benefit of w_C to country C is accepted. The marginal type that is indifferent about whether to accept the offer is given by $\gamma = w_C$ because the net benefit becomes zero in this case. All types with lower costs γ will strictly prefer to accept the offer. The first-order condition is

19 In contract theory, the assumption of an increasing hazard rate is more common; see Bolton and Dewatripont (2005, pp. 87–88). For several probability distributions, the two assumptions are equivalent (Block et al. 1998); for an application of the equivalence, see Inderst and Ottaviani (2012).

20 Although the assumption of ultimatum offers is borrowed from the AAH approach, the assumption is admittedly stronger here because there is no need for renegotiation with perfect information. For a formal analysis of multilateral and sequential negotiations with Rubinstein alternating offers, see Caparrós and Péreau (2017).

$$\frac{\partial w_A}{\partial w_C} = F'(w_C)(3\pi^O - w_C) - F(w_C) = 0. \tag{5}$$

This determines a unique value w_C as the solution of the equation

$$\frac{1}{3\pi^O - w_C} = \frac{F'(w_C)}{F(w_C)} = \frac{F'(\gamma^*)}{F(\gamma^*)}. \tag{6}$$

Denote this offer in the multilateral case as w_C^* . Because there is a one-to-one relationship between the material benefit w_C and critical type γ that still accepts the offer, the choice w_C^* also determines the the critical cost γ^* and the equilibrium probability with which the multilateral regime leads to full coordination.

3.2. The sequential framework: First negotiating with B and then negotiating with C

Suppose that A offers some material payoff w_B to B in stage 1. If the offer is rejected, the game ends. If the offer is accepted, then partial coordination takes place and stage 2 arrives. In stage 2, country A offers some w_C to country C . If country C accepts, full coordination applies, leading to global welfare $3\pi^O$. Alternatively, C rejects and the game ends with the partial coordination equilibrium and material payoffs $(w_A, w_B, w_C) = (2\pi^P - w_B, w_B, \pi^T)$. We start with the analysis of the continuation game at stage 2. Let w_B be the material payoff that was offered to B and accepted at stage 1. Player C is a bystander to the partial coordination by A and B . This gives the reservation payoff π^T to C . Moreover, C has an acceptance cost of γ . Thus, C accepts A 's offer if $w_C - \gamma - \pi^T \geq 0$, i.e., if $\gamma \leq w_C - \pi^T$. The acceptance probability is a function of w_C and equal to $F(w_C - \pi^T)$. The stage 2 objective function of A is

$$F(w_C - \pi^T)(3\pi^O - w_C - w_B) + (1 - F(w_C - \pi^T))(2\pi^P - w_B). \tag{7}$$

The value of w_B was determined in stage 1 and is a constant with respect to A 's optimization problem at stage 2. The equilibrium offer is implicitly given by the first-order condition

$$F'(w_C - \pi^T)(3\pi^O - w_C - 2\pi^P) - F(w_C - \pi^T) = 0. \tag{8}$$

This condition can be written as

$$\frac{1}{3\pi^O - (w_C - \pi^T) - \pi^T - 2\pi^P} = \frac{F'(w_C - \pi^T)}{F(w_C - \pi^T)} = \frac{F'(\gamma^{bc})}{F(\gamma^{bc})}. \tag{9}$$

The first equation (9) has a unique solution for w_C for given π^T , and we denote it w_C^{bc} . Because C accepts for all γ with $\gamma \leq w_C^{bc} - \pi^T$, this equilibrium offer also determines the acceptance probability $F(\gamma^{bc}) = F(w_C^{bc} - \pi^T)$ and a unique equilibrium level of agreement cost $\gamma^{bc} = w_C^{bc} - \pi^T$ such that C accepts if the true agreement cost is not higher than γ^{bc} . This is used in the second equation in (9). Now, turn to stage 1. Because B 's preferences are common knowledge, and because w_B does not affect the continuation game

in stage 2 once the offer w_B has been accepted, A will make the smallest offer that B is willing to accept: $w_B^{bc} = \pi^N = 0$.

Moreover, we obtain A 's expected payoff by inserting γ^{bc} into A 's payoff function (7), which is $F(\gamma^{bc})(3\pi^O - \gamma^{bc} - \pi^T - 2\pi^P) + 2\pi^P$.

3.3. The sequential framework: First C and then B

Suppose that A offers payoff w_C to C in stage 1. If this negotiation fails, the game ends. If C accepts, they coordinate their tax policies, and the game moves to stage 2. In stage 2, country A offers w_B to B . We solve by backward induction. Let w_C be the offer that was made to C and accepted. Country B 's reservation utility is π^T . Thus, B agrees if $w_B > \pi^T$. Among these offers, $w_B^{cb} = \pi^T$ is the one that maximizes A 's payoff. This offer is superior to not making an offer if $3\pi^O - \pi^T - w_C > 2\pi^P - w_C$ or, equivalently, $3\pi^O > 2\pi^P + \pi^T$. This condition holds due to (1).

Turn next to stage 1. Both A and C anticipate the outcome $w_B^{cb} = \pi^T$ of possible negotiations in stage 2. Player C has a material reservation payoff of $\pi^N = 0$ and agreement costs of γ . Thus, C is willing to accept any offer $w_C \geq \gamma$. For a given w_C , there is an agreement with probability $F(w_C)$. The game ends if C does not accept, and A has a utility of $\pi^N = 0$. Using $w_B^{cb} = \pi^T$ and the acceptance of this offer by B with probability 1 in stage 2, the objective function of A becomes

$$F(w_C)(3\pi^O - \pi^T - w_C). \tag{10}$$

The first-order condition is

$$F'(w_C)(3\pi^O - \pi^T - w_C) - F(w_C) = 0. \tag{11}$$

This condition can be transformed into the first equality in

$$\frac{1}{3\pi^O - w_C - \pi^T} = \frac{F'(w_C)}{F(w_C)} = \frac{F'(\gamma^{cb})}{F(\gamma^{cb})}. \tag{12}$$

It determines the unique equilibrium offer w_C^{cb} . Moreover, C accepts if $\gamma \leq w_C^{cb}$. We denote the largest γ for which C accepts w_C^{cb} by γ^{cb} . Accordingly, C 's acceptance probability in the equilibrium is $F(w_C^{cb}) = F(\gamma^{cb})$ that is used for the second equality in (12).

Furthermore, inserting into (10) yields A 's expected payoff $F(\gamma^{cb})(3\pi^O - \gamma^{cb} - \pi^T)$.

3.4. Comparisons

The three conditions (6), (9) and (12) characterize the equilibrium offers w_C^* , w_C^{bc} and w_C^{cb} to C . These conditions determine the critical levels of C 's agreement cost γ^* , γ^{bc} and γ^{cb} such that C accepts the equilibrium offer in the respective negotiation regime if the agreement cost is less than or equal to this critical agreement cost. The outcome of the comparison depends on the size of π^T and $2\pi^P$.

We first compare multilateral bargaining with sequential offers, first to B , then to C . We show the following results.

PROPOSITION 1. *Compared with multilateral bargaining, if A conducts the complete-information negotiations with B in stage 1 and the incomplete-information negotiations with C in stage 2, then the probability of achieving global coordination is*

$$\left. \begin{array}{l} \text{lower} \\ \text{equal} \\ \text{higher} \end{array} \right\} \text{with sequential negotiations if } \begin{cases} \pi^T + 2\pi^P > 0 \\ \pi^T + 2\pi^P = 0 \\ \pi^T + 2\pi^P < 0. \end{cases}$$

Proof. A comparison of (6) and (9), using the monotonicity of the inverse hazard rate γ^* is larger than γ^{bc} if $\pi^T + 2\pi^P > 0$, which in turn implies that the agreement probability $F(\gamma^*)$ exceeds the agreement probability $F(\gamma^{bc})$. The inverse relationship holds if $\pi^T + 2\pi^P < 0$. ■

The full aggregate material payoff of $3\pi^O$ is obtained only if B and C accept A's offer. Country B always accepts the equilibrium offer. Thus, the probability of achieving global coordination is equal to the probability with which C accepts the equilibrium offer. If $\pi^P > 0$ and $\pi^T > 0$ then C already has a reservation utility of π^T rather than $\pi^N = 0$. Additionally, A already appropriated an amount $2\pi^P$ of the possible efficiency gains by successfully negotiating partial coordination with B. What is at stake for A, when making an offer to C at stage 2, is $3\pi^O - 2\pi^P - \pi^T$. Compared with the multilateral negotiations in which A's stake is $3\pi^O$, the stake is lower by $\pi^T + 2\pi^P$. If this sum is positive, the potential gain from acceptance is lower, but the change in probability from a change in w_C , i.e., the nature of uncertainty defined by $F(\gamma)$, remains the same. In such situations, the ultimatum offer-maker chooses a more aggressive offer. If, instead, $\pi^T + 2\pi^P < 0$, then, for the same logic the stakes in the sequential negotiation in stage 2 are higher than the stakes in the multilateral negotiation. Accordingly, the sequential negotiations would make the offer-maker more cautious.

Turn now to the reverse sequencing of negotiations. Let A delay the negotiations with the more predictable negotiation partner B and start with an ultimatum offer to the less predictable country C.

PROPOSITION 2. *Compared with multilateral bargaining, if A makes an ultimatum offer to C in stage 1, followed by complete-information negotiations with B if the offer to C is accepted, then the probability of achieving global tax coordination is*

$$\left. \begin{array}{l} \text{lower} \\ \text{equal} \\ \text{higher} \end{array} \right\} \text{with sequential negotiations if } \begin{cases} \pi^T > 0 \\ \pi^T = 0 \\ \pi^T < 0. \end{cases} \quad (13)$$

Proof. Comparing (6) and (12), the critical cost γ^* fulfilling (6) is larger (smaller) than γ^{cb} if and only if π^T is positive (negative). Correspondingly, the

offer w_C^* fulfilling (6) is larger (smaller) than w_C^{cb} fulfilling (12). Hence, for positive π^T , the agreement probability $F(\gamma^*)$ exceeds the agreement probability $F(\gamma^{cb})$. The inverse relationship holds if $\pi^T < 0$. ■

The result in proposition 2 has a similar intuition to the result in proposition 1. Suppose that $\pi^T > 0$. Sequential negotiations that start with the uncertain respondent C increase the material reservation payoff of B from $\pi^N = 0$ to $\pi^T > 0$. This reduces the stakes of country A in sequential negotiations that start with C relative to those under multilateral bargaining. For the same given bargaining offer to C in the two cases, bargaining failure is less costly for A in the sequential bargaining case. This induces A to make a more aggressive offer that entails a higher probability of failure.

Last, we compare success probabilities for the two sequential bargaining protocols.

PROPOSITION 3. *Sequential negotiations are more likely to be successful if A first conducts incomplete-information negotiations with C rather than first conducting complete information negotiations with B if $\pi^P > 0$. The inverse probability ordering holds if $\pi^P < 0$.*

Proof. Compare (9) and (12). The value γ^{bc} solving (9) is smaller (larger) than γ^{cb} solving (12) if and only if π^P is positive (negative). Hence, for positive π^P , the agreement probability $F(\gamma^{cb})$ exceeds the agreement probability $F(\gamma^{bc})$. The inverse relationship holds if $\pi^P < 0$. ■

Again, the change in A 's stakes from successful negotiations explains this outcome. Let $\pi^P > 0$. Then, A already appropriates the benefit $2\pi^P > 0$ once the negotiations with B are successfully completed. This makes the amount that is at stake for A in stage 2 in the uncertain negotiations with C smaller than in the case when these negotiations take place in stage 1 when A has not yet secured some rents. Hence, A 's offer is more aggressive when negotiating with C at the very end.

The results in propositions 1 to 3 can be illustrated in a diagram. Figure 1 combines the relevant functions that determine the equilibrium values for all three cases in one diagram. The hazard rate, which corresponds to the right-hand sides of (6), (9) and (12), is depicted by the downward-sloping solid line. The left-hand side of the first-order condition for (6) is represented by the black upward-sloping solid line (I). This curve has an intercept equal to $1/(3\pi^O)$. The intersection with the F'/F curve determines γ^* . This intersection also determines the value of $F'(\gamma)/F(\gamma)$ that applies in equilibrium, and in turn, this uniquely determines the probability of achieving a global tax union.

The dashed line (II) illustrates the left-hand side for (9) for $\pi^T + 2\pi^P > 0$. The function has an intercept of $1/(3\pi^O - \pi^T - 2\pi^P)$. For each value of γ , the left-hand side function of (9) has a greater slope than the corresponding curve for (6). The intersection of the dashed functions that determines γ^{bc} occurs to

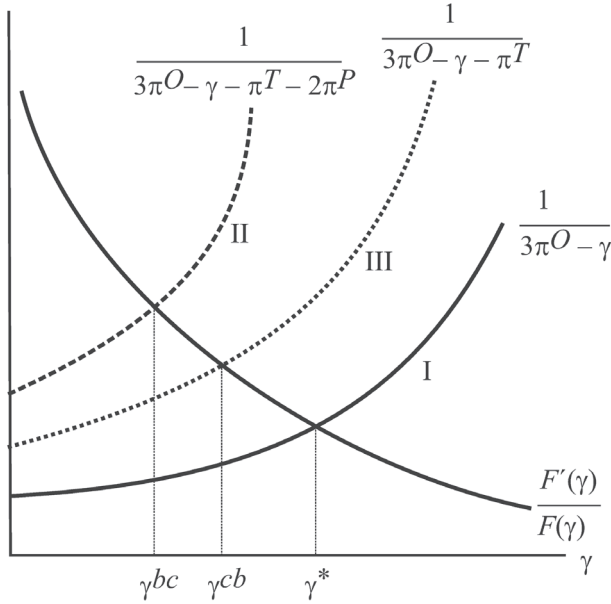


FIGURE 1 Comparison of equilibria

the left of the intersection of the solid functions.²¹ This implies a higher reversed hazard rate at the point of intersection, which in turn implies a smaller probability $F(\gamma^{bc})$ of reaching an agreement than in the case of multilateral negotiations.

The dotted line (III) illustrates the left-hand side of (12) for the sequential case with negotiations with C in stage 1. The intercept is $1/(3\pi^O - \pi^T)$, and we draw the case in which $\pi^T > 0$. The intersection of the dotted line with the hazard rate curve is above that for the multilateral case but below that of the sequential case with negotiations with C in stage 2.

3.5. The offer-maker's choice

We next ask whether, in terms of expected payoff, A prefers multilateral bargaining or sequential bargaining. The equilibrium payoffs for the three regimes are

$$\begin{aligned} \text{Multilateral} \quad w_A^* &= F(\gamma^*)(3\pi^O - \gamma^*) \\ \text{Sequential; first } B \quad w_A^{bc} &= F(\gamma^{bc})(3\pi^O - \gamma^{bc} - \pi^T) + (1 - F(\gamma^{bc}))2\pi^P \\ \text{Sequential; first } C \quad w_A^{cb} &= F(\gamma^{cb})(3\pi^O - \gamma^{cb} - \pi^T). \end{aligned}$$

21 For the diagram, we have implicitly assumed equilibria with positive political costs γ .

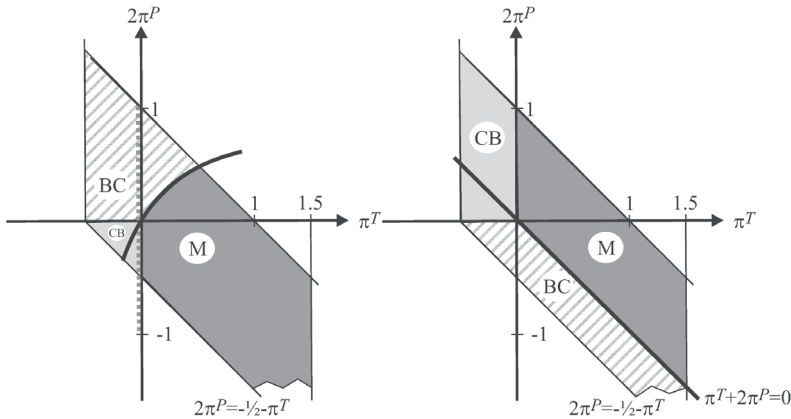


FIGURE 2 Strategies maximizing: (a) Player *C*'s expected payoff and (b) acceptance probabilities

The comparisons between *A*'s expected payoffs are not straightforward because the precise size of π^O , π^T and π^P and the shape of the cumulative distribution function matter. We solved for a parametric version with $3\pi^O = 1$ and γ uniformly distributed on the interval $[-0.5, 0.5]$. Inserting the equilibrium acceptance probabilities into *A*'s equilibrium payoff functions for the three negotiation routes, the comparison shows:²² the offer-maker *A* prefers multilateral negotiations to sequential ones if π^T is non-negative and $2\pi^P < -\frac{1}{2} - \pi^T + \sqrt{\frac{1}{4} + 4\pi^T}$. Sequential negotiations starting with *C* are chosen if $\pi^P < 0$ and $\pi^T < 0$, and in the remaining range, the offer-maker favours sequential negotiations starting with *B*. Figure 2(a) illustrates these outcomes, where the solid dark grey area is the one in which simultaneous offers (M) are chosen, the solid light grey area is the one in which a sequential offer is made to *C* first and the hatched area is the one in which an offer is made to *B* first.²³ Figure 2(b) illustrates the corresponding parameter ranges in which multilateral bargaining or one or the other of the sequential bargaining routes yield maximum acceptance probability. It is evident that the offer-maker's choice of the negotiation route is not always in line with the maximization of acceptance probabilities. Sequential negotiation may be preferred even though it leads to excessive negotiation failure.

²² The complete derivation of the results can be found in the online appendix.

²³ To ensure interior solutions, i.e., all acceptance probabilities being $F(\gamma) \in (0, 1)$, some parameter constraints apply: $\pi^T \in (-0.5, 1.5)$ and $\pi^T + 2\pi^P > -\frac{1}{2}$. Also the total payoff with partial cooperation cannot exceed the payoff from global coordination: $\pi^T + 2\pi^P < 1$.

4. Conclusions

We have analyzed whether multilateral or sequential negotiations provide the better route to global tax coordination, positing incomplete information as the reason that negotiations might fail. For this purpose, we used a tax-competition interpretation of the model by Aghion et al. (2007), which was originally designed to analyze free-trade negotiations with complete information. This re-interpretation of their model is perhaps interesting in its own right, but it is mainly the starting point for our focus of interest. It yields an efficiency benchmark for analyzing the implications of incomplete information for efficiency and rent distribution for different routes of sequential bargaining.

Multilateral bargaining may achieve globally efficient tax coordination with a higher or a lower probability than sequential bargaining. Furthermore, comparing different sequencing options, the probability of reaching a global agreement is higher when negotiations start with the candidate country that exhibits more uncertainty with respect to the costs of an agreement. The offer-making country, which wants to maximize own expected rents, will prefer multilateral negotiations over sequential bargaining where offers must be made to the less transparent country first. We cannot rule out that the offer-making country does not choose sequential negotiations with the transparent country receiving the last offer. This negotiation procedure has the lowest success probability but may nevertheless maximize the offer-making country's expected rent.

Ultimatum offers provide a simple but formally tractable framework for analyzing international negotiations, and this approach follows the tradition begun by Aghion et al. (2007). A natural complement is to move away from their convenient but narrow assumptions about the bargaining protocol, pre-specified negotiation routes, the binding nature of contracts, and so forth. An example is Caparrós and Péreau (2017), who employ a variant of the Rubinstein alternating-offer game to allow for an endogenous bargaining power of countries that is driven by externalities. In a complete information context, they show that the leader may prefer sequential negotiations because this might be the only way to reach a stable global agreement in this setting.²⁴

There is a large variety of plausible models for describing negotiations between countries and for comparing multilateral and sequential negotiation strategies. The questions we addressed are relevant in many of these other frameworks of endogenous coalition formation. Our results on the effects of incomplete information are supported by a strong intuition. One can therefore expect the results to be robust and qualitatively similar results to emerge in other models describing international negotiations.

²⁴ Caparrós and Péreau (2017) also extend the game to include more than three players and analyze the internal stability of agreements.

Supporting information

Supplementary material accompanies the online version of this article.

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