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## Three essays in public economics: fiscal decentralization, coordination and secessions

Tjaša Bjedov

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UNIVERSITÉ DE FRIBOURG - FACULTÉ DES SCIENCES ECONOMIQUES ET  
SOCIALES

UNIVERSITÉ LUMIÈRE LYON 2 - ECOLE DOCTORALE SCIENCES ECONOMIQUES  
ET GESTION

Groupe d'Analyse et de Théorie Economique

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THREE ESSAYS IN PUBLIC ECONOMICS: FISCAL  
DECENTRALIZATION, COORDINATION AND  
SECESSIONS

Thèse de Doctorat (NR)

*Présentée et soutenue publiquement par*

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# *Introduction générale*

Cette thèse de doctorat s'inscrit dans le domaine des finances publiques et des choix publics. Elle s'articule autour des notions de polarisation idéologique, de décentralisation et de conflit. Ce triptyque est au cœur de nombreux grands débats qui transcendent les frontières nationales. Le niveau de polarisation idéologique s'est, par exemple, particulièrement accru ces dernières années au Congrès des États-Unis. Ceci a conduit à une augmentation des conflits entre le Parti Démocrate et le Parti Républicain comme le montrent Layman et al. (2006) et McCarty et al. (2006). Cette source de conflit est aussi prégnante en Europe avec la montée de partis nationalistes qui dépassent les clivages politiques traditionnels. L'Union démocratique du centre (UDC) en est un bon exemple en Suisse. Les effets de la polarisation idéologique ont fait l'objet d'une littérature importante au niveau des pouvoirs exécutifs et législatifs nationaux. Moins d'études, en revanche, se sont intéressées aux effets de la polarisation idéologique sur les choix fiscaux et budgétaires des échelons de gouvernement infranationaux. Nous contribuons à cette littérature en étudiant les effets de la polarisation idéologique à l'intérieur des partis politiques sur les dépenses publiques cantonales. Les pays de l'OCDE, comme les pays en voie de développement, ont connu une vague de décentralisation sans précédent au cours de ces dernières années qui font qu'une part croissante des recettes fiscales et des dépenses publiques a été dévolue aux échelons infranationaux (OECD 2014). Cette vague de décentralisation a plusieurs origines que la théorie du fédéralisme financier a bien cernées depuis les travaux précurseurs de Oates (1972). Les raisons de la décentralisation peuvent aussi être d'ordres politique et identitaire: la croyance que la décentralisation constituerait un moyen efficace de lutter contre les velléités sécessionnistes de certaines régions. Cette question n'est pas tranchée et nous essayons de contribuer à cette réflexion (Lustick et al. 2004; Guibernau 2006; Miodownik et Cartrite 2009; Flamand 2011).

Les trois essais qui sont présentés dans cette thèse de doctorat s'intéressent successivement à ces trois notions et les abordent de façon indépendante. Le premier essai s'intéresse aux déterminants politiques des choix budgétaires. L'accent est mis sur l'effet de la polarisation idéologique entre partis politiques mais aussi à l'intérieur des partis politiques sur le niveau et la composition des dépenses publiques cantonales. L'analyse empirique est menée au niveau des parlements cantonaux suisses et repose sur l'exploitation et le traitement économétrique d'une base de données très riche. L'originalité de ce premier essai est de montrer que la dispersion idéologique *entre* partis politiques a un effet sur les dépenses publiques cantonales opposé à celui de la dispersion idéologique *à l'intérieur* des partis politiques. En particulier, la dispersion idéologique à l'intérieur des partis augmente les dépenses publiques alors que la dispersion idéologique entre les partis politiques les diminue. Ceci prouve qu'en plus des frontières entre partis politiques, il convient d'intégrer, dans l'étude des déter-

minants politiques des choix fiscaux et budgétaires, la fragmentation idéologique qui existe au sein des partis politiques. Les deux essais suivants utilisent l'économie expérimentale. Le deuxième essai s'intéresse à la question du conflit d'objectifs qui peut exister entre agents économiques dans le cadre d'un jeu de coordination en deux étapes avec paiements asymétriques. Il apparaît que les sujets résolvent ce conflit d'objectifs grâce à l'adoption de stratégies coordonnées de type *take turn*, en particulier quand la communication entre sujets est autorisée. Le protocole expérimental reproduit certaines caractéristiques de situations économiques réelles autorisant ainsi des applications au domaine des finances publiques. Finalement, le troisième essai s'intéresse à un type de conflit particulier : la sécession politique. Plus précisément il traite du lien entre sécession, décentralisation et identité de groupe. Dans ce dernier chapitre nous essayons de déterminer si décentraliser l'offre de biens publics permet de réduire la probabilité pour un groupe de faire sécession. Nous mettons en exergue l'importance de l'identité au niveau local. Le protocole expérimental ne permet évidemment pas de reproduire l'ensemble des arbitrages auxquels les mouvements séparatistes font face. Il permet, néanmoins, de capturer au moins deux forces essentielles qui les affectent. La première est la décentralisation de la fourniture des biens publics qui à la fois rapproche l'offre des biens publics des préférences des citoyens et réduit les phénomènes de passagers clandestins, avec pour conséquence, une diminution de la probabilité pour un groupe de faire sécession. La deuxième est l'importance de l'identité qui elle, au contraire, avive les mouvements séparatistes.

Le premier essai analyse l'impact de la dispersion idéologique entre partis et à l'intérieur des partis politiques sur le niveau et la composition des dépenses publiques locales. L'analyse a été appliquée aux parlements cantonaux suisses. La Suisse est un terrain de recherche stimulant car elle est considérée comme un laboratoire politique du fait de sa diversité culturelle, linguistique et religieuse. De plus, il existe une fragmentation politique et idéologique différente au sein des vingt-six parlements cantonaux qui disposent d'une grande autonomie financière et budgétaire. Pour construire la variable de dispersion idéologique nous utilisons les données d'une enquête (*Smartvote*) qui quantifie les préférences des membres de tous les partis politiques qui ont été candidats aux élections fédérales et qui permet, ainsi, d'obtenir un score idéologique pour chaque candidat. Nous commençons par calculer la variance totale des scores idéologiques de ces candidats que nous séparons ensuite en ses deux composantes pour définir la dispersion entre partis et à l'intérieur des partis. Pour trouver la variance à l'intérieur des partis, nous calculons, d'abord, la variance des scores idéologiques des membres au sein de chaque parti (variance intra-partis). Ensuite, nous définissons la dispersion idéologique à l'intérieur des partis comme étant la moyenne de ces écarts. Pour déterminer la dispersion idéologique entre les partis, nous calculons la variance de la moyenne des scores idéologiques des parties (variance inter-partis).

De nombreux auteurs ont étudié la relation entre la fragmentation politique et la politique budgétaire, à commencer par Roubini et Sachs (1989) qui montrent que les gouvernements constitués de coalitions ont tendance à dépenser plus que les gouvernements dirigés par un parti majoritaire unique. Ils expliquent leurs résultats en utilisant l'argument du *common pool* proposé par Weingast et al. (1981) dont le raisonnement est le suivant. Un parti politique s'occupera, principalement ou exclusivement, de projets publics qui bénéficieront à son électorat alors que les coûts de ces projets sont universels et supportés par tous les citoyens d'un pays. Pour

augmenter les chances d’approbation de l’un de ses projets, un parti politique peut consentir, en échange, à soutenir le projet d’un parti concurrent. Il en résulte un nombre trop élevé (par rapport à l’optimum) de projets publics et naturellement une augmentation des dépenses publiques. Par conséquent, un gouvernement composé de plusieurs partis politiques, s’efforçant de satisfaire les attentes de différents groupes électoraux, aura tendance à dépenser plus qu’un gouvernement dirigé par un seul parti politique.

Toutefois, la littérature sur l’impact de la fragmentation politique sur les dépenses publiques suppose que les partis politiques sont des entités monolithiques et fait généralement abstraction des différences d’idéologie entre membres d’un même parti. La contribution essentielle faite dans ce premier essai est de remettre en cause cette hypothèse et d’analyser les effets sur les dépenses publiques de la dispersion idéologique en plus de la fragmentation politique, à la fois à l’intérieur et entre partis politiques.

À notre connaissance, dans la littérature sur l’impact de la fragmentation politique sur les dépenses publiques, il n’existe pas de travaux ayant étudié les effets de la dispersion idéologique à l’intérieur des partis politiques sur les choix budgétaires et fiscaux. Pour remédier à ce manquement, nous avons construit une base de données originale au niveau cantonal qui inclut la dispersion idéologique des parlementaires cantonaux entre et au sein des partis politiques. Nos données proviennent de l’Office Fédéral Suisse de la statistique et couvrent la période allant de 2003 à 2010. Pour construire la variable de dispersion idéologique nous utilisons les données d’une enquête menée auprès des politiciens suisses, *Smartvote*. *Smartvote* est une plate-forme d’aide au vote en ligne destinée aux électeurs suisses. Avant l’élection, l’équipe de *Smartvote* demande aux candidats électoraux de répondre à des questionnaires couvrant différents sujets d’intérêt politique. Les profils politiques des candidats sont générés à partir de leurs réponses à ces questionnaires. *Smartvote* construit également un diagramme de dispersion appelé *SmartMap* qui place chaque candidat sur deux axes. L’abscisse représente la dimension habituelle gauche-droite et l’ordonnée l’échelle conservateur-libéral. La *SmartMap* affiche les positions relatives des candidats et facilite ainsi les comparaisons entre les partis et les candidats. Dans notre étude, nous utilisons ces coordonnées pour déterminer les profils politiques des candidats aux deux chambres du Parlement fédéral. Les candidats sont, cependant, désagrégés par canton et parti. Il en résulte que pour chaque parti, dans chaque canton, nous obtenons à la fois un score pour l’idéologie moyenne du parti et pour la dispersion idéologique au sein du parti. Pour chaque année d’élection, nous calculons ensuite la variance totale de l’idéologie, ainsi que la décomposition de cette variance. La variance intra-partis est définie comme la moyenne des variances de la position idéologique au sein des partis, pondérée par le nombre de sièges occupés par chaque parti au parlement cantonal. La variance inter-partis est définie comme la variance de la position idéologique moyenne des partis, également pondérée par le nombre de sièges occupés par chaque parti au parlement cantonal. La position d’un parti politique est calculée comme la moyenne des profils de ses membres.

Nos variables dépendantes sont les dépenses publiques cantonales totales par habitant et en pourcentage du PIB cantonal total. Nous estimons également le modèle en utilisant les dépenses publiques désagrégés selon qu’elles soient d’investissement ou de fonctionnement. Nous incluons dans nos estimations les variables de contrôle

économiques et politiques suivantes. Pour tenir compte du processus de prise de décision politique, nous incluons le nombre de sièges occupés par chaque parti au sein des parlements cantonaux car la littérature démontre qu'il existe une corrélation positive entre le nombre de sièges occupés et la fragmentation politique. Pour capter le fait que les gouvernements peuvent manipuler les dépenses au cours des cycles électoraux, nous incluons une variable muette pour les années d'élection. Enfin, nous contrôlons pour l'idéologie des partis au sein de la coalition qui gouverne en incluant la moyenne des positions idéologiques de ces partis.

Pour contrôler le contexte économique, nous incluons la dette publique nette par habitant de l'année précédente. Nous nous attendons à ce qu'elle affecte négativement les dépenses publiques dans l'année qui suit. Nous contrôlons aussi pour le PIB par habitant, le pourcentage de population dépendante (car la littérature démontre que cette variable augmente les dépenses publiques). Enfin, nous incluons le taux de chômage pour la période considérée (lequel devrait augmenter les dépenses publiques).

En plus du contexte politique et économique, nous prenons aussi en compte certaines caractéristiques institutionnelles spécifiques à la Suisse telles que le degré de décentralisation budgétaire dans le canton, en incluant les dépenses communales rapportées à la somme des dépenses communales et cantonales, ainsi que la fragmentation territoriale que nous calculons en divisant le nombre de communes par la population cantonale.

Nous estimons différents modèles en utilisant des effets fixes sur notre panel de vingt cantons sur huit ans. Le résultat principal est que la dispersion idéologique à l'intérieur des partis politiques augmente les dépenses publiques, alors que la dispersion idéologique entre partis politiques les diminue. En outre, nous trouvons que ces résultats sont plus forts pour les dépenses de fonctionnement que pour les dépenses d'investissement.

Nos résultats indiquent que la dispersion idéologique et la politique à l'intérieur des partis sont des facteurs importants d'explication des dépenses publiques. Ce résultat est d'autant plus important que la littérature à ce sujet fait abstraction de la dispersion idéologique. Par conséquent, il est important pour la compréhension des processus de création des budgets publics dans les gouvernements et parlements de considérer les partis politiques comme étant, en soi, des unités fragmentées. Nos résultats impliquent que les frontières idéologiques et partisanes existent non seulement entre les partis politiques mais également à l'intérieur de ces derniers et qu'elles affectent le niveau des dépenses publiques.

L'originalité du deuxième et du troisième essai est le recours à l'économie expérimentale. Les données expérimentales générées en laboratoire sont particulièrement utilisées quand on ne dispose pas de données statistiques issues d'enquêtes de bonne qualité. Il s'agit de reproduire dans un environnement contrôlé une situation économique stylisée au sein d'un modèle théorique. Les sujets sont invités à prendre une série de décisions selon un protocole défini et ils sont rémunérés en fonction de leurs décisions. Toutes les décisions sont prises de manière anonyme. L'économie expérimentale permet, en particulier, de mesurer l'effet propre d'un changement exogène (un changement de règle, de politique ou d'environnement) sur les choix économiques, toutes choses égales par ailleurs (Falk et Heckman 2009).

Le deuxième essai s'intéresse aux problèmes de coordination qui sont fréquents dans les organisations et qui conduisent à des pertes d'efficacité indéniables. Plusieurs études ont montré que la communication peut atténuer les défaillances de coordination, à la fois lorsque les intérêts des joueurs sont alignés (Cooper et al. 1992; Crawford 1998; Blume et Ortmann 2007) et quand ils ne le sont pas (Cooper et al. 1989; Dickhaut et al. 1995; Duffy et Feltovich 2002; Duffy et Hopkins 2005; Cason et Mui 2014). En particulier, avoir des gains asymétriques génère habituellement un conflit entre deux joueurs car ces derniers ont une incitation à sélectionner l'option qui maximise leurs propres paiements. Pour résoudre le conflit, un joueur doit se montrer conciliant et accepter de jouer l'option qui conduit à une récompense inférieure. Une illustration typique de ce type de jeux est le modèle de différenciation verticale formalisé par Gabszewicz et Thisse (1979) et Shaked et Sutton (1982) dans lequel les entreprises peuvent éviter des guerres de prix dans la deuxième étape du jeu en offrant des biens ayant des niveaux de qualité différente dans la première étape. Un autre exemple peut être donné par le modèle de concurrence fiscale où les régions décident d'abord du montant d'investissement dans les infrastructures pour attirer les entreprises et, ensuite, choisissent leurs taux d'imposition. Dans cette situation, si les deux régions sont incapables de se différencier en termes de qualité des infrastructures dans la première étape, les régions entrent dans une course à la baisse des taux d'imposition dans la deuxième étape pour attirer des entreprises avec pour conséquence des effets négatifs sur les finances publiques (Justman et al. 2005).

La stratégie de coordination de type *take turn* (alternance régulière des options les plus rémunératrices sur le plan individuel) est utilisée pour résoudre ce type de problème de coordination dans les jeux répétés (Bornstein et al. 1997; Bhaskar 2000; Helbing et al. 2005; Lau et Mui 2008, 2012; Kaplan et Ruffle 2012; Bruttel et Guth 2013; Cason et al. 2013). Cette stratégie permet en effet de promouvoir l'efficacité tout en réduisant les inégalités dans le long terme. La communication peut aussi s'avérer utile pour aider à surmonter ce type de conflits. La littérature ne recense, cependant, que quelques articles où la communication et la stratégie du *take turn* sont étudiées simultanément (Zillante 2011; Leibbrandt et Sääksvuori 2012; Evans et al. 2013). Pourtant, la communication peut aider les joueurs à apprendre cette stratégie plus rapidement et de décider qui devrait en premier prendre l'avantage. En outre, la littérature sur les échecs de coordination a principalement considéré les jeux en une étape. La question qui se pose alors est de savoir si la communication et la stratégie du *take turn* sont aussi efficaces quand un jeu est en deux étapes?

L'objectif de ce deuxième essai consiste à étudier, au moyen d'une expérience de laboratoire, les effets de la communication et l'émergence du *take turn* dans un jeu de coordination en deux étapes dont les gains sont asymétriques, répété un nombre fini de fois. Pour reproduire ce type de situations stratégiques, dans la première étape de notre jeu, deux joueurs doivent choisir indépendamment et simultanément entre deux options, sachant que leurs décisions détermineront les options qui seront disponibles dans la deuxième étape et, de ce fait, les gains réalisables. Dans la deuxième étape, après avoir été informé sur le choix de l'autre joueur dans la première étape, les joueurs doivent choisir indépendamment et simultanément entre deux nouvelles options. Les gains sont déterminés et distribués aux joueurs seulement à la fin de la deuxième étape. Le jeu a deux équilibres parfaits en sous-jeux. Si les deux joueurs choisissent dans la première étape l'option qui maximise leurs paiements sans



tenir compte du gain de leur partenaire, ils auront à choisir dans la deuxième étape entre deux options conduisant à des gains asymétriques mais qui, dans tous les cas, leur rapporteront moins que s'ils s'étaient différenciés dans leur choix à la première étape. A l'inverse, la coordination - correspondant à l'optimum social - est atteinte lorsque les deux joueurs choisissent des options opposées à chaque étape. Dans notre contexte, cela conduit alors un joueur à gagner plus que l'autre au cours des deux étapes du jeu.

Le design expérimental présenté dans le deuxième essai implique des couples fixes de deux joueurs qui interagissent de façon répétée pendant 20 périodes. Il vise à vérifier si les joueurs apprennent à se coordonner sur les choix opposés dans les deux étapes en utilisant des stratégies qui permettent d'éviter une confrontation frontale. En particulier, nous examinons avec quelle fréquence les partenaires adoptent une stratégie de *take turn*.

Nous émettons l'hypothèse que la communication peut faciliter l'utilisation de la stratégie dite de *take turn* dans notre jeu. Pour tester cette hypothèse, nous introduisons la communication (Farrel et Rabin 1996) dans certains traitements de deux manières différentes. Dans un traitement la communication est bidirectionnelle: les deux membres d'un même couple peuvent envoyer et recevoir des messages écrits grâce à une boîte de dialogue au début de chaque période. Dans le dernier traitement, seulement un des deux joueurs est autorisé à envoyer des messages à l'autre joueur. Le droit d'envoyer des messages est déterminé par la performance relative de chaque joueur dans une tâche préliminaire. Doter un seul joueur du droit de communiquer vise à tester si ce joueur profite de son statut plus élevé pour augmenter ses revendications et si cela amène à modifier la fréquence de l'alternance entre les périodes.

Nous obtenons les trois principaux résultats suivants. Tout d'abord, en l'absence de communication près de la moitié seulement des couples sélectionnent simultanément les options identiques aux deux étapes du jeu. Ils ne réussissent par conséquent pas à résoudre le conflit. Notre deuxième constatation est que seulement 18% des groupes utilisent la stratégie du *take turn*. Le troisième résultat est que l'introduction de la communication bidirectionnelle fait passer le nombre de couples qui réussissent à résoudre le conflit à 91% en leur permettant de mettre en œuvre immédiatement une stratégie de *take turn* systématique et durable. Parmi ces couples, 86% des groupes ont joué l'optimum social. Enfin, doter un seul joueur du droit d'envoyer des messages n'affecte ni la probabilité de se coordonner sur le résultat socialement optimal, ni la fréquence de l'alternance à prendre son tour par rapport à la double communication. En effet, dans ce traitement l'optimum social est joué dans 87% des cas et 77% des groupes utilisent la stratégie de *take turn*.

Dans l'ensemble, nous montrons dans ce deuxième essai que dans des situations complexes de coordination à deux étapes où l'inégalité est inévitable, la communication atténue les conflits et accroît l'efficacité, pour autant que les positions relatives puissent être échangées de manière équitable.

Le troisième et dernier essai cherche à identifier si, donner davantage d'autonomie à des collectivités publiques dotées d'une identité culturelle, augmente ou réduit le risque de sécession par rapport à la situation d'un État unitaire. La problématique du dernier essai s'inspire des événements marquants qui se sont produits au cours

des dernières décennies. Depuis 1990, un grand nombre de nouveaux États souverains a été créé par des sécessions, la décolonisation et le démantèlement de pays existants. Spolaore (2008) cite, parmi d'autres, les exemples de l'Union soviétique qui a été divisée en quinze pays indépendants, de la Yougoslavie qui a donné lieu à six États souverains, ou encore de la Tchécoslovaquie qui a éclaté en deux États distincts. Depuis 1945, le nombre d'États souverains dans le monde internationalement reconnu est passé 74 à 193 (Spolaore 2008). Plus récemment, l'Écosse et la Catalogne se prononçaient sur leur indépendance alors qu'en Belgique les menaces de sécession de la Flandre ont été faites à plusieurs reprises ces dernières années. Parallèlement, à ces tendances indépendantistes, les pays de l'OCDE, comme les pays en voie de développement, ont connu une vague de décentralisation. L'OCDE compte aujourd'hui 140'000 gouvernements infranationaux que la tendance à la décentralisation des vingt dernières années a rendus plus puissants et plus susceptibles d'influer sur le cours d'un pays. La question se pose alors des moyens existants pour endiguer ces mouvements et plus particulièrement si la décentralisation et le fédéralisme réduisent les incitations pour un groupe de faire sécession?

Lorsque les gouvernements centraux sont confrontés à une menace sécessionniste dans une ou plusieurs régions, ils ont la possibilité de décentraliser une partie de leur pouvoir ou de leurs compétences à l'entité régionale de façon à apaiser le mouvement séparatiste (comme discuté par exemple dans Sorens 2004; Lustick et Miodownik 2004; Bakke et Wibbels 2006; Miodownik et Cartrite 2009; Flamand 2011). Toutefois, l'octroi à une région d'une plus grande indépendance peut avoir deux effets opposés. D'une part, une plus grande indépendance rapproche la fourniture de biens publics des préférences des individus vivant dans leurs régions respectives et donc augmente leur bien-être. D'autre part, la création de collectivités autonomes ou décentralisées est susceptible de contribuer à la sécession en donnant aux groupes sécessionnistes les ressources politiques nécessaires pour se mobiliser et engager des luttes séparatistes (Lustick, Miodownik et Eidelson 2004). Par conséquent, octroyer une partie du pouvoir d'auto-administration à des niveaux inférieurs de gouvernement est une épée à double tranchant. La littérature théorique répertorie de nombreuses forces jouant sur l'arbitrage entre faire sécession et rester partie prenante du pays. Parmi ces forces, figurent le degré de proximité entre les préférences des citoyens et la fourniture de biens publics, l'importance des économies d'échelle dans l'offre de biens publics, les différences de répartition du revenu entre régions, la présence de ressources naturelles dans une région donnée, mais aussi des raisons socioculturelles telles que les différences entre groupes ethniques ou la langue (Alesina et Spolaore 1997; Bolton et Roland 1997). Par conséquent, compte tenu de la multitude de facteurs en jeu, les mouvements sécessionnistes sont difficiles à analyser.

Ce troisième essai vise à étudier le phénomène de sécession. Plus particulièrement, nous examinons les effets (1) d'une offre décentralisée de biens publics et (2) de l'identité des groupes locaux sur la probabilité de réalisation de cet événement. A cet effet, nous testons un protocole expérimental en laboratoire. Nous commençons par émettre l'hypothèse que les mouvements séparatistes peuvent être considérés comme un exemple de dilemme social. Un dilemme social apparaît dès lors que les personnes doivent choisir entre faire ce qui est dans leur propre intérêt et ce qui est le meilleur pour l'intérêt du groupe dans son ensemble. Mais au final, la recherche rationnelle de l'intérêt individuel aboutit toujours à un résultat qui n'est bénéfique pour personne. Dans notre protocole nous définissons la sécession comme étant le

résultat d'un vote majoritaire au sein des trois groupes locaux, formant ensemble le grand groupe global, en faveur d'une fourniture de biens publics uniquement locale. La conséquence concrète de ce vote est un démantèlement du groupe global et la perte des biens publics fournis au niveau global. Les individus prennent cette décision en ayant connaissance que les biens publics locaux sont individuellement plus profitables alors que les biens publics globaux sont collectivement plus avantageux. Ainsi, notre raisonnement est construit sur la supposition que le choix d'un groupe local de faire sécession du groupe global est moins bénéfique pour le groupe global dans son ensemble. Une décision en ce sens répond à l'intérêt individuel mais elle est néfaste pour la prospérité de la collectivité dans son ensemble.

Dans le but d'appréhender ce dilemme social, nous construisons une expérience basée sur un jeu de biens publics et le mécanisme de contribution volontaire (VCM) (Isaac et Walker 1988) avec trois biens publics fournis à deux niveaux différents: au niveau local et au niveau global. Dans notre protocole expérimental trois groupes locaux, constitués de trois membres chacun, forment ensemble le groupe global composé des neuf membres. Seuls les membres d'un groupe local peuvent contribuer aux biens publics locaux alors que tous les membres du groupe global peuvent contribuer aux biens publics globaux. Ainsi, chaque membre interagit à la fois avec les deux autres membres de son groupe local et avec les huit autres membres du groupe global. Les biens publics fournis au niveau local ont un rendement marginal par personne plus élevé que celui des biens publics fournis au niveau global. En revanche, comme neuf personnes ont la possibilité de contribuer aux biens publics globaux, ces derniers possèdent un rendement potentiel par personne plus élevé que les biens publics locaux. Nous appliquons trois traitements différents correspondant à trois contextes sociopolitiques différents. Chaque traitement comprend trois parties de 12 périodes chacune. Dans la première partie du traitement de base, les individus décident, simultanément, combien de leur dotation initiale ils souhaitent contribuer à un compte public local et deux comptes publics globaux. Dans la deuxième partie, les participants sont confrontés au même schéma de décisions avec pour différence que tous les comptes publics sont des comptes locaux. Au début de la troisième partie, les individus sont appelés à choisir entre la configuration de la partie 1 ou celle de la partie 2 en votant pour la configuration qu'ils préfèrent. La conséquence de ce vote sera l'imposition à tous, pour les 12 périodes suivantes, de la configuration qui aura obtenu la majorité. Si la majorité vote en faveur de la configuration composée de trois biens publics locaux, nous interprétons ce résultat comme étant une indication de forte préférence pour le niveau local et de souhait de sécession avec pour conséquence un démantèlement du groupe global.

Pour étudier les effets de la décentralisation de la fourniture de biens publics sur la décision de faire sécession nous construisons un deuxième traitement qui vise à reproduire une fourniture de biens publics davantage décentralisée. Le traitement Décentralisation est construit comme le traitement de base. Nous modifions, cependant, la proportion des catégories de biens publics disponibles: le nombre de comptes publics locaux est augmenté alors que le nombre de comptes publics globaux est diminué. Comme dans le traitement de référence, les individus doivent simultanément décider leur contribution à deux comptes publics locaux et un compte public global. Les traitements Identité, appliqués aux traitements de base et Décentralisation, diffèrent des deux traitements précédents en cela que l'identité des groupes locaux est renforcée. Pour réaliser cela, nous ne formons pas les groupes locaux de

manière aléatoire comme ils l'étaient dans les deux traitements précédents mais à l'aide d'un questionnaire. Avant le début de la première partie, les participants sont invités à répondre à un questionnaire composé de quatre affirmations permettant d'identifier leurs opinions. Grâce à un algorithme, les groupes locaux sont constitués sur la base de la proximité des réponses qu'ils ont données au questionnaire. Ainsi, chaque groupe local est formé de participants qui partagent les croyances les plus proches. Les participants en sont informés.

Ce protocole expérimental nous permet d'étudier à la fois les effets du niveau de décentralisation de la fourniture de biens publics et de l'identité sur les niveaux de contributions et sur la probabilité que la majorité vote en faveur de la sécession.

Ce troisième essai aboutit à deux résultats principaux. Premièrement, la décentralisation augmente les contributions aux biens publics locaux aux dépens du bien public global, alors que l'identité n'affecte pas de manière significative le niveau des contributions individuelles pour aucun des deux biens. Deuxièmement, en ce qui concerne le résultat de vote, nos résultats indiquent que la décentralisation diminue la probabilité d'un éclatement du groupe global aussi lorsque l'identité locale est rendue plus saillante. En fait, une forte identité locale augmente la probabilité de sécession seulement lorsque les membres des groupes locaux sont des coopérateurs et qu'ils contribuent aux biens publics locaux.

Les résultats des tests menés en laboratoire de notre protocole expérimental indiquent que décentraliser la fourniture de biens publics permet d'endiguer les mouvements sécessionnistes. La décentralisation permet de rapprocher l'offre de biens publics des préférences des citoyens et permet ainsi de respecter et d'intégrer l'hétérogénéité des différents groupes locaux qui ensemble forment un pays unitaire. De surcroît, la proximité entre les contribuables permet une surveillance qui réduit les phénomènes de passagers clandestins néfastes à la provision de biens publics. Ceci est bénéfique pour la collectivité dans son ensemble car l'unité permet de conserver les biens publics fournis au niveau global qui disparaîtraient dans le cas contraire. Nos résultats indiquent également que l'identité des collectivités est un facteur déterminant dont il faut impérativement tenir compte. Dans notre protocole expérimental, rendre l'identité locale plus forte n'a pas abouti à une modification des contributions individuelles. Elle a, par contre, encouragé, lorsque les membres des groupes locaux étaient des coopérateurs, le vote pour les biens publics locaux. Ceci suggère que même si elle n'a pas d'impact concret sur le niveau de fourniture de biens publics, une identité locale forte renforce l'attraction pour le niveau local, voire peut conduire à déclencher des mouvements séparatistes.

# Chapter 1

## *Effects of within and between-party ideological dispersion on fiscal outcomes: Evidence from swiss cantonal parliaments<sup>1</sup>*

### 1.1. Introduction

The impact of the fragmentation of executive and legislative bodies on the level and composition of government expenditure is a feature of politics that has attracted considerable attention from economists (Roubini and Sachs 1989 ; Kontopoulos and Perotti 1999; Freier and Odendahl 2012). Political fragmentation is present in all democratic countries, albeit to varying degrees. In most countries of continental Europe, where coalition governments are the norm, political fragmentation manifests itself in a large number of political parties both at the executive and legislative levels (Müller and Strøm 2003). Ceron (2011) also reports, relying on case studies in at least 38 countries, that intra-party divisions and factions are an important part of the political lives of these countries. For its part, the European Parliament is becoming more fragmented owing to the enlargement of the Union. Indeed, the number of parties represented increased from 51 in 1979 to over 170 at the end of the first decade of the 2000s (Hix, Noury and Roland 2009). We also recently observed explicit political fragmentation in parliaments of Westminster tradition, which are usually characterized by single party majorities. For example, in 2010, the United Kingdom saw its first formal coalition government since 1945.<sup>2</sup> At the end of the first decade of the 2000s, Canada and Australia were governed by minority governments, in which the single governing party did not hold a majority of the seats.<sup>3</sup> To stay in power, the largest parties in these three parliaments have had to

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<sup>1</sup>Bjedov. T., Lapointe. S. and Madiès T., 2014, “The impact of within-party and between-party ideological dispersion on fiscal outcomes: evidence from Swiss cantonal parliaments,” *Public Choice*, vol. 161(1), pages 209-232. **Acknowledgments** The authors would like to thank Julien Fiechter for access to data from Smartvote surveys, Mark Schelker for Swiss institutional data, as well as participants at the Sinergia seminar in St. Gallen, at a seminar at the University of Fribourg, three anonymous referees, Roger Couture, and the editor for helpful comments.

<sup>2</sup>Short-lived minority governments and pacts occurred between 1974 and 1978 and in 1997 (Maer 2010).

<sup>3</sup>Australia had its first minority government in over 70 years in 2010, when the Labor Party and the coalition led by the Liberals both failed to capture a majority of seats (Horne 2010). However, minority and coalition governments are more common in Australian sub-national jurisdictions. For its part, Canada was led by minority governments from 2004 to 2011 (the Parliament of Canada’s website has details on the length of all minority governments in Canadian history: <http://www.parl.gc.ca/Parlinfo/compilations/parliament/DurationMinorityGovernment.aspx>). Hung parliaments are more common in Canada than in

bargain with other parties.

Numerous authors have studied the relation between political fragmentation and fiscal outcomes. An early example is the paper by Roubini and Sachs (1989), which shows that coalition governments tend to spend more than single-party majorities, relying on the common-pool argument suggested by Weingast, Shepsle and Johnson (1981). Other more recent papers, reviewed below, confirm that more fragmentation is associated with more public spending or larger public deficits.

However, these papers all assume that political parties are monolithic entities, and most abstract completely from ideology. In this paper, we relax those two assumptions, and analyze the effect of both within-party and between-party ideological dispersion on fiscal outcomes. The existing literature reveals that intra-party politics may affect policy outcomes. For example, Ceron (2011) shows that the existence of factions within parties will force parties to mobilize resources to satisfy these factions, such that it affects inter-party coalition negotiations, and thus fiscal outcomes. To our knowledge, the concept of intra-party politics is not addressed in the current literature on political fragmentation. In practical terms, we decompose the total variance in ideological scores for individual candidates running in Swiss elections into two components. First, to find intra-party variance, we calculate the variance of members' ideological scores within each party. Then, we define intra-party ideological dispersion as the mean of these variances. Second, we define inter-party variance as the variance of the parties' average ideological positions. We do so by compiling an original database at the sub-national (cantonal) level using data from a survey (Smartvote) quantifying the preferences of individual party members that were electoral candidates.

Our main contribution is to show that both intra-party and inter-party ideological dispersion are factors that are significant in determining fiscal outcomes. In particular, we find that intra-party ideological dispersion increases public spending, while inter-party ideological dispersion decreases it. We also find that these results are stronger for current expenditures than for investment expenditures.

Our econometric results are discussed in greater detail in Section 1.6. Before turning to this discussion, however, Section 1.2 reviews important contributions to the literature on political fragmentation, while Section 1.3 reviews contributions related to intra-party politics and ideological dispersion. This latter section also provides the basis for the theoretical argument underlining our empirical findings. Section 1.4 highlights features of the Swiss political system that are particularly relevant to the topic at hand. Then, Section 1.5 describes the data sources and the methodology used to estimate ideological dispersion. Conclusions are given in Section 1.7.

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Australia, although this seven-year-long string of minority governments was a first. Before that, a minority government ruled for six months in 1979.

## 1.2. The effects of fragmentation and coalition governments on fiscal outcomes

Social scientists have long shown interest in the relationship between the characteristics of political entities such as parliaments and governments around the world and the corresponding fiscal outcomes. For example, Alesina and Tabellini (1990) consider policymakers with different preferences that alternate in office, and use government debt as a strategic tool to influence the decisions of their successors. Persson and Svensson (1989) consider a related model in which, due to time-inconsistent preferences, a conservative government may borrow more when it knows the next government will be expansionary. This section will review some contributions related to the ideological position of governments (i.e., left-wing versus right-wing governments), the type of government (coalitions versus majorities), as well as the fragmentation of the executive and legislative branches (i.e., the number of parties represented).

One could suspect that the spending patterns of right-wing and left-wing governments will differ. Empirically, Roubini and Sachs (1989) show that leftist governments tend to spend more in OECD countries. Mulas-Granados (2003), for his part, finds that ideology is the strongest predictor of the fiscal policy stances of European governments, and that left-wing governments on that continent are less likely to cut public investment and employment. Tavares (2004: 2447), using a panel of large fiscal adjustments in OECD countries, finds that “the left tends to reduce the deficit by raising tax revenues while the right relies mostly on spending cuts.” Rudolph and Evans (2005) argue that conservative governments bear heavier ideological costs when increasing public spending, such that conservatives will have to rely to a greater degree on trust between them and their constituents. They show, using a US dataset, that “[t]he effects of political trust among conservatives are of such sizable magnitude that they frequently erase the ideological gap between liberals’ and conservatives’ level of support for government spending” (Rudolph and Evans 2005: 668).

Another strand of the literature explores political fragmentation, including procedural fragmentation and fragmentation in the number of coalition parties, both in the executive and legislative branches. These papers mostly rely on the common-pool argument, which Weingast et al. (1981) coined as the “law of  $1/n$ ”. This argument states that because public projects often have localized benefits for constituencies but universal costs, governments have a tendency to overspend. Alternative theoretical explanations include Tsebelis’s (2002: 188) veto players argument. This argument states that the existence of veto players *delays* fiscal adjustments, such that some “policy inertia” exists. Spolaore (1993), relying on the veto players argument and

extending the wars of attrition model (see Alesina and Drazen 1991), shows that coalition governments may delay fiscal adjustments longer than single-party majorities. Padovano and Venturi (2001), for their part, find that more fragmented governments are less likely to engage in wars of attrition, when taking into account both the government and the opposing coalitions. Hallerberg, Strauch and von Hagen (2009) provide a framework for classifying governments according to the powers held by individual ministers. In the first category, named *fiefdom*, each minister wields considerable power over spending in his domain, resulting in severe common-pool problems. To reduce this problem, governments can instead choose *delegation* to a finance minister, or *commitment* to strict budgetary norms.

A large number of authors in the past two decades have tested the common-pool argument empirically. Ricciuti (2004) offers a comprehensive literature survey. One way of distinguishing governments in the context of the common-pool argument is by classifying them in coalitions and majorities. In a coalition government, the argument is that each party in the coalition takes into account only the costs bearing on its own constituents, and not its allied parties (Freier and Odendahl 2012). Roubini and Sachs (1989) were among the first to test this question empirically. These authors find that coalition governments spend more than single-party governments, using a panel of OECD countries between 1960 and 1985. Freier and Odendahl (2012) make an argument in opposition to this early finding, using a regression discontinuity approach with data from German municipalities over two electoral cycles (1996-2002 and 2002-2008). In fact, they find that absolute majorities spend more than coalition governments. They exploit a discontinuity in election results, by comparing absolute majorities that barely won the last decisive seat with coalition governments that include a party that almost made the cut-off to govern alone.

Instead of just differentiating coalitions from majorities, Kontopoulos and Perotti (1999) focused on cabinet size, as captured by the number of spending ministers. Indeed, the common-pool problem may also exist in a majority government with a large number of spending ministers. Using a panel of 20 OECD countries from 1960 to 1995, they find that the greater the number of ministers competing for the common pool of resources, the larger will be the budget deficit. De Haan et al. (1999) find a similar relation between the number of political parties in government (i.e., coalition size) and the growth of the central government debt-to-GDP ratio, also using a panel of OECD countries from 1979 to 1995. Perotti and Kontopoulos (2002) include both types of fragmentation: the number of ministers and the size of the coalition. They find (again with a panel of 19 OECD countries, from 1970 to 1995) that cabinet size is the strongest determinant of fiscal policy, with particularly strong effects on transfers. Using a panel of Swiss cantons between 1980 and 1998, Schaltegger and Feld (2004) find a positive effect of cabinet size on cantonal



government expenditures. However, they are unable to draw strong conclusions on the effects of coalition size (again, defined as the number of parties in the coalition) on cantonal public expenditures.

The literature thus offers some evidence that political fragmentation affects fiscal policy. However, other papers have cast some doubt on the robustness of the results. For example, Elgie and McMenamin (2008) show that the results depend on the sample choice. The authors successfully replicate the results of previous papers using a panel of OECD countries, but fail to do so when adding non-OECD countries (in an unbalanced panel, ranging from 1975 to 2004). They explain this result by entering a variable measuring the institutionalization of the country, defined as the age of the democracy. They argue that political institutions are more important in older democracies. Therefore, in those countries, political fragmentation does affect the budget surplus, but not in younger democracies. In earlier work, de Haan and Sturm (1997), using a panel of OECD countries between 1982 and 1992, also fail to replicate the results of Roubini and Sachs (1989). As mentioned above, de Haan et al. (1999) do find a relationship between coalition size and public debts. However, they fail to replicate the results of Roubini and Sachs (1989) when using the latter's classification of governments. In a panel covering local and state governments in the United States, Gilligan and Matsusaka (1995) find that the number of seats in the legislatures has a positive impact on public spending. However, that finding is only true for the upper chamber.

### **1.3. Ideological dispersion and intra-party politics**

Most models described above define fragmentation in a limited sense, namely by the number of parties in the coalition. That definition captures the common-pool argument, or the extent to which individual policymakers internalize the costs of their decisions (Perotti and Kontopoulos 2002). However, the relationship between political fragmentation and fiscal policy also depends on ideology. The idea that ideology matters was explored by Volkerink and de Haan (2001). These authors argue that large ideological differences in government matter because they make compromise more difficult. They also argue that when ideological differences in the parliament are large, the opposition is weaker, thus granting more freedom for the government to impose its policies. Empirically, however, the authors find no evidence that ideological differences affected public spending in a panel of 22 OECD countries between 1971 and 1996. In a more recent paper, Eslava and Nupia (2010) argue that the lack of evidence resulted from an improper specification. In partic-

ular, they assert that ideology and size fragmentation (i.e., the number of parties in parliament) are inter-related, such that econometric analyses must allow for an interaction between the two. In fact, with a panel of 22 presidential democracies for the 1978-2005 period (including developed and developing countries), they find that size fragmentation affects public spending only when some ideological polarization between parties is present. They also find that this polarization tends to increase public spending.<sup>4</sup>

Lindqvist and Östling (2010) also study the relationship between ideological dispersion (which they call polarization) and fiscal policy, albeit taking a different approach. These authors use data from interviews with voters carried out between 1995 and 2002 to estimate ideological dispersion in a cross-section of 74 countries. They find that this measure of ideological dispersion, derived from the perceptions of the electorate, has a significant negative effect on government size. The advantage of their approach is that their data measure political preferences directly instead of relying on proxies for them (ethnicity or religion, for example). However, in contrast to our new dataset, their data are only available for the electorate and not for politicians. Furthermore, as acknowledged by the authors, the link between polarization in the electorate, polarization in the legislature, and public spending is not completely understood, although they find that a polarized electorate is not associated with a fragmented legislature.

The current literature implicitly assumes that parties are monolithic entities and are the only decision-making units. The two papers cited in the previous section measure ideological dispersion (i.e., polarization) only between parties (Eslava and Nupia 2010), or take into account only the ideological dispersion in the electorate but not within political parties (Lindqvist and Östling 2010). However, this rationale abstracts from intra-party politics. The idea that parties are not unitary actors is not new. In earlier work, Belloni and Beller (1976) argue that the study of party factions has been neglected relative to parties and interest groups, because these latter groups have more obvious structures.<sup>5</sup> However, they also argue that party

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<sup>4</sup>These authors use two measures of ideological polarization. The first is a variable describing the maximum distance between the governing parties (the executive party and the three main coalition partners) on the usual left-right scale (taking a value of two if one party is at the right end and another at the left end), while the second is the standard deviation of the ideology of the three main governing parties.

<sup>5</sup>More recently, the emergence of the Tea Party, an American grassroots movement mostly associated with the Republican Party, is another example of a somewhat official faction, now even recognized as an official Congressional Member Organization (CMO). The relation between the Tea Party movement in the public at large and the CMO is not clear, with many members of the former not recognizing the latter. However, the members of the CMO are supporters of the larger movement. Party factions also exist in France. Indeed, major French parties are characterized by smaller factions. For example, the Socialist Party has a social-democratic, more moderate branch, but also includes members of a more radical leftist tradition. Similarly, the *Union pour un mouvement populaire* (UMP) is comprised of a socially conservative branch as well as a more market-oriented faction.

factions play an important role in the political institutions of many countries. They point out that in some cases, such as in Italy and Japan, factions have a long tradition and are almost official groups. For a recent literature survey on intra-party politics and factions, see Ceron (2011).

To our knowledge, no existing papers have studied the relation between ideological dispersion, intra-party politics, and fiscal outcomes. We argue that the ideological dispersion within parties impacts policy-making just as does dispersion between parties. More specifically, we argue that intra-party ideological dispersion affects public spending through two main channels: political factions, and logrolling (i.e., vote-trading).

### 1.3.1. POLITICAL FACTIONS

The first channel rests on the theory of factions, which relies on the same type of common-pool argument outlined above, but does so within parties. The literature showed that patronage is one reason for the existence of factions, but that factions could also be classified along the traditional left-right scale (Bettcher 2005; Golden and Chang 2001; Zuckerman 1979). Furthermore, Ceron (2011: 30) shows that “factions hold different preferences and conflicting views about party platform” (see also Debus and Bräuninger 2009). Lower unity within political parties will lead to important costs, as parties will mobilize resources to satisfy some of its factions to avoid party fissions. Party leaders can either mobilize internal resources within the party, or promise to target some public spending towards issues that are relevant to the factions. Following Ceron (2011), we argue that higher intra-party ideological dispersion should be associated with a larger number of factions, or factions that differ significantly from each other. To summarize the argument, higher intra-party ideological dispersion leads to more factions or more different factions, which in turn leads to more promises for targeted policies from party leaders to these factions. In turn, these policy accommodations should lead to more spending overall.

In a similar line of reasoning, the existence of factions (or simply the existence of ideological divergences) within parties may also affect negotiations between parties to form broad coalitions or alliances on certain legislative projects (see Laver and Shepsle 1990, for example). Pedersen (2010) distinguishes between parties who favor policy purity versus policy influence. She argues that influence-driven parties that are ready to make concessions may be more likely to be included in coalitions, while policy-pure parties, less ready to yield on their positions, will be excluded and will have to influence policy by indirect means, such as public debate, or maybe, in the case of Switzerland, referendums. In a similar fashion, we argue that more ideolog-

ically dispersed parties have greater strategic flexibility, thus facilitating coalition bargaining or the implementation of deals on specific legislative proposals. Warwick (2000), on a similar argument, advances the notion that parties have a “policy horizon”, which defines the range over which parties are ready to compromise in order to form a government. Other authors, including Bäck (2008), argue that such ideological dispersion has a negative impact on coalition-building. The existence of opposing views regarding the link between intra-party factions and inter-party negotiations shows that the specific institutional context should be taken into account in our analysis.

### 1.3.2. LOGROLLING AND VOTE-TRADING

The second channel through which intra-party ideological dispersion affects fiscal outcomes relies on the theory of logrolling and vote-trading. Miller (1999) defines logrolling as “the exchange of political support, particularly in the legislative process.” Miller (1999) also distinguishes between “explicit” logrolling as experienced in, for example, the United States, and “implicit” logrolling, the latter “occurring in the construction of legislative programs and party platforms or manifestos, within one-party cabinets, and in inter-party negotiations leading to coalition governments.” For logrolling to occur, there must exist pairs of legislative projects for which some members of parliament win by exchanging votes. Carrubba and Volden (2000) develop a game-theoretical model of logrolling, detailing conditions under which logrolling coalitions are sustainable.

Logrolling may occur between any pair or group of members of parliament. In a country where party discipline is sufficiently weak, it can take place both between members of different parties and members of the same party. How would ideological dispersion affect logrolling? We argue that within parties, trust between members is strong enough that coordination costs are relatively low. Greater trust implies that individuals are more likely to believe that their partners will not defect from their agreement. Furthermore, we argue that as intra-party ideological dispersion increases, trading possibilities are more frequent. Indeed, some dispersion raises the chance of having preferences different from other party members, thus creating trading opportunities. At the other extreme, perfectly coinciding ideological positions would correspond to a situation in which there is nothing on which to trade. Since parties are more ideologically cohesive than parliament as a whole, less trust between partners is needed to have sustainable logrolling coalitions. In contrast, when between-party ideological dispersion rises, logrolling should occur relatively less often. Indeed, trust between members of different parties being lower, coordination costs are higher.

To briefly summarize, we argue that intra-party ideological dispersion should positively affect coalition building, and thus increase public spending. In contrast, inter-party ideological dispersion, at least in Switzerland, should have a negative impact on coalition-building, thus reducing public spending.

## 1.4. Swiss institutional and political background

The institutional arrangement of Switzerland allows economists and political scientists to benefit from a sort of natural laboratory in which 26 sub-national governments have large fiscal autonomy (Kriesi and Trechsel 2008), but share the same institutional and socio-economic context. Indeed, this country is organized in a decentralized federal system with three layers of government: federal, cantonal, and municipal (known as communes). The country comprises 26 cantons of different cultures and languages, enjoying a relatively high level of independence from the federal government (Kriesi and Trechsel 2008). Cantonal governments also enjoy considerable fiscal autonomy and account for a large portion of total public spending in Switzerland. For example, in 2008, cantonal governments' revenues accounted for 24.4% of total government revenues, with cantonal governments enjoying full discretion on the entirety of that revenue.<sup>6</sup> Finally, studying a single country at a time can also circumvent the issue of coding different government systems, a problem that could be exacerbated by adding an ideological component to the analysis.

Our paper focuses on the cantonal governments and parliaments. The parliaments of the 20 cantons included in the analysis are unicameral with a varying number of elected members (with an average of 120 seats; see Table 2). Each canton has an executive council that is also elected by the voters at large. Kriesi and Trechsel (2008) offer a more complete description of the Swiss political system, and of the factors that contributed to its particular development. The remainder of this section will focus on important distinctive features that are particularly relevant to our analysis.

First, the entrusting of executive power to a council (called "Conseil d'État" in French or "Kantonsregierung" in German) without a clear leader is unique to Switzerland. Indeed, most countries vest considerable executive power in a single person, such as a president. In the context of our paper, this distinction is important because all the parties represented in this council share executive power and can influence the elaboration of the budget directly. The minister of finance is one among

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<sup>6</sup>Swiss sub-national governments enjoy full discretion on the tax rates and the levels of tax allowances and reliefs (reductions in the amount owed). For more details, see the OECD Fiscal decentralization database, available at <http://www.oecd.org/tax/federalism/oecdiscaldecentralisationdatabase.htm>.

other decision makers, such that the common-pool problem is not internalized fully. Moreover, the budgetary process is subject to a number of fiscal rules that limit the discretionary power of the ministers (see Feld and Kirchgässner 2006 for examples of fiscal rules). In the terms of Hallerberg, Strauch and von Hagen (2009), Swiss sub-national governments would be classified in the *commitment* category. In most countries, the executive power is held either by a single party, or by a coalition assembled through negotiations between parties. In a slight abuse of language, we will refer to the parties in the executive council as the *governing coalition*, even though they do not form a coalition in the usual sense. We will refer to the other parties as the *fringe group*. In our data, the governing coalition includes between 65% and 100% of the members of parliament. In Switzerland, the executive council does not have to face periodic votes of confidence from the parliament. Therefore, there is no need for parties to build an official coalition. Instead, parties may build *ad hoc* coalitions that can change often and be valid only for a certain number of projects. Bächtiger, Schwarz and Lutz (2006) tallied the coalition patterns in the Swiss federal government between 1996 and 2005, and found that the coalition comprising the four parties in government (those with executive power) account only for 17% of coalitions.

Another important feature of Switzerland's political system is the remarkably high collegiality of the legislature (Kerr 1978). It is a system in which consensus and stability are important (Church and Vatter 2009), despite considerable fragmentation (Ladner 2001). Kriesi and Trechsel (2008) argue that this feature stems from the tradition of direct democracy in Switzerland. Indeed, before presenting a budget or a new law, the government devotes substantial time consulting not only other political parties, but also a wide variety of interest groups. This process ensures that the project is accepted widely, and not subject to a popular vote (referendum) after adoption. Consequently, direct democracy leads to the inclusion in the decision process of all political parties that can make a credible referendum threat (Kriesi and Trechsel 2008). In the terms of Tsebelis (2002), referendums supply veto player roles for political actors who can organize them. Moreover, collegiality is reinforced by the fact that parties in the executive branch must find a way to collaborate.

Political fragmentation and ideological dispersion are closely related to party discipline. If a party member is not satisfied with the party's position, he can always decide to vote against the rest of his party. The willingness of party members to obey party leaders will vary according to their outside options. Indeed, we can safely assume that a politician who could resign and immediately find lucrative employment in the private sector would be more willing to face the consequences from the party than a politician with limited options out of politics.<sup>7</sup>

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<sup>7</sup>Following the 2011 federal elections, close to one third of the National Council members were

In Switzerland, cantonal politicians are not professionals, and often even keep their previous jobs. For this reason, we should expect low party discipline, which favors logrolling, as explained in the previous section. Indeed, Jeitziner and Hohl (1997), Hertig (1978) and Lanfranchi and Lüthi (1999) show that Swiss parties, especially those in the center and on the right wing of the political spectrum, exhibit little party discipline. This feature contributes to the importance of accounting for ideological dispersion when analyzing the relationship between political fragmentation and fiscal outcomes. Moreover, since party discipline is far from perfect in most countries, ideological dispersion should be important in the analysis of other countries as well.

The impact of both institutional and political features of Switzerland on fiscal outcomes has been the focal point of a number of studies. Feld and Kirchgässner (2000) surveyed a number of empirical studies showing that direct democracy affects public spending. First, citizens have better information on political issues, which reduces the ability of politicians to behave as rent seekers. Second, the authors argue that citizens are less selfish and feel more responsible for their own communities, thus more readily accepting personal material losses resulting from political choices. This second argument is in line with Rudolph and Evans (2005) and Hetherington (2006). Feld, Kirchgässner and Schaltegger (2003), using a panel of 26 Swiss cantons over the 1980-1998 period, showed that greater decentralization and stronger institutions of direct democracy reduce total cantonal revenue per capita. Feld and Kirchgässner (2006), using a panel dataset over the same period, show that fiscal constraints reduce public budget deficits while direct democracy reduces public debt. Fiscal constraints were also studied in the United States by Poterba (1994), who finds that “more restrictive state fiscal institutions [...] are correlated with more rapid fiscal adjustment to unexpected deficits” (Poterba 1994:799). Using a panel of Swiss cantons between 1980 and 1998, Schaltegger and Feld (2004) find a positive effect of cabinet size on cantonal government expenditures.

## 1.5. Description of the Variables

As mentioned in the previous sections, the key contribution of our paper is that it acknowledges the ideological dispersion between and within political parties. This section describes the construction of our measures of ideological dispersion. It also describes the more traditional political fragmentation variables, and presents the various control variables included in our econometric models.

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new. At that date, the median tenure in parliament was slightly under four years, highlighting the fact that turnover is high in Swiss politics, at least at the federal level.

### 1.5.1. POLITICAL DISPERSION AND FRAGMENTATION

Hug and Schulz (2007) discuss different methods for estimating the positions of Swiss politicians and political parties on the usual left-right scale. These methods use data from the parties' voting recommendations, the results of roll-call voting, and the contents of party manifestos. We depart from these methods of positioning elected representatives and instead consider directly their ideological positions on a multitude of issues to construct a composite index of their political profiles. For that purpose, we use data from a survey of Swiss politicians called Smartvote. Smartvote is an online voting advice application for Swiss voters that was first launched in the run-up to the 2003 Swiss federal elections, and used again for the elections in 2007 and 2011. Prior to the election, the Smartvote team asks electoral candidates to answer questionnaires on a wide range of topics.<sup>8</sup> The political profiles of the candidates are generated from their answers to the questionnaire. Smartvote also builds a scatter plot called Smartmap that places each candidate on two axes. The x-axis represents the usual left-right dimension and the y-axis represents the conservative-liberal scale. To locate the x-y coordinates for each candidate, the Smartvote team uses correspondence analysis. The Smartmap displays the relative positions of the candidates and facilitates comparisons between parties and individuals.<sup>9</sup>

In our paper, we use the coordinate corresponding to the most important axis indicated by the correspondence analysis. In each election year, the chosen axis explains about 80% of the variation in the answers of the candidates. The coordinate is rescaled as an index that varies from zero to one. We use the political profiles of candidates for both the lower and upper chambers of the federal legislature, but these candidates are disaggregated by canton and party. For each party in each canton, we thus obtain an average ideological score, along with the ideological dispersion within the party. As mentioned in the previous section, politicians consult a wide range of stakeholders before proposing new laws, including other political parties, and most likely members of their own parties. For this reason, we use the ideologies of the political parties at large (i.e., all candidates), and not only elected members.

With the ideological indices and dispersions obtained for each election year, we calculate the total variance, as well as a decomposition of the variance (intra- and inter-party) of the ideological positions. Intra-party variance is defined as the average of the variances of the ideological position within parties, weighted by the

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<sup>8</sup>The 2011 questionnaire is available on the Smartvote website at [http://smartvote.ch/11\\\_ch\\\_nr/questionnaire](http://smartvote.ch/11\_ch\_nr/questionnaire).

<sup>9</sup>During the electoral campaign, voters can answer the same questionnaire on the Smartvote website and have their answers compared to those of the candidates. As a result, Smartvote matches each voter with a specific ranking of all competing candidates.



number of seats held by each party in the cantonal parliament. Inter-party variance is defined as the variance of the parties' average ideological positions, again weighted by the number of seats held by each party in the cantonal parliament. The position of a political party is calculated as the average of its members' profiles.<sup>10</sup> Furthermore, as mentioned earlier, we split the political parties into two groups: a governing coalition and a fringe of often-smaller parties. We calculate the variance decomposition for the governing coalition group alone, as well as for all parties combined. We thus obtain two measures for each group (INTRACOAL and INTERCOAL for coalition parties, and INTRAALL and INTERALL for all parties). We use data from the Swiss Federal Statistical Office for the party breakdown of the cantonal parliaments and executive councils from 2003 to 2010 (the years for which the remainder of the data is available).

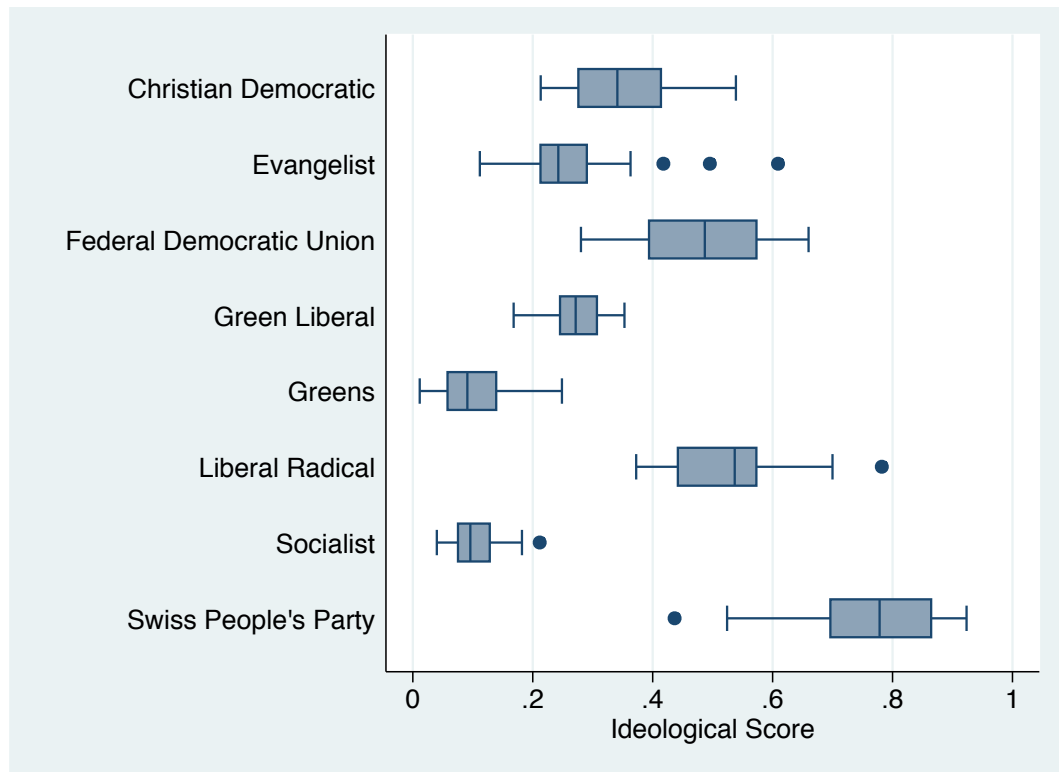


Figure 1: Ideological ranges of the main parties in Zürich

<sup>10</sup>The composition of the parliament varies following every cantonal election (or by-election), while ideology scores (the average score of, and variance within, each party) stay constant between each federal election. For this reason, our variables have at least some variation every year, if only for composition effects.

Figure 1 illustrates both the ideological position (measured by the median) and the dispersion (measured by the quartiles and the range) of the main parties in the Canton of Zurich.<sup>11</sup> It shows that ideology varies both within parties, as seen in the large ideological span of some parties, and between parties. The figure also shows that some parties have overlapping ideological distributions. Table 1 summarizes the inter-cantonal differences in party positions. It shows that the mean ideology of the four main parties in Switzerland differs across cantons, but we also see that differences across parties are larger.

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<sup>11</sup>The box plots for other cantons are available from the authors.

Table 1: Average and standard deviation of the ideology scores of candidates by canton, for selected parties

Canton	Swiss People's Party		Socialist		Christian Democrats		Liberal Radicals	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Aargau	0.697	0.175	0.110	0.042	0.429	0.109	0.547	0.142
Bern	0.679	0.112	0.114	0.056	0.372	0.095	0.526	0.099
Basel-Landschaft	0.746	0.146	0.074	0.051	0.387	0.091	0.532	0.198
Basel-Stadt	0.798	0.073	0.078	0.025	0.365	0.105	0.414	0.057
Fribourg	0.709	0.082	0.113	0.041	0.428	0.079	0.496	0.115
Geneva	0.644	0.106	0.107	0.063	0.306	0.068	0.501	0.072
Graubünden	0.665	0.104	0.082	0.046	0.394	0.114	0.537	0.064
Jura	0.662	0.058	0.102	0.035	0.410	0.102	0.354	0.150
Luzern	0.740	0.090	0.072	0.025	0.458	0.096	0.506	0.079
Neuchâtel	0.661	0.199	0.105	0.042	0.279	0.065	0.399	0.057
St. Gallen	0.773	0.083	0.055	0.031	0.450	0.097	0.556	0.126
Schaffhausen	0.655	0.064	0.124	0.064	0.269	0.079	0.649	0.097
Schwytz	0.849	0.130	0.088	0.039	0.515	0.093	0.636	0.084
Solothurn	0.761	0.132	0.115	0.042	0.394	0.118	0.540	0.078
Ticino	0.689	0.017	0.103	0.056	0.463	0.134	0.495	0.081
Thurgau	0.689	0.129	0.153	0.064	0.405	0.129	0.592	0.111
Valais	0.815	0.082	0.106	0.037	0.438	0.084	0.513	0.089
Vaud	0.680	0.113	0.102	0.038	0.298	0.064	0.495	0.097
Zug	0.834	0.045	0.073	0.023	0.461	0.118	0.555	0.088
Zurich	0.762	0.125	0.103	0.034	0.351	0.089	0.532	0.105
Swiss Average	0.721	0.126	0.103	0.048	0.395	0.108	0.519	0.108

The richness of our database allows us to construct variables measuring the ideologies of individuals and parties in ways that differ from previous papers. It is therefore important to discuss the results that we can expect from our estimations. The decomposition of the variance in within-party and between-party components allows a *ceteris paribus* interpretation of their effects. In Section 3 we argued that intra-party ideological dispersion increases public spending. We also argued that, at least in the Swiss case, inter-party ideological dispersion should reduce public spending.

To stay in line with the literature reviewed earlier, we also construct a measure of fragmentation similar to what is called size fragmentation in the literature (Volkerink and de Haan 2001; Perotti and Kontopoulos 2002). More precisely, we use the effective number of political parties (Laakso and Taagepera 1979). This measure is in essence the inverse of a Herfindahl-Hirschman concentration index. This index (ENPCOAL and ENPALL) takes a value of one for a parliament in which a single party holds all of the seats. It is constructed in line with the current literature, so we expect a larger effective number of political parties to be associated with more public spending.

### 1.5.2. DEPENDENT VARIABLES AND CONTROL VARIABLES

The rest of the data comes from the Swiss Federal Statistical Office, and covers the period 2003-2010. Our dependent variables are total cantonal public spending per capita and as a percentage of total cantonal GDP; both were taken without interest charges. As explained later, we will also estimate the model using public spending disaggregated by their purpose: investment expenditures and current expenditures.

We also add economic and political control variables to our models. To account for the political decision-making process, we enter the number of seats in the cantonal parliament. The previous literature documented a positive correlation between the number of parliamentary seats occupied and political fragmentation. To capture the fact that governments can manipulate spending over electoral cycles, we also include a dummy variable for election years. Finally, we control for the ideological biases of parties in the governing coalition by including the average of the ideological positions of these parties.

To control for the economic context, we include the lagged net public debt per capita, which we expect to affect public spending negatively. We also control for GDP per capita.<sup>12</sup> We also include the share of the dependent population in total population.

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<sup>12</sup>Cantonal GDP data are not available for every year. We obtain data for GDP per capita from the Swiss Federal Statistical Office for 2003-2005. For the years from 2006 to 2010, we extrapolate the data using the national growth rate of GDP per capita, assuming that the growth rate is similar across cantons.

We define the dependent population as the sum of people 20 years old and younger and of people 60 years old and older. The empirical literature usually shows that this variable increases public spending since it represents stronger demand for spending for schooling and social welfare programs. Finally, we include the unemployment rate for the time period considered, which we expect to increase public spending.

We also control for some institutional features of Switzerland. First, we control for the fiscal decentralization in the canton (FEDERALISM), by including the ratio of local spending to the sum of local and cantonal spending (both without interest charges). We also control for territorial fragmentation by using a proxy variable (TERRITORIALFRAG), which is calculated by dividing the number of municipalities by the cantonal population. We cannot control directly for the presence of mandatory referendums, an important aspect of Swiss direct democracy, since it stays constant throughout our sample period, and thus is captured fully by the fixed effects. Feld and Kirchgässner (2006) also encounter this problem in their analysis. Because their primary variables of interest would have been completely or partially captured by fixed effects, they decide not to include the latter. Since their model would be inappropriate, they use cantonal dummies as instruments to cope with possible endogeneity. Since these institutional variables are interesting to us only as control variables, we decide to rely on fixed effects and not to include controls already captured by fixed effects. Table 2 summarizes the variables included.

Table 2: Summary description of variables

Name	Description	Expected Sign	Mean	Std. Dev.
<i>Dependent variables</i>				
Spendcapita	Total public spending per capita (in thousands of CHF)		10.1	3.8
Spending as % of GDP	Total public spending as a percentage of cantonal GDP		19.15	9.09
<i>Variables of interest</i>				
intracoal	Intra-party variance of the governing coalition	positive	0.0061	0.0045
intercoal	Inter-party variance of the governing coalition	negative	0.037	0.201
enpcoal	Effective number of parties in the governing coalition	positive	3.33	0.64
intraall	Intra-party variance of all parties	positive	0.018	0.079
interall	Inter-party variance of all parties	negative	0.031	0.0297
enpall	Effective number of parties in parliament	positive	4.46	0.84
<i>Political control variables</i>				
nbseats	Number of seats in the cantonal parliament	positive	120.32	35.86
election	Election year	positive/negative	0.24	0.42
federalism	Local spending divided by the sum of cantonal and local spending	negative	0.28	0.095
territorialfrag	Total number of municipalities divided by the population	positive	0.001	0.001
meanideology	Average ideological position of parties in the coalition	negative	0.49	0.10
<i>Economic control variables</i>				
lagdebt	Lagged net debt per capita (in thousands of CHF)	negative	6.78	7.45
unemployment	Cantonal unemployment rate	negative	3.39	1.24
pcdependent	Dependent population as a percentage of total population	positive	43.9	1.3
GDP	GDP per capita (in thousands of CHF)	positive	57.5	20.087

## 1.6. Econometric results

This section presents the regression estimates obtained from a variety of models. We obtain these estimates using standard fixed effects models<sup>13</sup> on our panel of 20 cantons over eight years.<sup>14</sup> All models are estimated with clustered robust standard errors.

Our starting point is to estimate the effect of total ideological variance on public spending. The results are available in the appendix to this paper. We find only limited evidence that total variance has a negative impact on public spending. Indeed, this result is not robust to the specification of the model. Like much of the literature, we thus fail to find a strong linkage between total ideology dispersion and public spending. This lack of result further motivates the exploration of other avenues of research, such as intra-party politics. We reviewed the recent literature on that topic and concluded that we should not treat inter-party dispersion in the same manner as intra-party dispersion (see Section 1.3). Therefore, we continue our analysis using ideological dispersion separated into its two components: inter-party variance and intra-party variance.

Our main model includes the governing coalition variables (INTRACOAL, INTERCOAL, ENPCOAL), in addition to the control variables identified in the previous section. Estimation results are shown in columns one and two of Table 3. With both dependent variables, we obtain significant coefficients of the expected signs for both intra- and inter-party dispersion (INTRACOAL and INTERCOAL). In particular, we observe that intra-party ideological dispersion in the coalition group is associated with more public spending. The size of the coefficient is difficult to interpret, because the variable is not measured in any of the usual units. However, we can obtain a general idea of its scale. If we could increase the coalition group's intra-party dispersion by one times its standard deviation, while keeping everything else constant, we would observe an increase in public spending per capita of 754 francs.<sup>15</sup> Using the model with the alternate dependent variable would lead to an increase of 0.70 percentage points in public spending as a percentage of cantonal GDP. Thus, the effect is also economically significant.

In both regressions, we also find that inter-party ideological dispersion in the coali-

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<sup>13</sup>To obtain a causal interpretation, researchers have turned in recent years to quasi-experimental methods such as instrumental variables or regression discontinuity designs. Obviously, we would welcome the use of such methods to study the relationship between ideological dispersion and fiscal outcomes. However, our specific framework does not allow for these. The presence of endogeneity not being obvious, we believe that our results, while needing to be interpreted with some caution, are still interesting.

<sup>14</sup>Ticino is an exception. For that canton, we are able to collect observations for four years only, thereby limiting the number of observations suitable for our model.

<sup>15</sup>Using the average exchange rate over the period, this amount corresponds to 490 euros or 635 US dollars.

tion group is negatively associated with public spending, although the effect is smaller than the one from intra-party dispersion. As above, we can obtain an idea of the scale of the estimated coefficient. If we could increase the inter-party dispersion in the coalition group by one times its standard deviation, while keeping everything else constant, we would observe a reduction in public spending per capita of 442 francs.<sup>16</sup> Using the model with the alternate dependent variable, the estimated coefficient would lead to a decrease of 1.26 percentage points in public spending as a percentage of cantonal GDP.<sup>17</sup> As explained in depth in Section 3, the results for intra-party and inter-party dispersion may depend on intra-party dynamics, inter-party negotiations, and logrolling opportunities.

As a robustness check, the second model we estimate (columns three and four of Table 3) includes all of the previous variables, but considers all political parties instead of only the ones in the governing coalition. As discussed in Section 4, in Switzerland all parties may play roles in the legislative process, especially if they are able to organize referendums. For this reason, it could be important also to include the smaller parties in the analysis. Additionally, in some cantons, large parties such as the Swiss People’s Party (SVP)<sup>18</sup> are not elected to the executive council even though they are represented in the legislature.

Some of our findings for the coalition group’s inter-party and intra-party dispersion are robust to this change of specification, although only for one of the two dependent variables, namely public spending as a share of GDP. We still observe a positive, albeit smaller effect of intra-party dispersion on public spending, and a negative effect of the coalition’s inter-party dispersion on public spending. We can summarize the results obtained so far as follows:

**Result 1:** *Larger intra-party and lower inter-party ideological dispersion are both associated with more public spending.*

The results regarding inter-party dispersion are somewhat different from the results of Eslava and Nupia (2010), who found that ideological dispersion, when measured as the standard deviation of the ideological scores of the main parties in government, tended to increase public spending. They rely on the common-pool argument, arguing that this ideological polarization was a catalyst in the relationship between political fragmentation and public spending. In a coalition government, it is true that a larger number of parties should lead to more spending, owing to the common-pool problem. It is also true that in countries where the coalition government can

<sup>16</sup>Using the average exchange rate over the period, this amount corresponds to 287 euros or 372 US dollars.

<sup>17</sup>The effect of intra-party dispersion is larger on spending per capita than on spending as a percentage of cantonal GDP, while the opposite is true for inter-party dispersion. It is unclear whether there is any significance in this result.

<sup>18</sup>The Swiss People’s Party is one of the largest parties at the federal level in Switzerland, as well as in many cantons.

lose a legislative vote of confidence, thus being ousted from office, greater inter-party ideological dispersion between the coalition members should lead to more spending. Indeed, in these cases, the member parties have incentives to please everyone, thereby maintaining the coalition's strength. However, if such confidence votes are not held, as in Switzerland, incentives for cooperation are weaker, and inter-party ideological dispersion should reduce spending as parties have less common ground. Note also the contrast between intra-party and inter-party dynamics. Between parties, the incentives for cooperation are weak, thus more different partners will be less likely to cede ground to one another. Within parties, the incentives for cooperation are much stronger; party leaders thus will be more likely to cede ground to party activists or factions.

In a subset of the models considered, we observe a negative impact of the effective number of political parties on public spending. This result is consistent with the argument for inter-party ideological dispersion detailed above. However, this result is significant only at the 10% level. We also find that the average ideological score of the coalition group does not affect spending. However, the level of fiscal decentralization does affect public spending negatively, which is consistent with existing literature (including Switzerland).

One issue that can crop up in our analysis is that politicians may be office-seekers instead of motivated by ideology. In this case, one could argue that the policy preferences measured by electoral surveys (such as Smartvote) are irrelevant, and that politicians will decide to implement a different policy once elected. In this situation, we would have measurement errors in our variables of interest. This problem, however, may be of little importance in Switzerland. In fact, Schwarz, Schädel and Ladner (2010) study the statements of candidates before and after elections, and find that political congruence in Switzerland reaches 85%.

In Section 1.3, we argued that ideological dispersion could affect public spending by offering opportunities for more or less logrolling. It is also possible that exchanging votes is easier for projects that are not too distant in time. Indeed, as politicians in Switzerland are not professionals, their tenures often are expected to be relatively short. For this reason, a given politician will not want to enter a vote exchange agreement with another politician for a project that could be subject to votes only much later. Instead, they agree to help each other with projects that occur in the short-term (for example, to keep some already-existing government project running). In terms of public spending, we should thus expect that logrolling is prevalent mainly in current spending, and not so much for investment expenditures.

To test that hypothesis, we use data for spending disaggregated according to their short- or long-term characteristics. Our results are summarized in columns five to eight of Table 3. We find that our two ideological dispersion variables impact



current expenditures, with the same signs reported previously (namely, intra-party dispersion increases current expenditures, while inter-party dispersion reduces it). However, we find almost no impact on investment expenditures. Our model thus offers some support for the hypothesis that politicians forge logrolling agreements especially on short-term spending, but not on longer-term commitments.

Table 3: Regression results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Spending per capita	Spending (% GDP)	Spending per capita	Spending (% GDP)	Current expenditures per capita	Current expenditures (% GDP)	Investment expenditures per capita	Investment expenditures (% GDP)
Intra-party dispersion (Coalition)	123.608*** (36.88)	115.461** (43.67)			109.847** (40.80)	104.142** (43.93)	9.525 (8.70)	5.191 (15.21)
Inter-party dispersion (Coalition)	-11.936** (4.75)	-33.936*** (10.53)			-11.962** (4.19)	-31.072*** (7.64)	0.278 (1.95)	-1.660 (3.41)
Effective number of parties (Coalition)	-0.229 (0.24)	-0.181 (0.43)			-0.153 (0.21)	-0.145 (0.44)	-0.070 (0.07)	-0.027 (0.09)
Intra-party dispersion (All parties)			2.602 (3.35)	13.849** (4.96)				
Inter-party dispersion (All parties)			-0.944 (4.60)	-33.175*** (8.65)				
Effective number of parties (All parties)			-0.990* (0.52)	-1.107* (0.55)				
Average ideology of governing coalition	0.278 (1.91)	4.998 (3.70)	-3.095 (2.97)	4.107 (3.04)	0.460 (1.64)	4.463 (2.72)	-0.589 (0.69)	-0.480 (1.24)
Number of seats	-0.003 (0.01)	-0.004 (0.02)	-0.006 (0.01)	-0.008 (0.02)	0.000 (0.01)	0.000 (0.01)	-0.004** (0.00)	-0.005* (0.00)
Election year	0.066 (0.07)	-0.118 (0.18)	0.065 (0.09)	-0.019 (0.19)	0.018 (0.07)	-0.126 (0.16)	0.042 (0.04)	0.004 (0.06)
GDP	-0.000* (0.00)	-0.000** (0.00)	-0.000 (0.00)	-0.000** (0.00)	-0.000 (0.00)	-0.000* (0.00)	-0.000** (0.00)	-0.000*** (0.00)
% Dependent population	0.556* (0.31)	0.275 (0.63)	0.484** (0.19)	0.527 (0.50)	0.522* (0.28)	0.370 (0.60)	0.018 (0.06)	-0.091 (0.10)
Lagged net public debt	-0.081* (0.04)	-0.166 (0.10)	-0.142** (0.06)	-0.279** (0.11)	-0.066** (0.03)	-0.179* (0.09)	-0.026 (0.02)	-0.010 (0.02)
Unemployment	-0.018 (0.09)	0.212 (0.28)	-0.156 (0.13)	-0.045 (0.25)	-0.024 (0.08)	0.199 (0.29)	0.007 (0.05)	0.007 (0.07)
Federalism	-8.155** (2.86)	-21.855*** (6.59)	-11.052*** (3.48)	-24.386*** (7.06)	-9.846*** (2.79)	-22.183*** (5.90)	1.837 (1.20)	0.884 (2.00)
Territorial fragmentation	384.576 (1635.41)	294.217 (4295.45)	1476.440 (1552.47)	2434.242 (2291.16)	-1845.560** (780.86)	-1444.413 (3377.97)	2031.258* (1121.48)	1612.474 (1079.76)
Constant	-8.712 (13.54)	22.566 (25.63)	1.948 (7.17)	18.680 (17.73)	-9.135 (12.49)	14.633 (24.93)	1.261 (2.57)	8.093* (4.04)
N	135	135	135	135	135	135	135	135
R <sup>2</sup>	0.421	0.454	0.298	0.457	0.446	0.376	0.323	0.343
p-value (F-test for all variables)	0.000	0.000	0.001	0.000	0.000	0.000	0.037	0.000

Note: Robust standard errors in parentheses. Significance levels: \*\*\* 1% \*\* 5% \* 10%

Table 4 provides robustness tests using all parties rather than coalition partners only. The results hold for current expenditures, but only as a share of GDP. We obtained the same results when conducting this robustness test on total public spending. Interestingly, when all parties are included, we find a positive effect of intra-party dispersion on investment expenditures. We can summarize this second finding as:

**Result 2:** *Ideological dispersion tends to have a greater effect on current expenditures than on investment expenditures.*

Table 4: Robustness tests for current and investment expenditures, using all parties

	(1)	(2)	(3)	(4)
	Current expenditures per capita	Current expenditures (% GDP)	Investment expenditures per capita	Investment expenditures (% GDP)
Intra-party dispersion (All parties)	-1.017 (2.85)	7.604* (4.29)	2.998*** (0.88)	4.517*** (0.95)
Inter-party dispersion (All parties)	-0.441 (3.72)	-28.299*** (8.31)	0.225 (1.71)	-2.379 (2.18)
Effective number of parties (All parties)	-0.877 (0.55)	-0.914 (0.61)	-0.095 (0.06)	-0.179 (0.15)
Average ideology of governing coalition	-2.310 (3.01)	3.832 (3.33)	-1.023* (0.50)	-0.569 (0.74)
Number of seats	-0.002 (0.01)	-0.004 (0.02)	-0.004** (0.00)	-0.005* (0.00)
Election year	0.017 (0.09)	-0.036 (0.19)	0.041 (0.04)	0.008 (0.05)
GDP	-0.000 (0.00)	-0.000** (0.00)	-0.000** (0.00)	-0.000*** (0.00)
% Dependent population	0.468** (0.20)	0.576 (0.50)	-0.002 (0.06)	-0.060 (0.11)
Lagged net public debt	-0.123** (0.04)	-0.284** (0.10)	-0.028 (0.02)	-0.014 (0.02)
Unemployment	-0.137 (0.13)	-0.016 (0.27)	-0.009 (0.05)	-0.016 (0.06)
Federalism	-11.980*** (3.59)	-23.644*** (6.67)	1.156 (0.98)	-0.089 (1.79)
Territorial fragmentation	-1263.526 (1590.30)	-26.510 (2082.40)	2437.332** (895.09)	2084.253*** (725.29)
Constant	-0.159 (7.78)	11.370 (17.82)	2.857 (2.46)	7.888* (4.50)
$R^2$	0.361	0.370	0.356	0.392
N	135	135	135	135
p-value (F-test)	0.000	0.000	0.001	0.000

Note: Robust standard errors in parentheses. Significance levels: \*\*\* 1% \*\* 5% \* 10%

## 1.7. Conclusion

In this paper, we have made two main contributions to the literature on the impact of political fragmentation on public spending, both showing that ideology and intra-party politics matter. First, we have shown that intra-party and inter-party ideological dispersion both have an impact on public spending. In particular, intra-party dispersion is associated with more public spending, while inter-party dispersion is associated with less public spending. A corollary to this finding is that intra-party politics matter. This result is especially important, given that the previous literature mostly abstracts from ideological dispersion within parties. Our second finding is that ideological dispersion is especially relevant for current expenditures, and not so much for investment expenditures. We explain this result based on the fact that politicians are concerned mostly with short-term projects when agreeing to exchange votes with their colleagues.

Social scientists had already shown that intra-party politics matters for political outcomes. They had also shown that political fragmentation affects public spending. Our contribution rests at the intersection of these two sets of results. We believe that considering political parties as fragmented units themselves is important in understanding the budgeting process in governments and parliaments. Our paper is a first step in this direction. We have provided some theoretical background on these processes, along with empirical evidence. However, further research should explore these findings in other countries to verify if the mechanisms in play apply in other contexts.

One issue in our analysis may be measurement errors in the independent variables. Indeed, ideology is difficult to gauge. To confirm our results, one interesting avenue for future research would be to replicate our method using data from other countries. For example, the United States also feature a system in which the legislative and executive are clearly separated. Furthermore, parties in that country also show within-party ideological dispersion, even more so nowadays.

# Appendix 1 Total variance as the variable of interest

Table 5: Regression results with total variances

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Spending per capita	Spending (% GDP)	Spending per capita	Spending (% GDP)	Current expenditures per capita	Current expenditures (% GDP)	Investment expenditures per capita	Investment expenditures (% GDP)
Total variance (Coalition)	6.866 (7.54)	-22.879** (10.31)			4.502 (7.16)	-20.940* (10.20)	2.813 (1.81)	0.309 (2.59)
Effective number of parties (Coalition)	-0.470 (0.34)	-0.367 (0.47)			-0.365 (0.32)	-0.315 (0.48)	-0.097 (0.08)	-0.048 (0.10)
Total variance (All parties)			1.879 (2.65)	-3.304 (8.34)				
Effective number of parties (All parties)			-0.977* (0.52)	-1.198** (0.48)				
Number of seats	-0.004 (0.01)	-0.006 (0.02)	-0.006 (0.01)	-0.001 (0.02)	-0.000 (0.01)	-0.002 (0.02)	-0.004* (0.00)	-0.005* (0.00)
Election year	0.058 (0.09)	-0.130 (0.19)	0.056 (0.10)	-0.093 (0.16)	0.011 (0.08)	-0.136 (0.17)	0.042 (0.05)	0.004 (0.06)
GDP	-0.000 (0.00)	-0.000** (0.00)	-0.000 (0.00)	-0.000** (0.00)	0.000 (0.00)	-0.000** (0.00)	-0.000** (0.00)	-0.000** (0.00)
% Dependent population	0.369* (0.18)	0.087 (0.50)	0.443** (0.17)	0.209 (0.65)	0.355** (0.17)	0.199 (0.47)	0.003 (0.06)	-0.102 (0.10)
Lagged net public debt	-0.108* (0.06)	-0.182 (0.11)	-0.152** (0.07)	-0.236* (0.13)	-0.089* (0.05)	-0.193* (0.10)	-0.030 (0.02)	-0.013 (0.02)
Unemployment	-0.105 (0.11)	0.136 (0.27)	-0.204 (0.14)	0.260 (0.37)	-0.101 (0.11)	0.130 (0.29)	-0.002 (0.05)	0.000 (0.07)
Federalism	-8.045*** (2.74)	-21.708*** (6.88)	-11.105*** (3.25)	-24.153*** (7.65)	-9.746*** (2.62)	-22.049*** (6.00)	1.841 (1.18)	0.887 (1.97)
Territorial fragmentation	1325.631 (1265.03)	2025.746 (3286.99)	747.807 (1210.33)	2072.570 (4148.67)	-968.761 (1470.75)	113.753 (2628.58)	2005.501* (1068.24)	1586.875 (1101.00)
Constant	-0.466 (8.75)	33.729 (20.86)	1.833 (7.54)	34.256 (26.40)	-1.633 (8.18)	24.709 (20.19)	1.555 (2.63)	8.291* (4.13)
N	135	135	136	136	135	135	135	135
R-sqr	0.237	0.414	0.298	0.401	0.299	0.335	0.308	0.339
p-value	0.0004	0.0000	0.0004	0.0007	0.0000	0.0000	0.4834	0.0002

Note: Robust standard errors in parentheses. Significance levels: \*\*\* 1% \*\* 5% \* 10%

## Chapter 2

### *Communication and coordination in a two-stage game*<sup>19</sup>

#### 2.1. Introduction

Coordination failures are frequent in organizations and lead to huge losses of efficiency. Several studies have shown that communication can alleviate coordination failures, both when the players' interests are aligned (Cooper et al. 1992; Crawford 1998; Blume and Ortmann 2007) and when they are not (Cooper et al. 1989; Dickhaut et al. 1995; Duffy and Feltovich 2002; Duffy and Hopkins 2005; Cason and Mui 2014). In particular, the asymmetry of payoffs between two players usually generates a conflict because both have an incentive to select the option that maximizes their own earnings. To solve the conflict, one player has to be accommodating and accept to play the option that earns him a lower payoff. Turn taking is a coordination strategy that is used to solve the coordination problem in repeated games (Bornstein et al. 1997; Bhaskar 2000; Helbing et al. 2005; Lau and Mui 2008, 2012; Kaplan and Ruffle 2012; Bruttel and Güth 2013; Cason et al. 2013). Turn taking, where each player alternates the good and the bad turns, can maximize efficiency while minimizing inequality in the long run<sup>20</sup>. Communication may also help people to overcome these conflicts. Only a few papers have, however, considered turn taking and communication simultaneously (Zillante 2011; Leibbrandt and Sääksvuori 2012; Evans et al. 2013). Yet, communication might help players to learn the strategy more quickly and to decide who should take the first advantage. Moreover, the literature on coordination failures has mainly considered one-stage games. Are communication and turn taking as effective when a game is two-staged?

Our aim is to study by means of a laboratory experiment the impact of cheap talk communication and the emergence of turn taking in a symmetric two-player two-stage coordination game with asymmetric payoffs. A typical illustration of this

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<sup>20</sup>One can find several examples of turn taking strategies in real settings. Turn taking is indeed a frequent pattern in conversation, driving, product release, dividing household chores, etc. Lau and Mui (2012) give examples of common pool resources dilemmas and recall that Berkes (1992) reports examples from fishermen in Turkey using taking-turn strategies to allocate fishing spots and that Ostrom (1990) evokes rotation schemes in Spain and the Philippines for the use of irrigation systems.

type of games is the vertical differentiation model formalized by Gabszewicz and Thisse (1979) and Shaked and Sutton (1982) where firms can avoid price wars in the second stage of their interactions by offering goods of different quality levels in the first stage. Another example is the regional fiscal competition model (Justman et al. 2005) where regions have to decide first on how much to invest in infrastructures to attract firms and next, they have to design their tax policy. In this situation, if both regions are unable to differentiate in terms of quality of infrastructures in the first stage, they will start a tax war in the second stage to attract firms, with deleterious effects on profits.

To reproduce this type of strategic situation, in the first stage of our finitely repeated two-stage coordination game with asymmetric payoffs, two players have to choose independently and simultaneously between two options, knowing that their decisions will determine the options that will be available in the second stage and thereby the attainable payoffs. In the second stage, after being informed on the other player's choice in the first stage players have to choose independently and simultaneously between two new options. Payoffs are determined and distributed to players only at the end of the second stage. The game has two Subgame Perfect Nash Equilibria. If both players opt in the first stage for the option that maximize their own payoff and disregard the payoff of their partner, they will have to choose in the second stage between two options with conflicting payoffs but which, in any case, will earn them less than if they were able to differentiate their choices in the first stage. On the opposite, coordination – corresponding to the social optimum – is achieved when the two players select opposite options in each stage. In our setting this leads one player to earn more than the other one from both stages.

Our experimental design, involving repeated interactions in fixed pairs during 20 periods aims at testing whether players learn using strategies that avoid a head-to-head confrontation and allow them to coordinate on opposite choices in both stages. In particular, we examine how frequently partners adopt a turn taking strategy – meaning that each player takes turn over periods as the high earnings player – in order to maximize efficiency and reduce payoffs inequality in the long run.

We hypothesize that pre-play communication may facilitate the use of a turn taking strategy in our two-stage game. To test this hypothesis, we introduced cheap talk communication (Farrel and Rabin 1996) in some treatments. We implemented a two-way communication treatment (Two-Way, hereafter) and a one-way communication treatment (One-Way, hereafter). In the Two-Way treatment, subjects are allowed to exchange messages via a chat box for a minute at the beginning of each period. In the One-Way treatment only one of the two players –always the same– is allowed to send messages. The ability to send messages is determined by the relative performance of each player in a preliminary task. Endowing only one player with the right to communicate aims at testing whether this player takes advantage of his higher status to increase his claims, possibly changing the frequency of alternation between periods<sup>21</sup>.

Our main results are threefold. First, in the absence of communication almost half of the groups selected simultaneously identical options at both stages of the game

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<sup>21</sup>Early studies of one-way vs. two-way communication in simple coordination games (Cooper et al. 1992) and Battle-of-the-Sexes games have shown that two-way communication is more able to alleviate coordination failures than the one-way communication.

and consequently failed to solve the conflict. Our second finding is that some groups learned turn taking over time, which permitted a durable resolution of the conflict. The third result is that introducing two-way communication increased to 91% of the groups the likelihood of conflict resolution by allowing players to implement immediately a systematic and durable turn taking strategy. 86% of the groups played the social optimum. Finally, endowing only one player with the right to send messages affected neither the likelihood of achieving coordination on the socially optimal outcome, nor the frequency of alternation in taking turn. Indeed, in the One-Way treatment the social optimum was played in 87% of the observations and 77% of the groups took turn. Overall, we show that in complex two-stage coordination situations where inequality is unavoidable, communication can alleviate conflicts and increase efficiency provided that relative positions can be exchanged in a fair way.

The remaining part of the paper is organized as follows: Section 2 reviews briefly the related literature. Section 3 describes the theoretical background and the experimental design and procedures. Section 4 presents and discusses our results. Section 5 concludes.

## 2.2. Related Literature

While communication in static games has been early and widely studied in experimental economics<sup>22</sup>, there are much less studies on communication in two-stage games. An exception is Andersson and Wengström (2011) who test the impact of pre-play and intra-play communication between the stages of the game on cooperation. The payoffs of the game are such that players can sustain cooperation in a prisoner's dilemma played in the first stage by threatening to play the inferior equilibrium in a second stage coordination game with Pareto-ranked multiple equilibria. They find that pre-play communication increases cooperation but its effect is significantly reduced when intra-play communication is possible. With the same game setting, Cooper and Kuhn (2012) find, however, that adding intra-play communication to pre-play communication increases cooperation. This difference may derive from the fact that they use written free-form communication, while Andersson and Wengström (2011) implemented a structured communication where the only possible contents were the intended action choices.

A major difference with this previous literature is that the equilibrium payoffs of our two-stage game are asymmetric while in the previous studies payoffs were equal in equilibrium. Another difference is that while these studies used two successive different games, in our game the second stage is nested in the first one. Indeed, payoffs in the game are determined only after the two stages have been completed. Another difference with previous studies is that we do not allow players to communicate between the two stages of the game, and we compare one-way and two-way

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<sup>22</sup>See Isaac and Plott (1981), Isaac et al. (1984) and Isaac and Walker (1985) for experiments on the impact of face-to-face communication on bidding behavior, Ledyard (1995) and Sally (1995) for surveys on communication in social dilemmas, Cooper et al. (1992), Crawford (1998), and Blume and Ortman (2007) for coordination games, Bochet et al. (2006) for public goods games. See Cason and Mui (2014) on the relative impact of repetition and communication in an indefinitely repeated Divide and Conquer game.



communication.

In our game, successful coordination in the two stages implies that one of the partners has to sacrifice part of his earnings in both stages. Inequality aversion (Fehr and Schmidt 1999) and guilt aversion (Charness and Dufwenberg 2006) may create disutility if the same player has to sacrifice repeatedly. These preferences may motivate players to exchange between the good and the bad turn and to respect this rotation between the asymmetric outcomes over time. But turn taking may also be a profitable strategy for selfish players who want to establish a reputation of fairness in order to get higher payoffs than those obtained in case of conflict. The turn taking strategy has been modeled formally by Lau and Mui (2008, 2012) for respectively the battle-of-the-sexes game and for repeated symmetric 2x2 games (including chicken, common-pool-resources and prisoner's dilemma games) (see also Bhaskar 2000). They show that, without communication, a turn taking equilibrium may exist for these classes of infinitely repeated games and that the expected time taken to reach such equilibrium increases in the degree of conflict between the players. Experimental evidence of turn taking has been shown in various repeated games such as a kind of chicken game (Bornstein et al. 1997), traffic game (Helbing et al. 2005), entry game with incomplete information (Kaplan and Ruffle 2012), and a sequential public good game (Bruttel and Güth 2013). Using an indefinitely repeated common-pool resource assignment game and a perfect stranger experimental design, Cason et al. (2013) show that players use an efficiency-enhancing turn taking strategy, learn fast this strategy, and teach it to other players, especially when the degree of conflict is lower. We contribute to this literature by considering a game with two nested stages, which may make the adoption of turn taking slower.

Only a few papers have considered turn taking and communication simultaneously as we are doing in our study. In a multi-player entry game, Zillante (2011) shows that a multi-period signaling device (that differs from free-form communication) facilitates inter-temporal cooperation and turn taking outcomes. Evans et al. (2013) find stronger evidence of turn taking in finitely repeated coordination games with dominant strategy equilibrium when cheap talk is allowed because communication stimulates pro-social behavior. Their results are robust to variations in the degree of conflict between players. Leibbrandt and Sääksvuori (2012) have shown that the structure of communication matters and that only unrestricted communication helps groups to take turn in winning a contest. We extend this literature by comparing one-way and two-way communication.

## 2.3. Theoretical background and experimental design and procedures

### 2.3.1. THE GAME

We consider a two-player two-stage game with observable actions  $\Gamma = \left[ \{1, 2\}, \{u_i(s)\}_{i=1}^2, \{s_i\}_{i=1}^2 \right]$  where  $S_i$  is player  $i$ 's strategy set and  $u_i : S_r \times S_c \Rightarrow \mathbb{R}$  gives player  $i$ 's utility for each profile  $s$  of strategies. The game is characterized as a two-stage simultaneous-move game with complete but imperfect information.

Let us consider the one-shot version of this game. Figure 2 presents the game with the payoff values used in the experiment<sup>23</sup>.

		Column player				
		A		B		
		X	Y	X	Y	
Row player	A	X	3 ; 3	5 ; 2	8 ; 5	9 ; 4
		Y	2 ; 5	4 ; 4	12 ; 8	14 ; 5
	B	X	5 ; 8	8 ; 12	2 ; 2	4 ; 1
		Y	4 ; 9	5 ; 14	1 ; 4	3 ; 3

Figure 2: The two-stage coordination game

In the first stage of the game, both players have to choose simultaneously and independently between options A and B. In the second stage of the game, after being informed on the other player's first-stage choice, both players have to choose simultaneously and independently between options X and Y in the sub-game determined by the two players' choices in the first stage. Each player has 32 possible strategies:  $S_i = \{(A, B) \times (X, Y) \times (X, Y) \times (X, Y) \times (X, Y)\}$ .  $S_r \times S_c$  results in a set of 10245 strategy profiles.

The matrix in Figure 2 displays the payoffs for all possible strategies for the row and column players. Payoffs are asymmetric in 12 cells out of 16, i.e. except when both players select the same options in both stages. Symmetric payoffs are smaller than those earned when players choose opposite options<sup>24</sup>. The lower left and the upper right sub-matrices are symmetric, meaning that the same strategy leads to similar payoffs regardless of which player implements it. Payoffs are slightly higher in the upper left sub-matrix in comparison to the lower right-matrix, giving an advantage to option A in comparison to option B.

We use the Subgame Perfect Nash Equilibrium (SPNE) concept to solve this game. The game has five subgames, including four proper subgames. In each proper subgame both players have a dominant strategy. The row player's dominant strategy is option X in the first, third and fourth proper subgames, and option Y in the second proper subgame. The column player's dominant strategy is option X in the first, second and fourth proper subgames, and option Y in the third one. Each subgame entails a Nash equilibrium that is represented by the following action pairs  $(AX_r, AX_c)$ ,  $(AY_r, BX_c)$ ,  $(BX_r, AY_c)$  and  $(BX_r, BX_c)$ . Applying backward induction, we find that only the action pairs  $(AY_r, BX_c)$  and  $(BX_r, AY_c)$  are subgame perfect. Figure 3 displays the reduced normal form of the game.

<sup>23</sup>The extensive form of the game can be found in Appendix 1.

<sup>24</sup>Note that this situation is similar to a "price war" which leads both players to earn the lowest possible earnings in the whole game.

		Column player	
		A	B
Row player	A	3 ; 3	12 ; 8
	B	8 ; 12	2 ; 2

Figure 3: Reduced normal form of the two-stage coordination game

The pure strategies Nash equilibria of the reduced form game are the action pairs  $(A_r, B_c), (B_r, A_c)$  and the unique mixed strategy equilibrium is given by  $(x_r = \frac{2}{3}A_r + \frac{1}{3}B_r, x_c = \frac{2}{3}A_c + \frac{1}{3}B_c)$ . The two asymmetric outcomes ((A,B) and (B,A) in Figure 3) maximize total payoffs.

To sum up, the theoretical analysis of the game shows that players have to choose opposite options at both stages in order to earn the maximum possible payoff corresponding to the SPNE. It is easy to see that the SPNE of the game raise a conflict problem due to the asymmetry of payoffs.

Let us now consider the repeated version of this game. Players may try to solve the conflict by means of a turn taking strategy with a randomization in the first period (that can be avoided if communication is possible), and then a rotation between the asymmetric outcomes, with each player choosing the actions chosen by the other player in the previous period. If players do not deviate from this strategy, turn taking may last. Lau and Mui (2012) demonstrate how such a strategy profile can be supported as a subgame perfect equilibrium in a symmetric infinite horizon repeated game, if this strategy profile is unique and symmetric.

### 2.3.2. EXPERIMENTAL DESIGN

The experiment consists of three treatments and we used a between-subject design.

#### 2.3.2.1. BASELINE TREATMENT

The Baseline treatment consists of 20 periods of the two-stage coordination game described in sub-section 3.1. We pair participants at the beginning of a session and it is made common knowledge that pairs remain fixed throughout the session. Using a partner matching protocol allows us to study inter-temporal coordination within pairs. Each period is constructed as follows. Knowing the whole payoff matrix for the two stages of the game, each participant has to choose simultaneously and independently between options A and B. Then, after receiving a feedback on the choice of his co-participant, each player has to choose between options X and Y. Then, participants are informed on their co-player's second choice and payoffs are displayed. Participants have also an opportunity to fill out a history table on a sheet of paper to keep track of previous plays and payoffs.

#### 2.3.2.2. THE COMMUNICATION TREATMENTS

The Two-Way communication treatment is similar to the Baseline, except that in this treatment players are allowed to exchange free-form messages during one minute

at the beginning of the first stage of each period, using a chat box. Communication is not permitted between the two stages. Messages are free, except for the usual rules preserving anonymity and decent language. This treatment aims at testing whether individuals learn more rapidly to coordinate on the SPNE, in particular by using a turn taking strategy.

In the One-Way treatment, only one player in each pair is allowed to send messages and thus communication is limited to 20 seconds. To designate this player, we added a preliminary part in which participants have to perform a memory task during five minutes, before receiving instructions for the main game<sup>25</sup>. The task is not incentivized, but participants are informed that their performance will be used to assign roles in the next part of the experiment. After five minutes, we compare the relative performance of participants and divide them into two equal groups. Players are informed that the computer program then creates pairs composed of one player with median or above-median performance and one player with below-median performance. In each pair, the player with above-median performance is allowed to send messages throughout the session. This treatment aims at testing how endowing one of the two players with the right to communicate affects coordination. In particular we test if it motivates the player who got a higher status to try to keep a higher share of the payoffs, for example by proposing a less frequent rotation in turn taking compared to the previous treatment.

### 2.3.2.3. ELICITATION OF INDIVIDUAL CHARACTERISTICS

Individual characteristics may ease or hamper coordination. We have therefore measured some of them. In particular, we elicited risk attitudes at the beginning of the sessions, using the procedure of Gneezy and Potters (1997) and Charness and Gneezy (2012). Each subject is endowed with 80 monetary units and has to choose how much to invest (between 0 and 80) in a risky investment. With 50% chance the investment returns 2.5 times its amount and with 50% chance it is lost. A risk neutral expected utility maximizer should invest all his endowment, otherwise the individual is classified as risk averse. The participants received a feedback on the outcome of the random draw only at the end of the session. At the end of the experiment, a demographic questionnaire was also administered, including questions on gender, age, and relative wealth of the family compared to other students (on a scale from 0 for the poorer to 10 for the wealthier).

### 2.3.3. PROCEDURES

The experiment was conducted at GATE-LAB, Lyon, France. 162 participants were recruited from local engineering and business schools, using ORSEE (Greiner 2004). 50.62% of the participants are females. Their mean age is 25 years (S.D.=9.12), their mean relative wealth 5.14 (S.D.=1.88), and their mean investment in the risky asset is 45.33 (S.D.=22.69) showing evidence of risk aversion. Three sessions per

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<sup>25</sup>The screen displays the back of sixteen cards and the task is to reform eight pairs with similar pictures by clicking on the cards and memorizing their pictures (see snapshots in the instructions in Appendix 2). Once the eight pairs are reformed, new cards are displayed on the screen.

treatment were organized, with 56, 44, and 62 participants in the Baseline, the Two-Way, and the One-Way treatments, respectively. The experiment was computerized using z-Tree (Fischbacher 2007). Upon arrival, participants were randomly assigned to a computer after drawing a tag from an opaque bag. Sets of instructions were distributed after each part and read aloud. The payoff matrix (Fig.2) was distributed with the instructions (see Appendix 2). To facilitate its reading, each player was identified with a color (red for the row player and blue for the column player). In addition, we displayed the whole matrix at the beginning of each first stage and the relevant sub-matrix at the beginning of each second stage on the computer screens. Therefore, subjects had in front of them all relevant information when making their decisions. The understanding of participants was checked by means of a questionnaire and all questions were answered in private.

On average a session lasted 90 minutes, including payment. The participants were paid the sum of their earnings in each period in addition to their earnings from the risk elicitation task, at the rate of 1 experimental currency unit = 0.05 Euro. In addition, they were paid a €4 show-up fee. On average, participants earned € 17.20 (S.D.=3.30). Payments were made individually in cash and in private in a separate room.

## 2.4. Results

### 2.4.1. COORDINATION

We define coordination as a situation in which the two players select opposite options at both stages of the game. To study how groups coordinate, we focus on the following three situations. First, the Subgame Perfect Nash Equilibrium that requires that the two players choose opposite options in the two stages of the game: they play A and B in the first stage and Y and X, respectively, in the second stage (which corresponds to their dominant strategy in the symmetric subgames two and three, see Figure 1). Second, the situation when the two players fail to coordinate in the first stage (both play A or B) and play their dominant strategy in the second stage (both choose X, which corresponds to playing the Nash equilibrium in subgames one and four), which leads both subjects to jointly earn the lowest possible payoffs. The third relevant situation might be considered as a fallback situation and it occurs when the two players make the same choice in the first stage (both play A or B) but do not play the Nash equilibrium in subgames one and four (both choose Y), in order to attain the Pareto optimal outcome in these subgames. In this last case, both subjects earn a slightly higher payoff than that obtained when playing the Nash Equilibrium.

Only a few groups, after selecting opposite options in the first-stage of the game, opted for identical options in the second-stage (6.61% of the groups in the Baseline, 4.10% in the Two-Way and 4.83% in the One-Way). It is clear that the first-stage choices are crucial to the success of coordination in pairs. This is why we first report the analysis of behavior in the first stage before analyzing the data for the two stages taken together.

#### 2.4.1.1. DIFFERENTIATION IN THE FIRST STAGE OF THE GAME

In the first stage of the Baseline, both players choose option A in 32.86% of the cases (184/560 pairs\*periods) and both choose option B in only 7.14% of the cases (40/560 pairs\*periods). Both players' preference for option A is not surprising since it allows them to avoid the proper game that leads to the lowest payoffs (the lower right proper subgame in Figure 1). Thus, players are able to differentiate in only 60% of the observations (336/560 pairs\*periods) by choosing AB or BA, which is a condition for reaching the SPNE. This reveals a high rate of coordination failures when communication is not possible.

The picture changes dramatically when communication is introduced. Indeed, the two players are able to differentiate in 90% of the cases (396/440) in the Two-Way treatment and in 92.17% of the cases (553/600) in the One-Way treatment. The mean percentage of differentiated first-stage choices is significantly different in both the Two-Way and the One-Way treatments compared to the Baseline (two-tailed Mann-Whitney tests - MW, hereafter - with each pair's choices averaged over the 20 periods as an independent observation;  $p < 0.001$  in both treatments)<sup>26</sup>. There is no significant difference between the two treatments with communication ( $p = 0.918$ ).

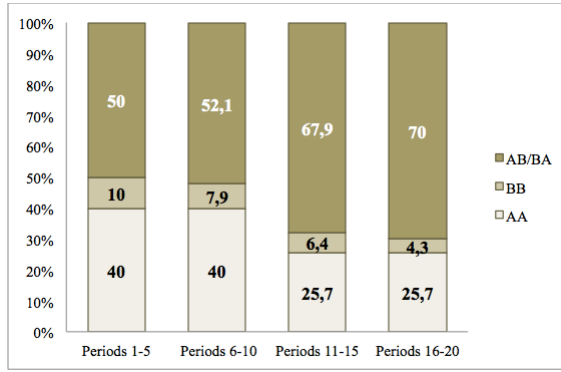
Both players choose option A in only 7.05% (31/440) and 6.5% (39/600) of the observations in the Two-Way and One-Way treatments, respectively. Again, these percentages are significantly different from those in the Baseline ( $p < 0.001$  in both cases), but they do not differ from each other ( $p = 0.977$ ). The percentages of choices of option B by both players are respectively 2.95% (13/440) and 1.33% (8/600). These percentages do differ statistically from those in the Baseline ( $p = 0.016$  and  $p = 0.003$ , respectively) and but not from each other ( $p = 0.943$ ). Thus, when they can discuss on a strategy (Two-Way treatment) or communicate a strategy (One-Way treatment), players are most of the time able to implement the first condition for reaching the SPNE.

Individuals learn over time to differentiate their choice in the first stage of the game but learning is quicker when communication is possible. The three panels of Figure 4 display for each treatment the evolution of the distribution of first-stage choices in the pairs, by blocks of five periods<sup>27</sup>.

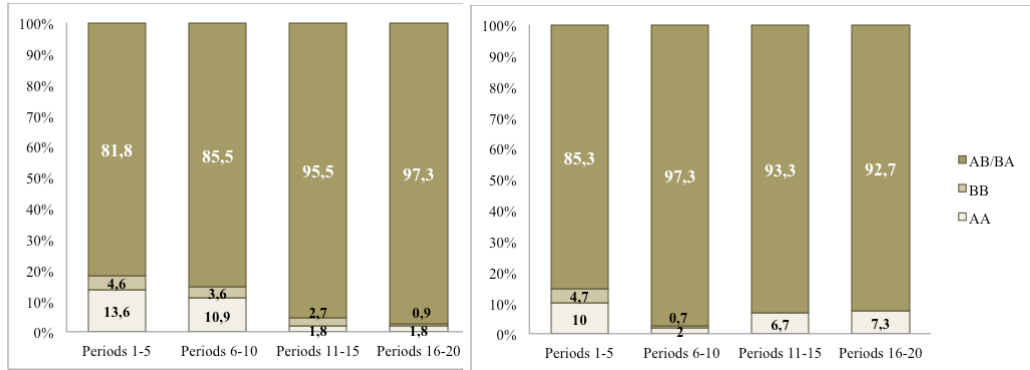
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<sup>26</sup>Unless specified otherwise, all the non-parametric tests reported in this paper are two-tailed and each pair averaged across all periods give one independent observation.

<sup>27</sup>For more detailed information, Figures A1, A2 and A3 in Appendix 3 display the distribution of first-stage choices between A and B for each pair and each period, for each treatment respectively.



(a) Baseline treatment



(b) Two-Way treatment

(c) One-Way treatment

Figure 4: Distribution of first-stage pairs' choices, by block of periods and by treatment

Figure 4a shows that in the Baseline treatment, players are more likely to differentiate their first-stage decision in the last ten periods compared to the first ten. Only three groups were able to start differentiating their first stage choices in the first three periods and continued throughout the game. Wilcoxon tests ( $W$ , hereafter) at the pair level indicate significant differences between the first ten and the last ten periods in the mean percentages of differentiated choices ( $p=0.004$ ), choice of option A by both players ( $p=0.011$ ), and choice of option B by both ( $p=0.067$ ). However, even in the last block of five periods, there are still 30% of the pairs that are not able to coordinate on opposite choices. In the absence of communication, it takes time for the players to learn differentiating their action. It is a standard result in coordination games but the difficulty is stronger here since one player has to accept to earn less in the anticipation of the second stage.

Learning occurs also in the communication treatments but it is more immediate. Wilcoxon tests indicate significant differences between the first ten and the last ten periods in the mean percentages of differentiated choices in the Two-Way and in the One-Way treatment ( $p=0.002$  and  $p=0.018$ , respectively). In the Two-Way treatment we find significant differences in the mean percentages of choice of option A by both players ( $p=0.001$ ), but not in the mean percentages of joint choice of option B ( $p=0.392$ ). The opposite results are found in the One-Way treatment ( $p=0.143$  and  $p=0.005$ , respectively). If learning occurs, 17 groups out of 22 in the Two-Way treatment and 23 groups out of 31 in the One-Way treatment were already

able to make opposite first-stage choices in the first three periods.

#### 2.4.1.2. OVERALL COORDINATION

First-stage choices are a necessary but not a sufficient condition for the achievement of coordination. Even if only few groups failed to reach the SPNE after starting with opposite options, the anticipation of the consequences of the second-stage choices on the payoffs influences first-stage decisions. In the following we analyze the decisions made by the subjects at both stages of the game. Table 1 displays the distribution of these situations by treatment and by block of five periods, as we expect some learning to occur<sup>28</sup>.

Table 6 shows that the players are able to coordinate on the SPNE in only 53.39% of the cases. When they are not able to differentiate their choices in the first stage, they are more likely to play the Nash equilibrium of the sub-game than the optimum (20.71% vs. 5%, respectively).

In contrast, communication makes coordination on the SPNE significantly more likely than in the Baseline (MW test,  $p < 0.001$  in both the Two-Way and One-Way treatments). Indeed, pairs are able to coordinate in 85.68% and 86.61% of the cases in the Two-Way and the One-Way treatments, respectively ( $p = 0.949$ ). While the percentage of pairs that played the SPNE more than 10 periods in total was only 14% in the Baseline, it is 91% in the Two-Way treatment and 90% in the One-Way treatment. When pairs made the same choice in the first stage, players play also significantly differently the Nash equilibrium in the second stage compared to the Baseline ( $p < 0.001$  in both treatments). Indeed, this characterizes only 2.50% and 2.90% of the observations in the Two-Way and One-way treatments, respectively. A difference is found in the choice of the optimum in the second stage in pairwise comparisons for the One-Way treatment ( $p = 0.056$ ) but not in the Two-Way treatment ( $p = 0.458$ ). Finally, while there were more than 20% of the observations that could not be characterized in the Baseline, this represents less than 10% of the observations in the treatments with communication ( $p < 0.001$ ).

Table 6 also reveals that some learning occurs. In the Baseline, the SPNE is played in 36.43% of the cases during the first five periods. This percentage increases to 46.43% in periods 6 to 10 and 62.86% in periods 11 to 15 to stabilize at 67.86% towards the end of the game. Pairs are significantly more likely to play the SPNE in the second part of the game than in the first one (W test,  $p = 0.004$ ). However, even in the last block of five periods, the number of pairs playing the SPNE remains different compared to both the Two-Way and the One-Way treatments (MW test,  $p = 0.001$  in both).

Coordination is much faster with communication. Indeed, in the Two-Way treatment the SPNE is already played 73.64% of the time in the first five periods and 68% of the pairs played the SPNE continuously after the third period. In the One-Way treatment the SPNE is already played in 68.39% of the time in the first five periods and among the 23 pairs who chose opposite options in the first stage, 22 selected also opposite options in the second stage in the first three periods. The SPNE is

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<sup>28</sup>For more detailed information, Figures B1, B2 and B3 in Appendix 3 display the strategies played by each pair of subjects in each period, for each treatment respectively.



Table 6: Summary statistics on coordination over time, by treatment and block of periods

Treatments	Baseline	Two-Way communication	One-Way communication
<i>Different options in both stages (SPNE) (AY and BX. BX and AY)</i>	299 (53.39)	377 (85.68)***	537 (86.61)***
Periods 1-5	51 (36.43)	81 (73.64)	106 (68.39)
Periods 6-10	65 (46.43)	89 (80.91)	144 (92.90)
Periods 11-15	88 (62.86)	103 (93.64)	143 (92.26)
Periods 16-20	95 (67.86)	104 (94.55)	144 (92.90)
<i>Same option in stage 1 (A or B) + Nash equilibrium in stage 2 (X)</i>	116 (20.71)	11 (2.50)***	18 (2.90)***
Periods 1-5	29 (20.71)	3 (2.73)	7 (4.52)
Periods 6-10	31 (22.14)	8 (7.27)	1 (0.65)
Periods 11-15	27 (19.29)	0 (-)	3 (1.94)
Periods 16-20	29 (20.71)	0 (-)	7 (4.52)
<i>Same option in stage 1 (A or B) + Optimum in stage 2 (Y)</i>	28 (5.00)	15 (3.41) <sup>ns</sup>	8 (1.29)*
Periods 1-5	14 (10.00)	8 (7.27)	7 (4.52)
Periods 6-10	11 (7.86)	4 (3.64)	1 (0.65)
Periods 11-15	3 (2.14)	0 (-)	0 (-)
Periods 16-20	0 (-)	3 (2.73)	0 (-)
<i>Other situations</i>	117 (20.89)	37 (8.41)***	57 (9.19)***
Periods 1-5	46 (32.86)	18 (16.36)	35 (22.58)
Periods 6-10	33 (23.57)	9 (8.18)	9 (5.81)
Periods 11-15	22 (15.71)	7 (6.36)	9 (5.81)
Periods 16-20	16 (11.43)	3 (2.73)	4 (2.58)
<i>Total number of observations</i>	560 (100)	440 (100)	620 (100)

Note: The Table displays the number of observations, with the percentages represented by each category of situation in parentheses. \*\*\*, \*\* and \* indicate significance levels at the 0.01, 0.05 and 0.1 levels respectively, and ns indicates no significance in two-tailed Mann-Whitney tests in which we compare each treatment to the Baseline treatment. Each pair of subjects gives only one independent observation.

played in 92% of the cases in each of the three following blocks of periods. Pairs are also significantly more likely to play the SPNE in the second part of the game than in the first one (W test,  $p=0.002$  in the Two-Way treatment, and  $p=0.018$  in the One-Way treatment).

To complement this analysis, we now report the results of an econometric analysis. Table 7 presents the estimates of Probit models in which the dependent variable is the probability for a pair of subjects to play the SPNE. Standard errors are clustered at the pair level since groups are fixed throughout the session. Model (1) pools the data of all treatments, model (2) considers the data from the Baseline, and model (3) the data from the treatments with communication. In model (1) the independent variables include dummies for treatments (the Baseline is the reference category). Model (3) includes a dummy variable for the One-Way treatment. In all models, the independent variables include a time trend and various mean individual characteristics of the pairs. The latter consist of the number of females in the pair, the mean wealth, the within-pair difference in wealth, the mean risk index and the within-pair difference in the risk index. Indeed, players with different characteristics matched in the same pair may possibly coordinate more easily. Table 7 reports marginal effects.

Table 7: Determinants of the play of Subgame Perfect Nash Equilibrium

	(1) All treatments	(2) Baseline	(3) Communication treatments
Two-Way Treatment	0.277*** (0.041)	-	-
One-Way Treatment	0.241*** (0.039)	-	0.000 (0.041)
Period	0.019*** (0.0024)	0.023*** (0.005)	0.014*** (0.002)
Number females in the pair	-0.022 (0.072)	0.277** (0.136)	-0.163** (0.069)
Mean relative wealth	0.008 (0.012)	0.005 (0.019)	-0.003 (0.013)
Within-pair difference in wealth	-0.000 (0.013)	0.014 (0.022)	-0.009 (0.014)
Mean risk attitude	0.003* (0.001)	0.003 (0.002)	0.003** (0.001)
Within-pair difference in risk attitudes	-0.000 (0.001)	-0.000 (0.002)	-0.001 (0.000)
Number of observations	1620	560	1060
Log-likelihood	-750.45688	-359.14942	-362.57027
p>chi2	0.0000	0.0004	0.0000
Pseudo R2	0.1821	0.0713	0.1645

Note: Marginal effects of a Probit model in which the dependent variable is probability for a pair of subjects to play the SPNE are reported. Robust standard errors are clustered at the pair level. \*\*\*, \*\*, \* indicate significance at the 0.01, 0.05, and 0.10 level, respectively.

The regressions reported in Table 7 confirm that the likelihood to play the SPNE

is significantly higher in the two treatments with communication (model (1)). This result is in accordance with the literature showing that communication considerably increases the likelihood of coordination on an efficient equilibrium (Cooper et al. 1992; Blume and Ortmann 2007; Brandts and Cooper 2007). In contrast, model (3) shows that giving a stronger influence to one of the pair member does not affect coordination. The significant effect of the time trend shows evidence of learning within pairs. The marginal effect is especially large in the Baseline (model (2)). Interestingly, we find that pairs with more females are more likely to play the SPNE when communication is not available but not when communication is possible. A lower mean risk aversion increases the probability of playing the SPNE in communication treatments and when data of all treatments are pooled but the difference in the degree of risk aversion in the pair has no effect.

**Result 1:** *In a two-stage game where the Subgame Perfect Nash Equilibrium requires that the two players make opposite choices in both stages and accept unequal payoffs, only half of the pairs are able to coordinate in the absence of communication.*

**Result 2:** *Communication increases dramatically the probability of pairs to play the SPNE. Assigning to only one player the right to communicate does not affect this probability.*

#### 2.4.2. TURN TAKING AND SUBMISSION

In this last sub-section we examine two possible coordination strategies in pairs: turn taking and submission. Turn taking means that players exchange the bad turn (choosing option B that yields a payoff of 8 ECU) and the good turn (choosing option A that yields a payoff of 12 ECU) repeatedly (every period, every two, four, five or even after 10 periods). We impose that the strategy is observed for at least 10 periods in a row to characterize the pair of players as turn takers. Submission is the opposite of turn taking: one pair member always keeps the bad turn for himself and leaves the good turn to his partner.

In the Baseline treatment, turn taking remains seldom and is applied by only 5 pairs out of 28 (17.86%) continuously for at least 10 periods until the end of the game<sup>29</sup>. One of these pairs was able to implement this strategy from the second period. On the opposite, two pairs play the SPNE repeatedly but never exchange turns, one player dominating the other one who makes an attempt to change turns but gives up rapidly.

Communication undeniably improves the probability of turn taking. The great majority of pairs take turns during at least 10 periods when communication is allowed (90.90% and 77.41% of the pairs in the Two-Way and the One-Way treatments, respectively). These proportions are both significantly different from that in the Baseline (proportion tests,  $p < 0.001$ ), but not significantly different from each other ( $p = 0.305$ ). In the Two-Way treatment, 20 pairs out of 22 have continuously exchanged their turns. Among these 20 pairs, 18 have exchanged their turns after each period and only two pairs exchanged turns after 10 periods. We do not find evidence of domination-submission in this treatment.

<sup>29</sup>For more detailed information, Figures C1, C2 and C3 in Appendix 3 display the strategies played by each subject within each pair in each period, for each treatment respectively.

In the One-Way treatment, 24 pairs out of 31 have continuously exchanged their turns in at least 10 periods<sup>30</sup>. Most of the groups exchange the good and bad turn after each period. The message sender monopolizes the good turn in only three pairs, and the player who cannot send a message accepts this submission without trying to punish his partner. The study of the communication content shows that in one pair the message sender mislead his partner, by making him believe that he would give him the good turn after 10 periods, what he eventually did not do. In two pairs, turn taking occurred not every period but after a first block of 10 periods. This obviously requires that the player who takes the first bad turn trusts the other player. This is why the message sender in both groups started with the bad turn.

The average difference of payoffs in absolute value between the treatments is 3.28, 2.64 and 3.98 ECU in respectively the Baseline, Two-Way and One-Way. Mann-Whitney tests indicate that there is a statistically significant difference between the Baseline and the communication treatments (MW tests, Baseline vs. Two-Way  $p=0.001$ , Baseline vers One-Way  $p<0.001$ ) but that there is no difference between the two communication treatment (MW test,  $p=0.8187$ ). Communication helps individual equalize long term payoffs by rotation between the good and the bad turn. Even if the mean duration of the turn taking strategy for those groups who are able to implement it during at least 10 periods without any interruption is 16.20 periods in the Baseline, 17.40 in the Two-Way treatment and 18.70 in the One-Way treatment pairwise Mann-Whitney tests show that the mean duration in the Baseline is significantly different compared to both the Two-Way and the One-Way treatments (MW tests,  $p<0.001$  in both) but there is no difference between the two communication treatments (MW test,  $p=0.386$ ). This suggests that communication is not only crucial to initiate this strategy but also to sustain it.

To further investigate the determinants of turn taking we estimate Probit models in which the dependent variable takes value 1 if the pair has played a turn taking strategy for at least 10 periods in a row, and 0 otherwise. One pair gives only one observation in these models. Model (1) is for the whole sample, model (2) restricts the sample to the Baseline treatment and model (3) to the treatments with communication. For consistency, we add the same independent variables as in the regressions reported in Table 7, except for the time trend. Table 8 reports marginal effects.

---

<sup>30</sup>Relaxing the definition by considering that players use turn taking when they alternate continuously during at least five periods instead of 10 does not make a difference: only 6 pairs out of 28 correspond to this larger definition in the Baseline, 21 out of 22 in the Two-Way treatment and 27 out of 31 in the One-Way treatment.

Table 8: Determinants of the probability of pairs to use turn taking in at least 10 periods

	(1) All treatments	(2) Baseline	(3) Communication treatments
One-Way Treatment	0.568*** (0.094)	- -	-0.057 (0.050)
Two-Way Treatment	0.564*** (0.85)	- -	- -
Number females in the pair	-0.127 (0.196)	0.426* (0.236)	-0.226** (0.099)
Mean relative wealth	0.0199 (0.031)	0.045 (0.032)	-0.010 (0.013)
Within-pair difference in wealth	-0.004 (0.003)	-0.003 (-0.025)	-0.015 (0.015)
Mean risk attitude	0.004 (0.003)	0.003 (0.004)	0.003* (0.001)
Within-pair difference in risk attitudes	0.001 (0.003)	-0.004 (0.003)	0.001 (0.001)
Number of observations	81	28	53
Log-likelihood	-31.934	-9.871	-15.107
p>chi2	<0.001	0.1127	0.1588
Pseudo R2	0.4019	0.2486	0.2697

Note: Marginal effects of a Probit model in which the dependent variable is probability for a pair of subjects to play the SPNE are reported. Robust standard errors are clustered at the pair level. \*\*\*, \*\*, \* indicate significance at the 0.01, 0.05, and 0.10 level, respectively.

Table 8 confirms that the two communication treatments significantly increase the probability of turn taking. In model (1)), a t-test comparing the two coefficients shows that there is no significant difference between the coefficients of the two communication treatments. ( $p=0.380$ ). Interestingly, model (3) indicates that pairs in which players are less risk averse have greater probability of turn taking.

To sum up, we have the following findings.

**Result 3:** *In a two-stage game with a SPNE with asymmetric payoffs, less than one fifth of pairs use a turn taking strategy when no communication is allowed.*

**Result 4:** *Communication increases the ability of players to implement durably a turn taking strategy to coordinate on the SPNE. There is no difference between two-way and one-way modes of communication in the probability of turn taking.*

**Result 5:** *Communication is more crucial to initiate a turn taking strategy of coordination than to sustain it.*

## 2.5. Conclusion

Our laboratory experiment investigates how individuals can coordinate in a two-stage game that captures some real features, like investment in infrastructure and fiscal competition between regions or vertical differentiation between firms. The literature has shown how frequent are coordination failures in one-stage games, and how communication can help individuals to coordinate, notably by implementing strategies like turn taking in order to reduce long-term payoff inequality. Our contribution is to study whether communication has the same ability to overcome coordination failures in a two-stage game where the Subgame Perfect Nash Equilibrium requires that the two players make opposite choices in both stages and accept unequal payoffs.

We find that coordination failures occur in almost half of the time and less than one fifth of pairs use a turn taking strategy to alleviate long-term payoff inequality. Communication increases dramatically coordination on the SPNE. This results from the fact that it increases the ability of players to initiate a turn taking strategy between the players. Its impact is also important in sustaining it. Finally, allowing both players or only one player to send messages to his partner has no effect on the probability of using turn taking and coordinating on the SPNE. Indeed, in the One-Way treatment in one fourth (25,81%) of the groups the player that could send the messages was also the one that started with the bad turn indicating the will of these players to implement turn taking.

By communicating together subjects were able to establish a long-lasting strategy that allowed them to increase efficiency and decrease inequality by exchanging their relative positions in a fair way. Our results show that communication is able to solve coordination conflicts even in more complex situations than in the one-stage games usually studied until now.

A natural extension of this research could aim at determining the frontiers of positive communication effects on conflict resolution. This would require strengthening the difficulty of finding a consensus in our two-stage game, for example by introducing a stronger conflict in the second stage of the game. The payoff structure could be modified such that the Subgame Perfect Equilibrium no longer corresponds to the social optimum. Finally, the decisions could be made partially or completely irreversible so that the application of turn taking would become more complicated.

# Appendix 1 Extensive form of the two-stage co-ordination game

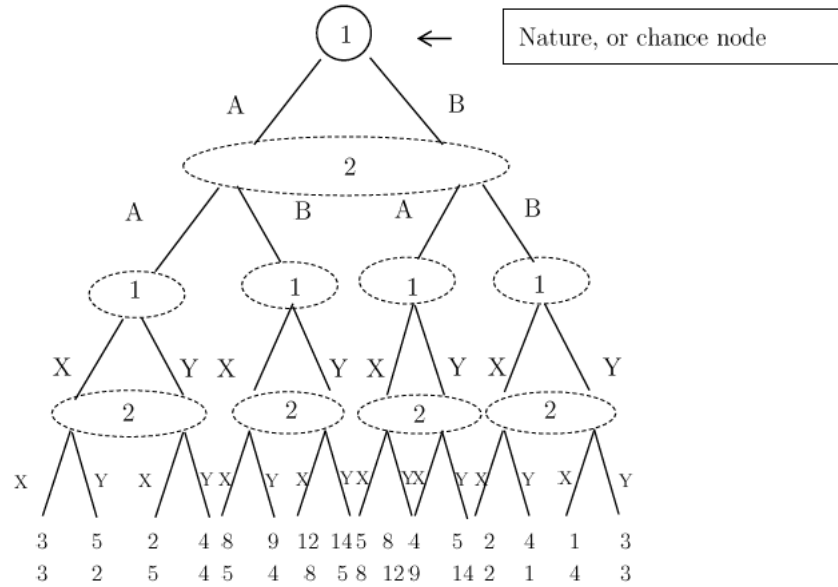


Figure 5: Extensive form of the two-stage coordination game

## Appendix 2 Instructions (translated from French)

*The following instructions are for the Baseline treatment. We add the instructions that are specific to the communication treatments in italics into brackets. The instructions for the additional part of the One-Way treatment are shown after the instructions for the other treatments.*

### *General information*

We thank you for participating in this experiment in economics. Your payoffs depend on your decisions. It is therefore important that you read the following instructions carefully.

Instructions are distributed for your personal use. We thank you for not communicating with other participants during the experiment unless you are invited to do so. All your decisions are anonymous: you will never enter your name into the computer during the experiment.

The experiment is divided into two independent parts. *[This sentence is replaced by the following in the One-Way treatment: The experiment is divided into three parts. The first part is independent of the following parts.]* First, we will explain the first part. Once the first part is completed, you will receive detailed information for the second part.

During the experiment, we will not talk about Euros but about ECU (Experimental Currency Units). All payoffs will be calculated in ECU. The conversion rate between ECU and Euros is:

$$100 \text{ ECU} = 5 \text{ Euros}$$

At the end of the experiment, the total number of ECU that you earned in each part will be converted into Euros. In addition to this amount, you will receive a show up fee of 4 Euros.

All payments will be made in private and in cash in a separate room. Other participants will never know the amount of your payoffs in this experiment.

### **Part 1**

#### **Description of the task**

You will receive 80 ECU. We ask you to choose an amount in ECU (between 0 and 80 ECU included) that you are willing to invest in a risky asset. You keep for yourself the ECU that are not invested.

#### **The investment**

There is one chance out of two that the investment is a success.

If this is a success, you will receive two and a half times the amount you have invested.

If the investment is not a success, you will lose the amount you invested.

1st example: You invest 0 ECU. You earn:  $(80 - 0) = 80$  ECU.



2nd example: You invest 40 ECU.

If the investment is a success, you earn  $(80 - 40) + 2.5 \times 40 = 140$  ECU.

If the investment is not a success, you earn  $(80 - 40) + 0 = 40$  ECU.

3rd example: You invest 80 ECU.

If the investment is a success, you earn  $(80 - 80) + 2.5 \times 80 = 200$  ECU.

If the investment is not a success, you earn  $(80 - 80) + 0 = 0$  ECU.

### **How do we determine if the investment is a success?**

We ask you to choose a color: black or white.

At the end of the session, the computer program will randomly select one of these two colors. Each color has the same chance of being selected.

If the randomly selected color is the one you have chosen, the investment is a success.

If the randomly selected color is not the one you have chosen, the investment is not a success.

You will be informed of your payoff in this first part only at the end of the session.

**To sum up:** You have to choose now the amount you wish to invest and the color. At the end of the session, the program will randomly select a color for all the participants and it will indicate to you the color randomly selected as well as your payoff for this part that will be added to your payoffs of the second part.

Please read these instructions. If you have any question about these instructions, please raise your hand and we will answer these questions in private.

## **Part 2** (*distributed after completion of Part 1*)

This part includes 20 independent periods.

Before the beginning of the first period, the computer program will randomly divide the participants in this session between Red participants and Blue participants. There are as many Red participants as Blue participants.

During these 20 periods, you will be either a Blue participant or a Red participant. You will keep the same color throughout the whole session. You will be informed of your color before the beginning of the first period.

At the beginning of this part, the computer program will form pairs composed of a Blue participant and a Red participant. You will be randomly paired with another participant in this session who has a different color from yours. You will remain paired with the same co-participant during the 20 periods. You will never know the identity of your co-participant.

### **Description of each period**

Each period consists of two stages. During each of the two stages you will have to choose between two options.

*[Two-Way treatment: At the beginning of each period, before starting the first stage, you can communicate with your co-participant. A dialog box will appear on your*

screen for this purpose. For a maximum of 1 minute, you can use this box to exchange messages with your co-participant. Your messages should not include information that identifies you or your co-participant. They must not contain rude language or threats. If you want to stop the communication before the minute has elapsed, press the “OK” button. Once you or your co-participant press the “OK” button, the dialog box is no longer available and the next screen appears at the same time for both co-participants. As soon as one of you press the “OK” button it is no longer possible to send messages. If you do not press the “OK” button, the dialog box closes automatically after one minute, and the next screen appears. ]

### **Stage 1**

You have to choose between **option A and option B**. Your co-participant also chooses between these two options simultaneously.

Once you and your co-participant have made your choices, you will be informed of the choice of your co-participant and your co-participant will be informed of your choice.

### **Stage 2**

You have to choose between **option X and option Y**. Your co-participant also chooses between these two options simultaneously.

Once you and your co-participant have made your choices, you will be informed of the choice of your co-participant and your co-participant will be informed of your choice. You are then informed of your payoff and of the payoff of your co-participant. The period ends and another period starts automatically.

### **Calculation of payoffs**

Your payoffs and the payoffs of your co-participant in the period depend on the choices between options A and B and between options X and Y. Table 1, in the attached sheet, represents all possible payoffs in a period. Please refer to this table.

Table 1 shows in red the choice (A, B, X, Y) and the possible payoffs of the Red participant in the period. It shows in blue the choices (A, B, X, Y) and the possible payoffs of the Blue participant in the period.

At the end of stage 1, one of the following four situations is possible:

- Both participants chose option A
- Both participants chose option B
- The Red participant chose option A and the Blue participant chose option B
- The Red participant chose option B and the Blue participant chose option A.

At the beginning of stage 2, only one of the 4 panels of Table 1 will be used to determine your payoffs for the period given your choice and the choice of your co-participant between options X and Y. We describe below the four possible cases, each case refers to a table in the attached sheet.

**a) If both participants chose option A in stage 1, Table 2** describes the possible payoffs given the choices made between X and Y in stage 2. Please refer to it.

Table 2 reproduces the North West panel of Table 1. Four situations are possible at the end of stage 2:

- Both participants chose option X. The Red participant earns 3 ECU and the Blue participant earns 3 ECU.
- Both participants chose option Y. The Red participant earns 4 ECU and the Blue participant earns 4 ECU.
- The Red participant chose option X and the Blue participant chose option Y. The Red participant earns 5 ECU and the Blue participant earns 2 ECU.
- The Red participant chose option Y and the Blue participant chose option X. The Red participant earns 2 ECU and the Blue participant earns 5 ECU.

**b) If both participants chose option B in stage 1, Table 3** describes the possible payoffs given the choices made between X and Y in stage 2.

Table 3 reproduces the South East panel of Table 1. Four situations are possible at the end of stage 2:

- Both participants chose option X. The Red participant earns 2 ECU and the Blue participant earns 2 ECU.
- Both participants chose option Y. The Red participant earns 3 ECU and the Blue participant earns 3 ECU.
- The Red participant chose option X and the Blue participant chose option Y. The Red participant earns 4 ECU and the Blue participant earns 1 ECU.
- The Red participant chose option Y and the Blue participant chose option X. The Red participant earns 1 ECU and the Blue participant earns 4 ECU.

**c) If the Red participant chose Option A and the Blue participant chose option B, Table 4** describes the possible payoffs given the choices made between X and Y in stage 2.

Table 4 reproduces the North East panel of Table 1. Four situations are possible at the end of stage 2:

- Both participants chose option X. The Red participant earns 8 ECU and the Blue participant earns 5 ECU.
- Both participants chose option Y. The Red participant earns 14 ECU and the Blue participant earns 5 ECU.
- The Red participant chose option X and the Blue participant chose option Y. The Red participant earns 9 ECU and the Blue participant earns 4 ECU.
- The Red participant chose option Y and the Blue participant chose option X. The Red participant earns 12 ECU and the Blue participant earns 8 ECU.

**d) If the Red participant chose option B and the Blue participant chose option A, Table 5** describes the possible payoffs given choices made between X and Y in stage 2.

Table 5 reproduces the South West panel of Table 1. Four situations are possible at the end of stage 2:

- Both participants chose option X. The Red participant earns 5 ECU and the Blue participant earns 8 ECU.
- Both participants chose option Y. The Red participant earns 5 ECU and the Blue participant earns 14 ECU.
- The Red participant chose option X and the Blue participant chose option Y. The Red participant earns 8 ECU and the Blue participant earns 12 ECU.
- The Red participant chose option Y and the Blue participant chose option X. The Red participant earns 4 ECU and the Blue participant earns 9 ECU.

At the end of stage 2, you will be informed of the choice of your co-participant, of your payoff and of the payoff of your co-participant in this period. The next period will start automatically.

You have at your disposal on your desk a history table that allows you to take notes on your decisions and the decisions of your co-participant and on the associated payoffs in each period.

#### **End of the part**

At the end of the 20 periods, you will be informed of your total payoff in this part. Your total payoff in this part is the sum of your payoffs in each of the 20 periods.

Then, a final questionnaire will appear on your screen. Afterwards, you will be informed when to go to the payment room.

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Please read again these instructions. If you have any question, raise your hand and we will answer to your questions in private. Thank you to fill out the understanding questionnaire that has been distributed. We will come to you to check your answers in private.

----

Choices of the red participant		Choices of the blue participant			
		A		B	
		X	Y	X	Y
A	X	3 ; 3	5 ; 2	8 ; 5	9 ; 4
	Y	2 ; 5	4 ; 4	12 ; 8	14 ; 5
B	X	5 ; 8	8 ; 12	2 ; 2	4 ; 1
	Y	4 ; 9	5 ; 14	1 ; 4	3 ; 3

Figure 6: Table 1. Payoffs with options A, B, X and Y at the beginning of stage 1

Choices of the red participant		Choices of the blue participant	
		X	Y
X	3 ; 3	5 ; 2	
Y	2 ; 5	4 ; 4	

Figure 7: Table 2. Payoffs with options X and Y when **both participants chose A** in stage 1

Choices of the red participant		Choices of the blue participant	
		X	Y
X	2 ; 2	4 ; 1	
Y	1 ; 4	3 ; 3	

Figure 8: Table 3. Payoffs with options X and Y when **both participants chose B** in stage 1

Choices of the red participant		Choice of the blue participant	
		X	Y
X	8 ; 5	9 ; 4	
Y	12 ; 8	14 ; 5	

Figure 9: Table 4. Payoffs with options X and Y when **Red chose A and Blue chose B** in stage 1

Choices of the red participant		Choices of the blue participant	
		X	Y
X	5 ; 8	8 ; 12	
Y	4 ; 9	5 ; 14	

Figure 10: Table 5. Payoffs with options X and Y when **Red chose B and Blue chose A** in stage 1

*Instructions for the additional Part 2 and for Part 3 in the One Way Communication*

## Part 2

In this part, we ask you to perform a task. Your score in this task will be compared to the scores of the other participants and it will be used to determine your role in the next part, as explained below.

### Description of the task

At the beginning of this part your screen will show 16 black rectangles, as shown in the figure below:

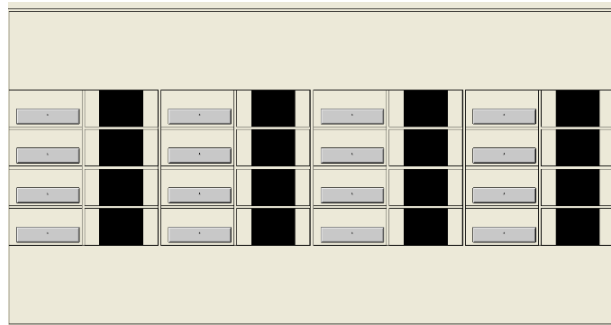


Figure 11: Beginning of the memory task

On the screen, the 16 black rectangles hide 8 pairs of identical images. The task is to reform a maximum of pairs of identical images for a period of 5 minutes. You score 1 point each time you form a pair of identical images, as shown in the figure below.

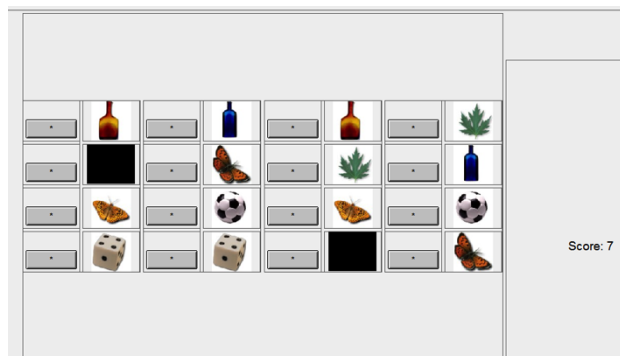


Figure 12: Illustration of the task

To see the image that hides behind a black rectangle, press the gray button to the left of the black rectangle. The first uncovered image remains visible while you are uncovering a second image. You can press gray buttons as many times as you want but you can only see two images at once.

If the two images you just uncovered are not identical, they disappear again behind black rectangles after half a second. When two identical images are displayed at

the same time, your score increases by 1 point and the 2 identical images remain permanently visible. To facilitate the search for pairs of identical images, you should try to memorize the images already uncovered behind the black rectangles.

Once you have uncovered the 8 pairs of images on the screen, a new screen appears with the same images, but arranged randomly in a different way. These images include a ball, a die, two kinds of butterflies, two types of bottles and two kinds of leaves.

Your total score in this part is given by the number of pairs of identical images you have been able to reform during 5 minutes.

To familiarize yourself with the task, you will have the chance to train for two minutes. At the end of this training period, the part will start automatically.

### **Relative performance**

At the end of this part the computer program will compare the scores of the participants in the room. It will define two groups according to the scores. One group will be composed of the half of participants who have the highest scores and the other group will be composed of the half of participants who have the lowest scores. Depending on your score you will be assigned to one of the two groups and your role will be different in the third part of this experiment. Please read again these instructions. If you have any question, please raise your hand and we will answer to you in private.

### **Part 3** (*distributed after completion of Part 2*)

This part includes 20 independent periods.

At the beginning of this part, the computer program will form pairs. You will be randomly paired with another participant in this session. You will remain paired with the same co-participant during the 20 periods. You will never know the identity of your co-participant.

Within each pair, one of the participants will be able to send messages to the other participant at the beginning of each period. It is always the same participant who will be able to send messages to the other.

To determine the participants who can send the messages, the computer program rank participants in this session based on the scores achieved in part 2. It forms two groups of equal size according to the scores achieved. Participants who belong to the group that made the highest scores in Part 2 will be allowed to send messages to their co-participant who belongs to the other group.

In addition, before the beginning of the first period, the computer program will randomly divide the participants in this session between Red and Blue participants. There are as many Red participants as Blue participants. Each pair consists of a Red participant and a Blue participant. Thus, during these 20 periods, you will either be a Blue participant or a Red participant. You will keep the same color throughout the session. In the pair, the participant who can send messages to the other participant can be either the Red participant or the Blue participant. The color assignment is independent of the ability to send messages.

You will be informed of your color before the beginning of the first period. The program will also inform you whether you are or not allowed to send messages to your co-participant, as explained below.

### **Description of each period**

Each period consists of two stages. During each of the two stages you will have to choose between two options.

At the beginning of each period, before starting the first stage, if you are the participant who can send messages to your co-participant, you can communicate with your co-participant. A dialog box will appear on your screen for this purpose. For a maximum of 20 seconds, you can use this box to send messages to your co-participant. Messages should not include information that identifies you or your co-participant. They must not contain rude language or threats.

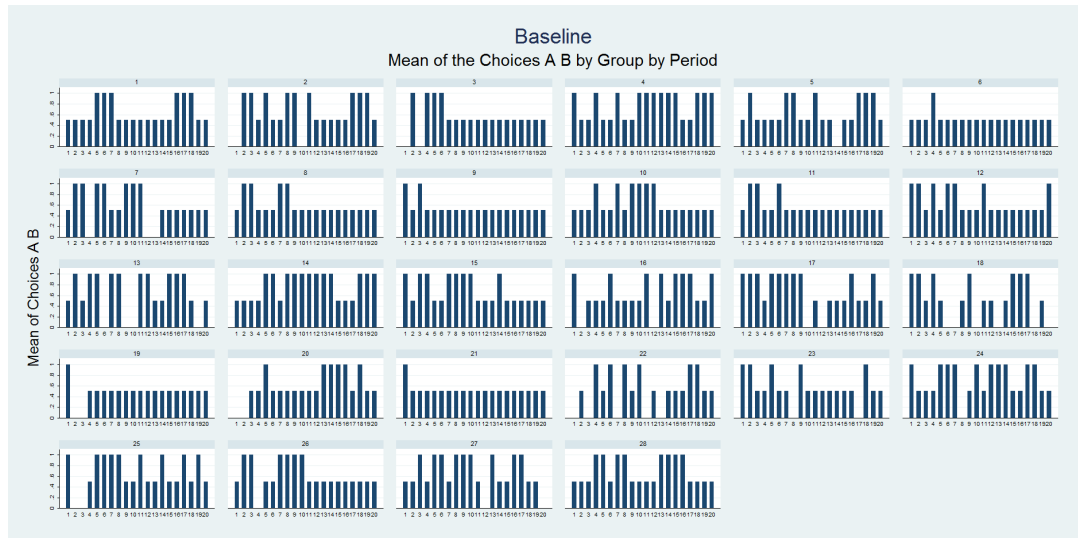
If you want to stop the communication before the 20 seconds have elapsed, press the “OK” button. Once you have pressed the “OK” button, the dialog box is no longer available and the next screen appears at the same time for both co-participants. If you do not press the “OK” button, the dialog box closes automatically after 20 seconds, and the next screen appears.

If you are the participant who is not allowed to send a message to your co-participant, you will see your co-participant’s messages appear in the dialog box on your screen. However, you cannot respond.

*The rest of the instructions is similar to the other treatments.*



## Appendix 3 Figures of pair decisions



Note: This graph displays the first-stage choices of each pair in each of the 20 periods. Choosing A corresponds to 1, choosing B corresponds to 0. Thus, a mean choice between A and B equal to 0.5 means that the two players in the pair have chosen opposite options.

Figure 13: Figure A1. Mean first stage choices between A and B, by pair and by period, Baseline

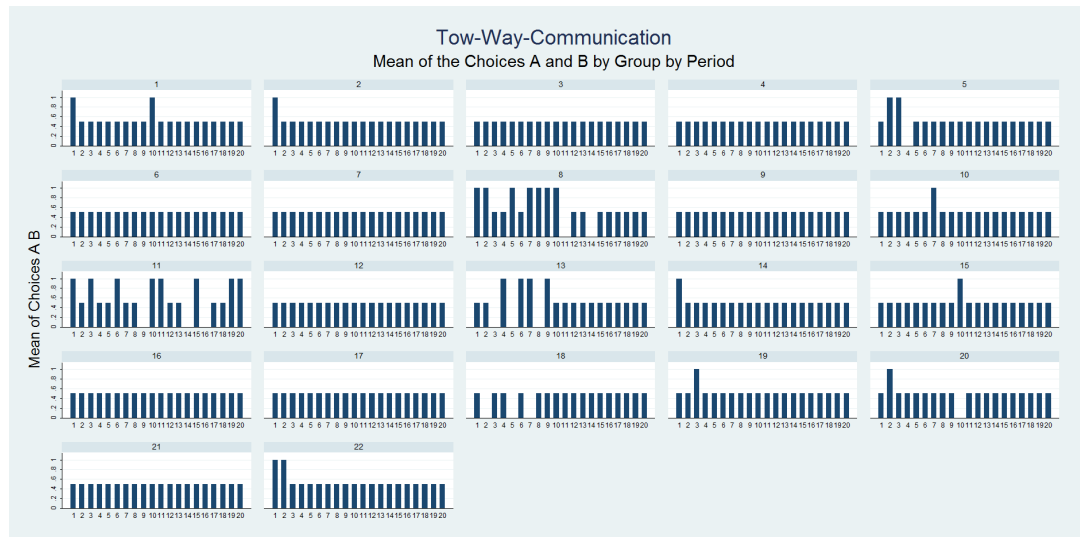


Figure 14: Figure A2. Mean first stage choices between A and B, by pair and by period, Two-Way treatment

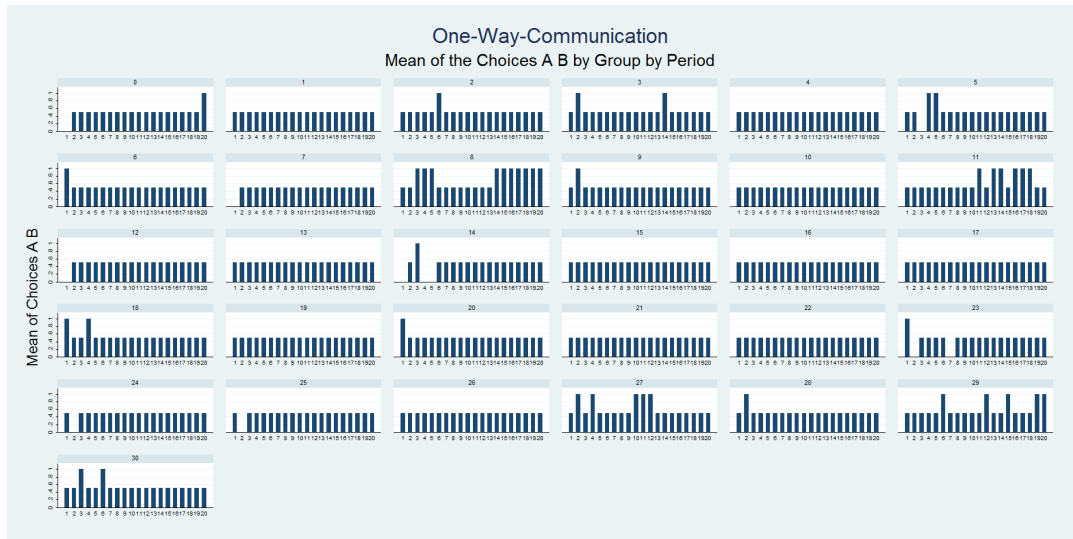
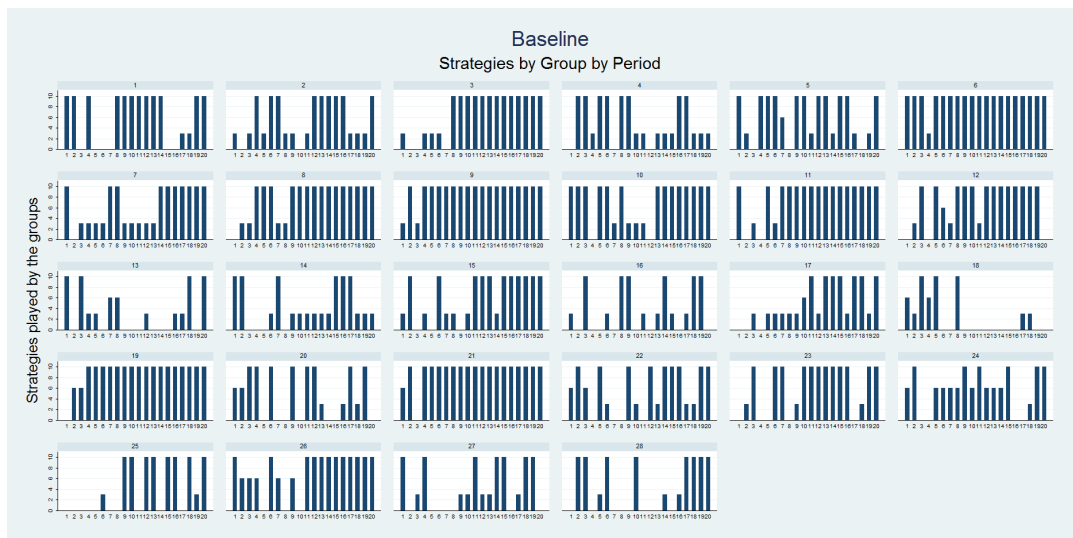


Figure 15: Figure A3. Mean first stage choices between A and B, by pair and by period, One-Way treatment



Note: This graph displays the two-stage strategy of each pair in each of the 20 periods. The values on the scale are arbitrary. Value 10 means that the pair chose opposite options in both the first and the second stages; they played the Subgame Perfect Nash Equilibrium. Value 6 means the two pair members have chosen the same option in the first stage and they played Pareto optimally in the second stage instead of following their dominant strategy. Value 3 indicates that after choosing the same option in the first stage, the two pair members played their dominant strategies in the second stage of the game. We set 0 for all the other strategies.

Figure 16: Figure B1. Mean strategies in the two stages, by pair and by period, Baseline

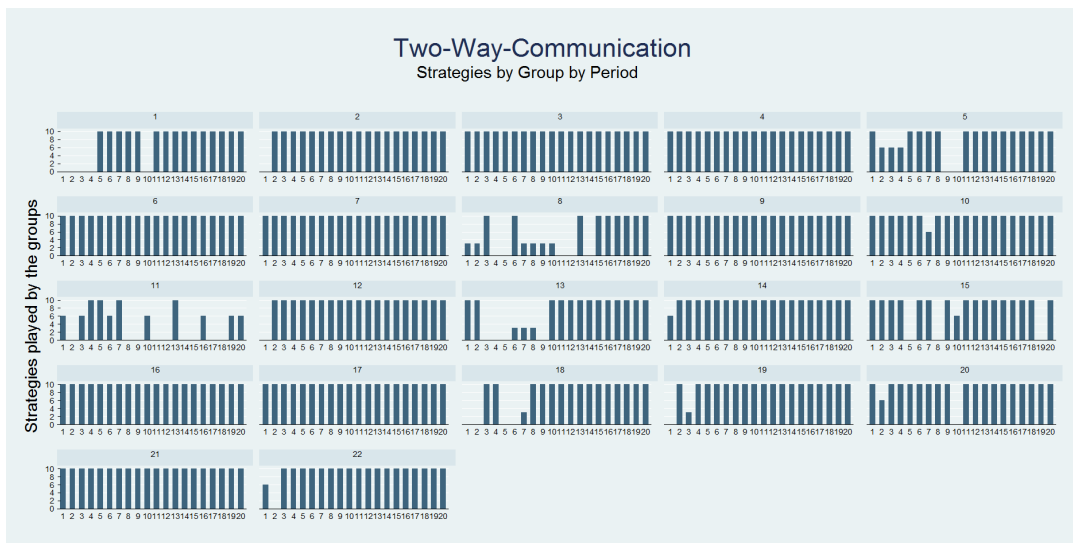


Figure 17: Figure B2: Mean strategies in the two stages, by pair and by period, Two-Way-Communication

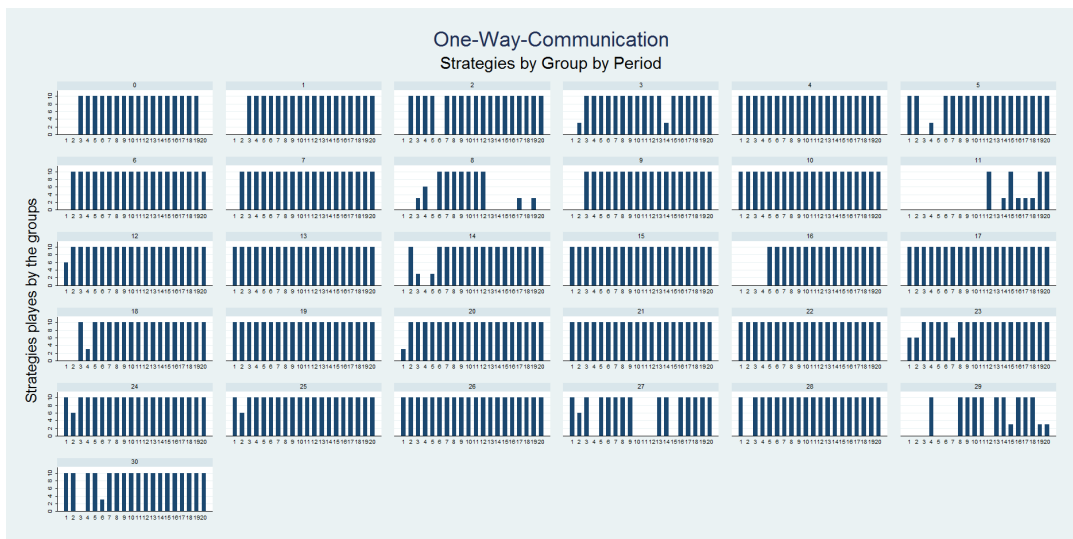
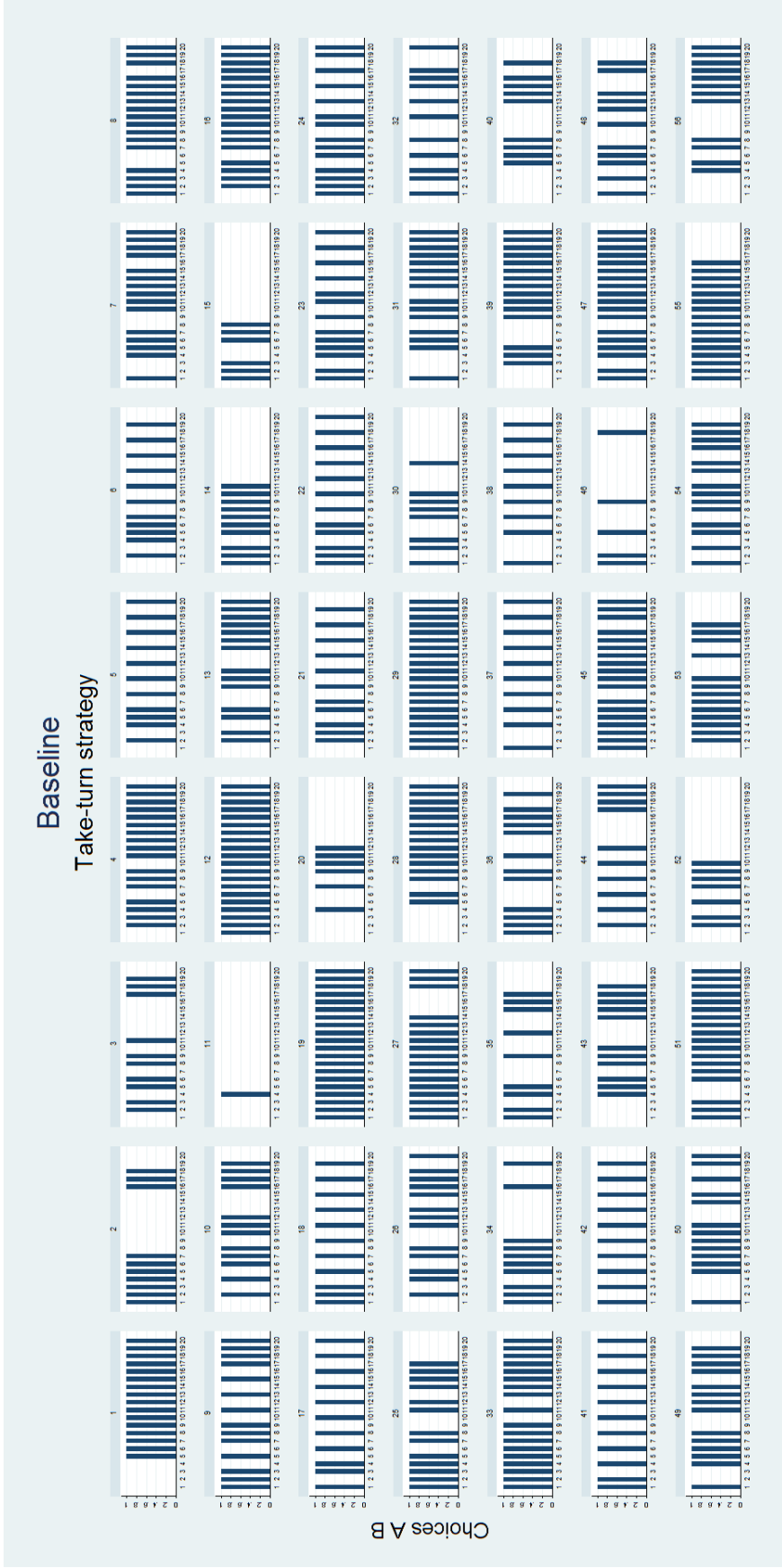


Figure 18: Figure B3: Mean strategies in the two stages, by pair and by period, One-Way-Communication



Note: This graph displays the strategy played by each subject taken individually in the 20 periods. There are two graphs for each pair, one for each player (for example, the first two charts correspond to player 1 and player 2 in pair 1). Value 1 means that the subject played the good turn in the period (choice of A). Value 0 indicates that the subject has played the bad turn (choice of B). To see which coordination strategy the pair members have used in a period, two graphs must be considered at the same time. Only 5 pairs (3, 9, 11, 19, and 21) out of 28 exchanged their turns. On the opposite, in pair 6 subjects never changed their turns.

Figure 19: Figure C1. Turn taking strategy, by pair and by period, Baseline

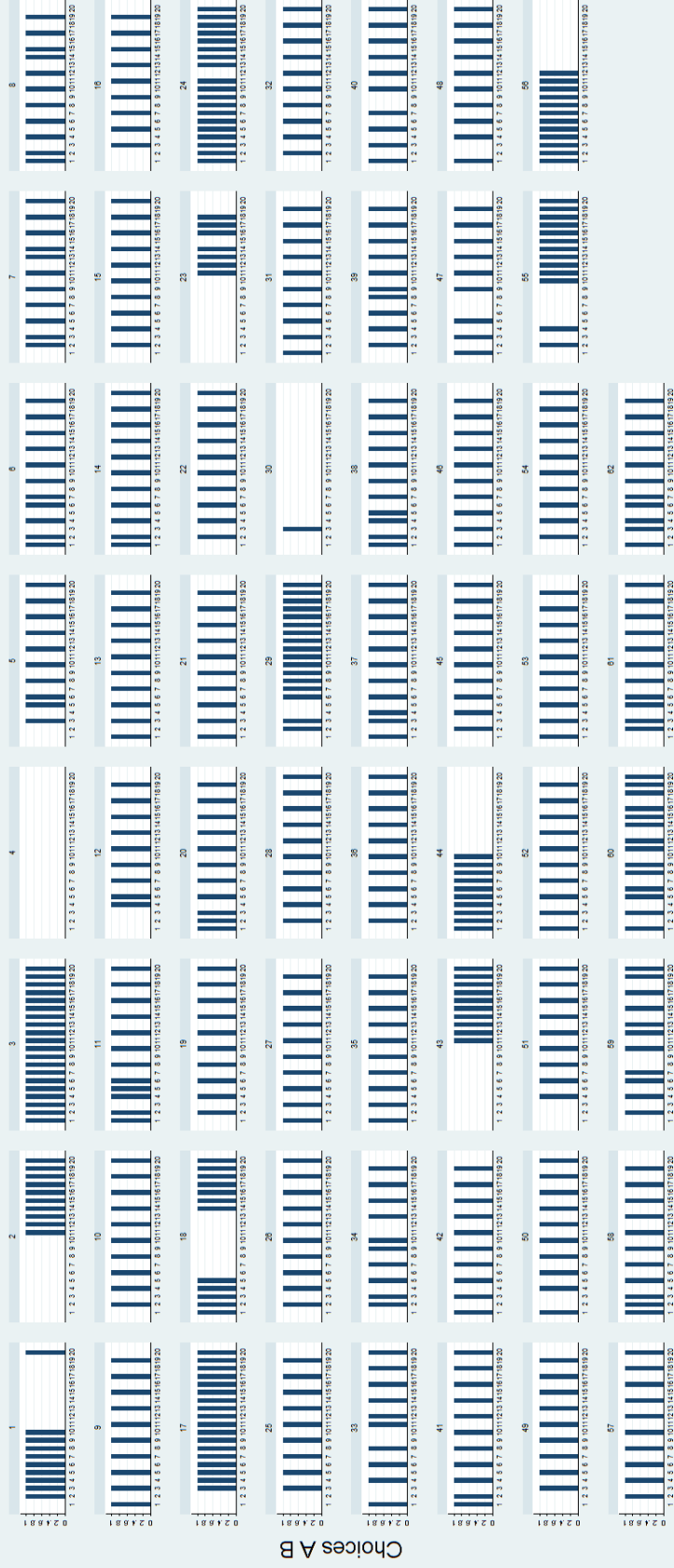
## Two-Way-Communication Take-turn strategy



Note: 19 pairs out of 22 have continuously exchanged turns. Among these 19 pairs 17 have exchanged turns after each period and two (pairs 1 and 19) exchanged turns after 10 periods.

Figure 20: Figure C2. Turn taking strategy, by pair and by period, Two-Way-Communication

## One-Way-Communication Take-turn Strategy



Note: 24 pairs out of 31 exchanged their turns. The message sender monopolizes the good turn in three pairs (8, 11 and 27).

Figure 21: Figure C3. Turn taking strategy, by pair and by period, One-Way-Communication

## Chapter 3

### *Should we break up? Experimental evidence of viewing political secessions as a social dilemma*

#### 3.1. Introduction

Since 1990, a great number of new independent states have been created either by secession, decolonization or by the dismantling of existing countries. Spolaore (2008) cites, among others, the examples of the Soviet Union, which was divided into fifteen independent countries, of Yugoslavia which led to six sovereign states, or of Czechoslovakia that broke into two distinct states. Since 1945, the number of sovereign states in the internationally recognized world increased from 74 to 193 (Spolaore 2008). More recently, Scotland and Catalonia voted, officially or not, over their independence while in Belgium the Flemish region regularly threatens the central government with secession. Simultaneously to these separatist trends, the OECD countries, as well as the developing countries, have experienced in the last twenty years an increase in the decentralization of the power of self-administration. Nowadays, the OECD counts 140'000 sub national governments that the decentralization trend of the last twenty years has made more powerful and more likely to influence the course of a country (OECD 2014). The question then arises of the existing means to curb these movements and more particularly if decentralization and federalism reduce incentives for groups to secede.

When central governments are confronted with a secessionist threat in one or more regions they can devolve some power or competences to the regional entity, in the hope that the decentralization of power will accommodate regional demand and thereby quell the separatist movement (Sorens 2004; Lustick and Miodownik 2004; Bakke and Wibbels 2006; Miodownik and Cartrite 2009; Flamand 2011). However, granting a region with greater autonomy may have two opposing effects. On the one hand, greater autonomy brings the overall mix of public goods closer to the local preferences, and more generally increases the confidence of citizens that their interests are well or even better represented. On the other hand, as argued by Lustick, Miodownik and Eidelson (2004: 210) : “*creating autonomous, federal, or otherwise devolved institutions of self-government or self-administration [...] is liable to contribute to secessionism by affording elites and groups the political resources they need to undertake mass mobilization and wage separatist struggles.*” Consequently, devolving the power of self-administration to other layers of government is a double edged sword.

Theoretical literature lists many causes driving the decision to secede. Among those

causes are economic motivations such as the degree of economies of scale in the provision of public goods, the differences in preferences for the public goods, the differences in income distributions, the presence of natural resources in a region, but also sociocultural reasons as differences among ethnic groups or the language (Alesina and Spolaore 1997; Bolton and Roland 1997). All these causes, except the first one, are determined as fostering separatist movements. Due to the multitude of factors in play and to the rarity, while not infrequency, of actual break-ups and secessions, real-world secessionist movements are difficult to analyze empirically (Spolaore 2008).

The present paper aims at studying the decision to secede depending on the decentralization of governments by means of a laboratory experiment. More particularly we examine the effects of (1) decentralized public goods supply and of (2) local group identities on the decision to secede.

To this purpose, we test an experimental protocol in the laboratory. We hypothesize that separatist movements might be considered as an example of social dilemma. A social dilemma appears from the moment when people have to choose between doing what is in their own interest and what is the best for the interest of the group as a whole. But the rational pursuit of self-interest ultimately always leads to a result that is beneficial to anyone. In our protocol we define secession as the result of a majority vote in the three local groups, which together form the global group, in favor of a supply of only local public goods. The direct consequence of this vote is a dismantling of the global group and the loss of public goods provided at the global level. Individuals make this decision in the knowledge that local public goods are individually more profitable while global public goods are collectively more advantageous. Thus, our reasoning is built on the assumption that the choice of a local group to secede from the global group is less beneficial for the global group as a whole. Such a decision meets individual interest but is detrimental to the welfare of the community as a whole. In order to apprehend this social dilemma, we build an experimental design based on a public good game using the voluntary contribution mechanism (VCM) (Isaac and Walker's 1988) with three public goods supplied at two different levels: at the *local* level and at the *global* level. Only 3 subjects (the members of a given local group) can contribute to a local public good while all 9 subjects (all the members of the global group) can contribute to the global public good, consequently, the global public good has a higher social return. Additionally, marginal per capita returns of these two types of public goods are different. Namely, the MPCR is 0.5 for the local public goods and 0.2 for the global public goods. We consider three treatments corresponding to three different sociopolitical contexts.

The Baseline treatment has three parts of 12 periods each. In the first part, individuals decide, simultaneously, on the share of their endowment they contribute to one local group account and two global group accounts while keeping the remainder on their private account. In the second part, participants face the same decision scheme except that all group accounts are local. At the beginning of the third part, individuals are asked to vote for the institutional arrangement they have experienced either in part 1 or in part 2 knowing that they will play for the next 12 periods in the configuration that obtained the majority of votes. The second treatment aims at capturing a decentralized public good supply and is called *Decentralization*. The Decentralization treatment is similar to the Baseline except that



the proportion of the available types of goods is changed: the number of local group accounts is increased from one to two whereas the number of global group accounts is decreased from two to one. As in the Baseline, individuals simultaneously have to decide the allocation of their endowment between two local group accounts and the unique global group account. The third and fourth treatments, called *Identity* and *Identity-Decentralization*, are administered to the Baseline treatment and to the Decentralization treatment. The Identity treatments were designed to emphasize local group identity. This was achieved by using a different procedure for local groups' formation. Without the Identity treatments, local groups were randomly constructed but when the Identity treatments were applied groups were constituted based on the proximity of subjects' opinions in a preliminary questionnaire. Each local group is formed with subjects that share the closest opinions.

Our experimental design aims at testing the effects of the Decentralization and Identity treatments on contributions levels and on the probability of the occurrence of a secession, i.e. the decision to vote for the institutional arrangement that includes only local public goods and whose consequence is the break-up of the global group and the loss of the global public good.

Our results show that the Decentralization and Decentralization-Identity treatments increase contributions to the local public goods at the detriment of the global public good. Interestingly, the Identity treatment does not affect significantly the level of individual contributions. As regards the vote outcome, our results indicate that the Decentralization treatment decreases the occurrence of the global group break-up also when identity is made more salient. In fact, reinforcing local group identity increases the likelihood of the global group break-up only when local group members are cooperators.

The remainder of the paper is organized as follows. Section 3.2 surveys the related literature. Section 3.3 describes the experimental design and procedures and states our predictions. Section 3.4 reports the experimental results and Section 3.5 briefly discusses the results and concludes.

## 3.2. Related literature

Relatively few experimental studies analyze the behavioral impact of having several group accounts. These studies can be broken into two groups. The first group decomposes a single public good into multiple parts, while the second group considers two different public goods. Our paper is most closely related to the studies of Wachsman (2002), Blackwell and McKee (2003), Bernasconi et al. (2009), McCarter, Samak and Sheremeta (2013), Fellner and Lünser (2014) and Nitta (2014).

In the first group, Bernasconi et al. (2009) explore behavior when an identical public good is duplicated. They compare contributions when a single group contributes to one public good or to multiple public goods. They show that subjects' voluntary aggregated contributions increase when a single public good is split into two identical public goods. Close to this design, McCarter, Samak and Sheremeta (2013) run a laboratory experiment where participants paired with either different or the same group members, under a single budget constraint, allocate money between two distinct public good games. They aim at testing the conclusions of two different

strands of literature. In organizational behavior and social psychology it is argued that straddling multiple collective efforts simultaneously affects negatively cooperation because of “divided loyalties” (Polzer et al. 1999; Wit and Kerr 2002; McCarter et al. 2010). Whereas in behavioral economics, based on the assumption that individuals are “conditional cooperators”, the opposite relationship is predicted: individual willing to contribute to a public good will do it the more others contribute, in other words conditionally on others members’ contributions (Fehr and Gächter 2001; Fischbacher et al. 2001; Gächter 2007) . McCarter, Samak and Sheremeta (2013) results support the conditional cooperator’s perspective. Indeed, they find that over the course of the experiment, participants allocating contributions between the two public goods with different groups, shift their contributions significantly more often towards the more cooperative group. Furthermore, individuals contribute more in total when they face two distinct public goods games with different groups members compared to the situation where they are paired with the same group members. McCarter, Samak and Sheremeta (2013) explain that individuals are influenced by the behavior of group members of both public goods games when they are simultaneous playing in two public goods games composed of different group members whereas when they are making choices in two public goods games played with the same group members, individuals’ behavior is only influenced by these group members.

The second strand of the literature studies the preferences of people when confronted with a local and a global project.

Projects at a local level usually provide more direct and higher benefits to their members than global projects that are distributed over more individuals. Additionally, interacting in local groups enables mutual monitoring and creates the opportunity of gaining social approval. These two factors have a positive effect on cooperation, especially because they are prerequisites of conditional cooperation (Fehr and Gächter 2001; Fischbacher et al. 2001; Gächter 2007). Thus, it can be assumed that the return from contributing to a local public good is higher. However, individuals may prefer more efficient outcomes and choose actions that maximize social surplus. Since more individuals can contribute to the provision of a global public good contributions to the global public goods may lead to higher efficiency.

The literature shows that participants in sessions with a high marginal per capita return contribute more than participants in sessions with a low marginal per capita return (MPCR)<sup>31</sup> (Marwell and Ames 1979; Isaac et al. 1984 and Isaac et al. 1985). Further, Kim and Walker (1984) and Brown-Kruse and Hummels (1993) find that participants significantly increase (decrease) their contributions when the marginal per capita return is increased (decreased) during the experiment. On the other hand, Isaac and Walker (1988a) show that increasing the group size from 4 to 10 participants (while keeping the marginal per capita return fixed) increases the average contributions of the participants. A result supported by a subsequent study where a group of 40 participants contributed a larger portion of their endowment than groups of 4 or 10 participants with the same marginal per capita return (Isaac et al. 1991).

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<sup>31</sup>The marginal per capita return (or the marginal payoff) corresponds to the factor that multiplies the total amount of contributions invested in the public good. It determines how much each participant will get for every unit invested (by any of the participants) in the public good and independently of the fact that a participant is a free-rider or not.

Wachsman (2002), is the first to build a public goods experiment in which participants can allocate their endowment to a local group account with a relatively high marginal per capita return and a global group account with a lower marginal per capita return. Participants were randomly divided into two four person groups that they termed local groups. The experiment consisted of treatments with varying degree of communication amongst the members of the local groups. Wachsman (2002), shows that when participants were not allowed to communicate they allocated more resources to the global group account, suggesting that individuals assign greater importance to the potential payoff<sup>32</sup> of the global group account than to the higher MPCR of the local group account. When communication was allowed subjects also attempted to coordinate their contributions on the global group account with the members of the other local groups. Close to Wachsman (2002), Fellner and Lünser (2014) investigate the tension between cooperation for a local public good with a higher MPCR that offers recognition and facilitates coordination with others and a global public good that is socially more efficient but more anonymous. In the local group, previous contributions of all members are revealed and the person with the highest contribution in a round is highlighted in the list, bringing additional social recognition to this person. Contributions in the global group are not revealed. Additionally, they have a control group where the potential payoff of the local and global public good is equally high. Contrary to Wachsman (2002), where individuals always attempt to reach cooperation in global public good, Fellner and Lünser (2014) show that stable cooperation is only achieved for the local public good. Individuals first attempt to cooperate for the global public good when it has a higher potential payoff, however, this tendency rapidly collapses and cooperation builds up and remains stable in the provision of the local public good. Fellner and Lünser (2014) argue that this difference is caused by elementary differences in the design such as a much higher social returns for the global public good that was one third higher in the study of Wachsman (2002).

Blackwell and McKee (2003) compare willingness to contribute to the provision of a local public good (excludable) versus a global (non-excludable) public good. They create three groups with different colors (red, blue and black) of four persons each. The local account has a marginal per capita return of 0.3 that remains fixed through all the sessions while the global account has a return that varies across treatments, taking on four possible values 0.1, 0.15, 0.2, and 0.3. They introduce the concept of average per capita return (APCR) that they define as being the total group return divided by the 12 participants for the comparison of the relative payoffs from the global public good and local public goods<sup>33</sup>. The results indicate that when the APCR of the global public good exceeds the APCR of the local public good, individuals contribute more to the global public good but do not reduce their contributions to the local public good.

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<sup>32</sup>The potential per capita return (or the potential payoff) corresponds to the maximal possible payoff each participant can get from a public good when all participants contribute the totality of their endowment. It is positively correlated to the number of participants playing the public good game.

<sup>33</sup>Note that in their experiments participants' effective payoff was not divided by 12. They defined the payoff function as:  $T_i = x_i + a_g \sum_{j=1}^n g_j + a_G \sum_{k=1}^N G_k$ . Where  $T_i$  is the payoff of individual  $i$ ,  $x_i$  contributions of person  $i$  to his personal account,  $g_i$  contributions of person  $i$  to his local account,  $G_i$  contributions of person  $i$  to his global account and  $a_g$  and  $a_G$  are the marginal per capita returns of the local and global public good respectively.

The last paper related to ours is from Nitta (2014) who investigates individuals' simultaneous contributions to a local and a global public good with heterogeneous endowments. His key finding is that overall contributions are higher when endowments are homogeneous. Interestingly, when endowments are heterogeneous, subjects contribute more to the local public good and less to the global public good.

In the study reported here we build a multiple public goods game played in different settings that aims at capturing some real features of separatist movements and more particularly the effects of decentralized public goods supply and of local group identities on the probability of the occurrence of this event. To this purpose from the technical point of view, our design differs from these previous studies in several regards. First, we explore individuals' behavior in a setting that combines concurrently three public goods that belong to the same or to two different categories of public goods. Second, we vary the number of each type of public goods available across the two first parts of a same treatment but also across treatments. Third, we allow subjects to state their preference over these different situations through a vote whose outcome is realized in a subsequent part of the experiment. Finally, in our design we account for local group identity by building two additional treatments where we reinforce local group identity allowing us to study its effects on the contributions levels and on the outcomes of the vote.

As regards to this last aspect of our experimental design the literature in both psychology and economics shows that the existence and the composition of groups have an impact on the cooperative behavior. For instance, Campbell (1958) argues that grouping individuals into a reference group enhances cooperation amongst members of the group while Kramer and Brewer (1984) and Brewer and Kramer (1986) find that individuals show more restraint in the consumption of a common good when they are identified as a part of a group. In behavioral economics, two early contributions showing that some form of group identity increases cooperation in public good games are Orbell et al. (1988), and Brown-Kruse and Hummels (1993). Following Hoffman et al. (1996), Dufwenberg and Muren (2006), Buchan et al. (2006) and, more recently, Ahmed (2007) all shown that group identity as well as social distance, defined as the perceived affinity and nearness between people or groups, are important factors of the economic decision-making. Additionally Luttermers' (2001) results indicate that different social groups may dislike sharing a public good with one another while Falk et al. (2013) bring evidence of a differentiated cooperative attitude towards the different groups individuals are affiliated with. Similarly, Carpenter and Cardenas (2011) report evidence of a significant change in the behavior of individuals in a common pool resource game depending on the cultural diversity within the group.

Thus, group identity is an important aspect influencing individuals' behavior and interestingly experiments in social psychology demonstrate that favoritism towards the membership group is easily triggered. Even in situations in which individuals have been assigned to groups based on arbitrary characteristics, they treat the members of their group significantly differently in comparison to the members of the other group(s) (Festinger's 1954; Tajfel et al. 1971; Tajfel 1974; Tajfel and Turner 1979). Tajfel (1970) named this experimental technique in which people are divided into groups on the basis of minimal information (for example, persons preferring action movies versus comedy movies) the minimal group paradigm.

Following the minimal group paradigm of Tajfel (1970), Chen and Li (2009); Chakravarty and Fonseca (2010, 2012) study the effects of induced group identity on social preference and public good provision and they rely in their experimental designs upon artificially induced identities. They introduce identity through an arbitrary task which is completely unrelated to the main focus of the experiment. Subjects were asked to review the paintings of two modern artists, Paul Klee and Wassily Kandinsky, and to state which paintings they prefer. Groups were formed according to the preferences of the participants as regards to these paintings. Participants preferring paintings from Klee were grouped together as were participants preferring Kandinsky’s paintings.

In our experimental design individuals are placed in three distinct local groups that together form the global group. In reference to the minimal group paradigm, we may assume that our experimental design induced by construction, inherently, a local group identity. With the purpose to reinforce this local group identity we constructed the Identity treatments where subjects were asked to answer to a short questionnaire and were then grouped with the subjects that among the overall group expressed the nearest opinions to theirs.

### 3.3. The experiment

#### 3.3.1. THE BASELINE TREATMENT

Our experiment has three treatments: the Baseline, the Decentralization, and the Identity treatments. In each treatment participants interacted under a partner matching protocol. Before the start of the first part the computer program forms randomly groups of 9 subjects. Each group of 9 subjects is composed of three sub-groups of 3 subjects. A group of 9 subjects is called a “*global group*” and a sub-group of 3 subjects a “*local group*”. A global group thus comprises 3 local groups labelled A, B and C. Each subject is at the same time a member of a local group with 2 other subjects and a member of a global group that includes his local group and the 6 members of the two other local groups (see Figure 22).



Figure 22: Local and global groups

*Note:* To illustrate the three subjects that form together a local group we labelled them in the above figure 1 2 and 3 for the local group A, 4 5 and 6 for the local group B and 7 8 and 9 for the local group C.

A session consists of 36 periods divided in three parts of 12 periods each. In each part subjects can contribute to three public goods. Public goods are either *local* or *global*. Two main differences distinguish local public goods from global public

goods. First, their potential contributors are different. While only 3 subjects can contribute to a local public good, all 9 subjects can contribute to the global public good consequently the global public good has a higher social return. Second, local and global public goods have different marginal per capita returns. Namely, the MPCR is 0.5 for the local public goods and 0.2 for the global public goods. Thus, each Experimental Currency Unit (ECU) that any local group member allocates to the local group account pays back 0.5 ECU while each ECU that any global group member allocates to the global group account pays back 0.2 ECU. At the beginning of each period, each participant receives an endowment of 60 ECU to allocate between a private account, a local group account and a global group account. The private account yields a one-to-one return. Players do not observe contribution decisions of any other player before they make their own choices.

The payoff of subject  $i$ ,  $\pi_i$ , equals:

$$\pi_i = (60 - c_i) + 0.5 \sum_{j=1}^3 c_j + 0.2 \sum_{k=1}^9 c_k$$

where  $c_i$  is player  $i$ 's contribution to the local and global public goods, and  $c_j$  and  $c_k$  that of each local group member,  $j = 1, 2, 3$  and global group member,  $k = 1, 2, 3, 4, 5, 6, 7, 8, 9$ .

In the first part, at each period players have to choose how many ECU of their endowment (between 0 and 60) to contribute to the unique local group account and to two global public accounts, with the remainder being kept in their private account. The total amount contributed to the local public account is shared equally among the 3 local group members while the total amount contributed to the global public accounts is equally shared among the 9 global group members (see instructions in the appendix for snapshots of computer screens displayed to participants).

After each period each participant is informed of his payoff, the total contributions of the global group, the total contributions of the local group and their individual contributions to each one of the three public goods. Participants are not informed on individual contributions of the members of the two other local groups.

In the 12 periods of the second part of the Baseline treatment subjects can contribute to 3 local public goods. There is no more global public goods. At each of the 12 periods players have to choose how to allocate their endowment between these three local group accounts and their private account.

After having experienced the settings of part 1 and part 2, subjects are asked at the beginning of the third (and last part) to express their preference for one of these two configurations with a vote between two options:

*Option 1:* For the next 12 periods would you like to have one local public good and two global public goods?

*Option 2:* For the next 12 periods would you like to have three local public goods?

Subjects can answer yes to only one of these two options. The final outcome of the vote is based on the double majority rule. Concretely, the computer program first determines how many members voted in favor of three local public goods in each local group. The majority is attained when two members out of three voted for the same situation. Then, the compute program calculates how many local groups

voted for the same situation. Again, majority is reached when two local groups out of three voted for the same situation<sup>34</sup>. The third part of the experiment is the application of the configuration that won the vote to all local groups. We opted for the double majority rule to resemble decentralized countries such as Switzerland, for instance, where the use of double majority rule in the case of referenda and popular initiatives permits to take into account the minorities.

We give the following interpretation to the results of the vote. If groups favor a situation with three local public goods and vote for option 2, we conjecture that subjects have a strong preference for the local level and wish to secede from the global group.

To account for the effect of the order in which parts 1 and 2 are played on the outcome of the vote, each treatment is conducted with parts 1 and 2 inverted. The following figures schematize the Baseline treatment:

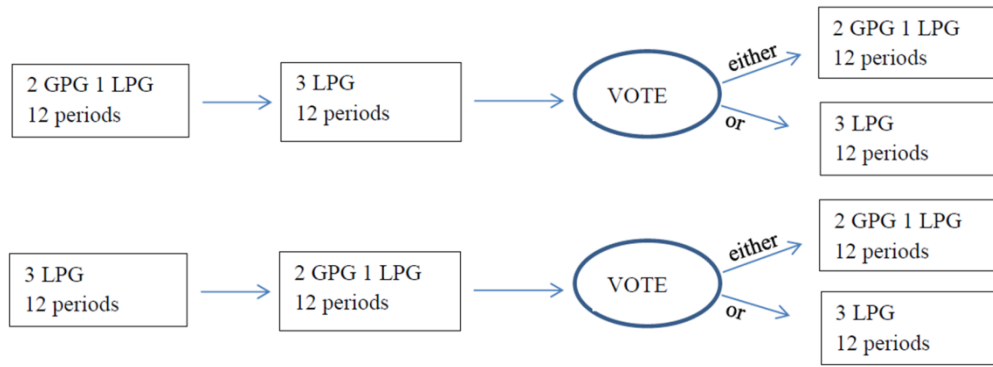


Figure 23: Illustration of the Baseline treatment

*Note:* GPG and LPG stands for global public goods and local public goods, respectively.

### 3.3.2. THE DECENTRALIZATION TREATMENT

The main difference between the Baseline and Decentralization treatments lies in the number of each category of public goods. We increase the number of local public goods from one to two and decrease the number of global public goods from two to one. As a result, players at each period have to choose how many ECU of their endowment (between 0 and 60) to contribute to the two local group accounts and to the unique global public account, with the remainder being kept in their private account.

All the other features of the Decentralization treatment are identical to those of the Baseline treatment. This treatment aims at testing whether individuals vote differently at the beginning of the third stage after experiencing a different configuration where more local group accounts are available.

The following figures schematize the Decentralization treatment:

<sup>34</sup>Illustration of the vote: in group A 2 subjects voted yes to the configuration with 3 LPG; in group B and C 2 subjects voted for the configuration with 1 LPG and 2 GPG. The result of the vote is that for the next 12 periods all groups will be in the configuration with 1 LPG and 2 GPG because 2 groups out of 3 have voter for this situation.

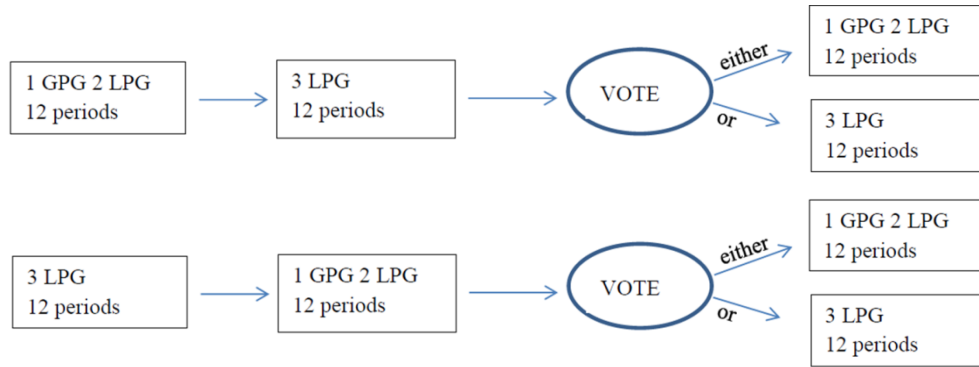


Figure 24: Illustration of the Decentralization treatment

*Note:* GPG and LPG stands for global public goods and local public goods, respectively.

### 3.3.3. IDENTITY TREATMENTS

The Identity treatment is administered to the Baseline treatment and to the Decentralization treatment. When administered to the Baseline we named it Identity and when administered to the Decentralisation treatment we named it Decentralization-Identity. As the literature shows (Festinger's 1954; Tajfel et al. 1971; Tajfel 1974; Tajfel and Turner 1979) placing participants of an experiment in groups and simply labeling those groups already creates group identity. Thus, in the Baseline and Decentralization treatments members of local groups already share a local group identity. The Identity treatments aim at reinforcing this already existing local group identity and at testing how it will affect the outcome of the vote. In particular we test if emphasizing local group identity leads subjects to vote more frequently in favor of three local public goods for the last part of the experiment.

As in previous treatments, at the beginning of the experiment the computer program randomly forms groups of 9 subjects and a group of 9 subjects is composed of three sub-groups of 3 subjects. But in the Identity treatments subject are not assigned randomly to local groups as in the previous treatments but instead according to their ideological preferences.

Prior to the first part of the experiment subject have to respond to a short questionnaire constituted of four proposals to which subjects were asked to give an appreciation by selecting one of the four following options: 1. I strongly disagree, 2. I disagree, 3. I agree and 4. I strongly agree (see in the appendix the instructions for a detailed presentation of the questionnaire). Once the questionnaire is completed the computer program uses an algorithm to form the local groups according to the proximity of the answers given to the different proposals.

On the local level each subject is paired with two other subjects that among the overall group of 9 subjects express the nearest opinions to his. As a result, each local group is formed with subjects that share the closest opinions. Consequently, from the point of view of each local group the other two local groups have more distant opinions. All the other characteristics of the Identity treatments are identical to the Baseline and Decentralization treatments.



### 3.3.4. PREDICTIONS

In all treatments, assuming that players maximize their own earnings, the subgame perfect equilibrium is to not contribute at all to the public goods, regardless of the category. Indeed, the marginal per capita returns of both types of public goods are always lower than the marginal return of the private goods. On the opposite, the socially optimal behavior is to contribute entirely to the global public good, as  $0.2 \times 9 > 1$ . However, as previous laboratory experimental studies on public good games reported that individuals do, generally, contribute to the public good (Ledyard, 1995), our first proposition is that contributions to both categories of public goods will not be zero. The second proposition pertains to how individuals behave within local and global groups. As contributions to global public goods may lead to higher efficiency we expect individuals to have an incentive for keeping this category of public good when they are asked to vote. At the same time, to the extent that the subjects identify as being a member of their local group, they will have a preference for contributing to local public goods. We expect local groups to be more cohesive, leading to larger contributions to local public goods. Free riding in local groups is also easier to detect and, consequently, less likely to occur. For both of these reasons, in addition to a higher MPCR, individuals should contribute more to local public goods. Based on this conjecture, we predict that the Decentralization treatment as it entails a higher numbers of local public goods that global public goods should decrease the probability for a local group to secede from the global group. On the other hand, the Identity treatments were designed to emphasize local group identity they should, therefore, support larger contributions to local public goods and thereby increase the probability of local groups to break-up from the global group.

From these propositions, the following set of specific hypotheses is constructed:

*Hypothesis 1.* Individuals will contribute positive amounts to both categories of public goods.

*Hypothesis 2.* Individuals will prefer contributing to the local public goods.

*Hypothesis 3.* The Decentralization treatment will decrease the probability for a local group to vote, in majority, in favor of a separation from the global group.

*Hypothesis 4.* The Identity treatments will increase the probability for a local group to vote, in majority, in favor of a separation from the global group.

### 3.3.5. PROCEDURES

The experiment consists of 33 sessions conducted at the GATE-LAB research institute located in Lyon, France. The 432 participants were recruited from local engineering and business schools, using the ORSEE software (Greiner, 2004). No subject participated in more than one session. 108 participants took part in the Baseline, Decentralization, Identity and Decentralization-Identity treatments, respectively. 55.79% of the participants are females and their mean age is 22.97 years ( $S.D. = 6.22$ ). We organized three sessions per treatment. To account for the effect of the order in which parts 1 and 2 are played on the outcome of the vote, three

supplementary sessions were organized for each treatment with parts 1 and 2 inverted. This results in a total of six sessions per treatment. The experiment was computerized using the ZTree software package (Fischbacher, 2007). The following Table summarizes the characteristics of the experimental sessions.

Table 9: Characteristics of the experimental sessions

Session Number	Number of participants	Number of Global Groups	Treatment
1	18	2	Baseline
2	18	2	Baseline
3	18	2	Baseline
4	18	2	Decentralization
5	18	2	Decentralization
6	18	2	Decentralization
7	9	1	Baseline-Order Effect
8	18	2	Baseline-Order Effect
9	18	2	Decentralization-Order Effect
10	18	2	Decentralization-Order Effect
11	9	1	Baseline-Order Effect
12	18	2	Baseline-Order Effect
13	9	1	Decentralization-Order Effect
14	9	1	Decentralization-Order Effect
15	9	1	Identity
16	9	1	Identity
17	9	1	Decentralization - Identity
18	9	1	Decentralization - Identity
19	9	1	Identity
20	9	1	Identity
21	9	1	Identity
22	9	1	Identity
23	9	1	Decentralization-Identity
24	9	1	Decentralization-Identity
25	9	1	Decentralization-Identity
26	18	2	Decentralization-Identity-Order Effect
27	18	2	Identity-Order Effect
28	9	1	Decentralization - Identity
29	9	1	Identity-Order Effect
30	9	1	Identity-Order Effect
31	18	2	Identity-Order Effect
32	18	2	Decentralization-Identity-Order Effect
33	18	2	Decentralization-Identity-Order Effect
Total	432	48	

Upon arrival, participants were randomly assigned to a computer after drawing a tag from an opaque bag. Sets of instructions were distributed at the beginning of each part and read aloud. On average a session lasted 90 minutes, including payment. The participants were paid the sum of their earnings in each period, at the rate of 100 Experimental Currency Units = 0.45 Euro. In addition, they were paid a € 5 show-up fee. On average, participants earned € 17.12 ( $S.D. = 1.68$ ). Payments were made individually in cash and in private in a separate room.

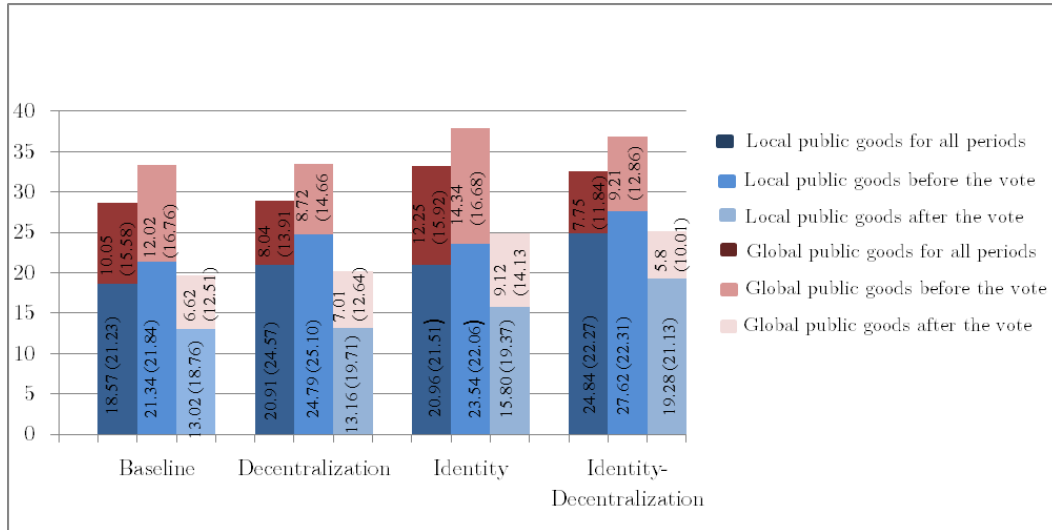
At the end of the experiment, we administered a demographic questionnaire including questions on gender, age, and relative wealth of the family compared to other students (on a scale from 0 for the poorer to 10 for the wealthier).

### 3.4. Results

We analyze first contributions' levels before and after the vote as well as their course over time and the incidence of the treatments on them. We then analyze the determinants of contributions. Lastly, we examine how the treatments affected the outcome of the vote.

#### 3.4.1. CONTRIBUTIONS TO LOCAL AND GLOBAL PUBLIC GOODS

To begin with, we consider in Figure 25 the average individual contributions to local public goods (in blue) and to global public goods (in red) in the Baseline, Decentralization and Identity treatments for all periods taken together (periods 1 to 36), before the vote (periods 1 to 24) and after the vote (periods 25 to 36).

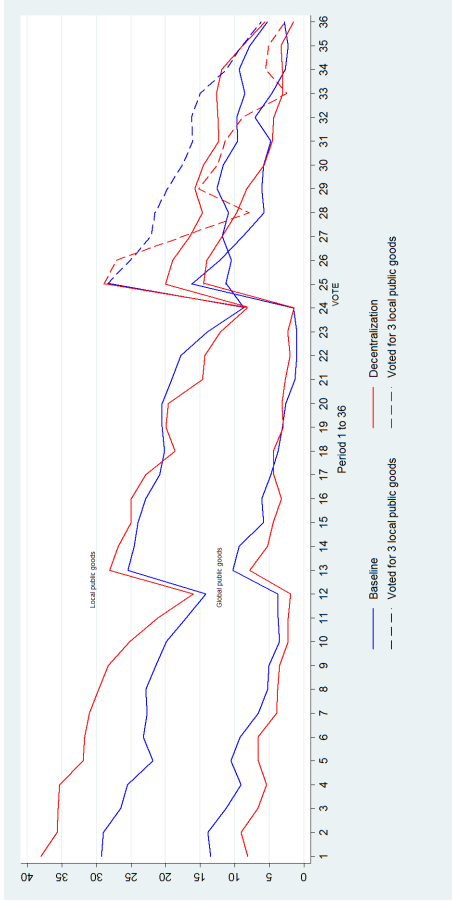


*Note:* In blue we highlighted the average individual contributions to local public goods and in red the average individual contributions to global public goods. We consider all periods taken together (represented in dark blue and red), the periods before the vote (represented by middle blue and red), and for the periods after the vote (represented by light blue and red). Numbers indicate mean values. Standard errors are in parentheses.

Figure 25: Average individual contributions by types of goods, treatments and blocks of periods

Interestingly, Figure 25 shows that average individual contributions are higher before the vote for both types of goods and in all treatments when the institutional arrangements were exogenously imposed to all the participants. Thus, implementing an endogenous setting with a vote did not encourage individuals' contributions. Wilcoxon tests (W, hereafter) at the global group level support that, in all the treatments, the mean individual contributions to local and global public goods by global group members are significantly different between the periods before the vote and the last 12 periods after the vote (W tests local goods: Baseline  $p=0.004$ ; Decentralization  $p=0.003$ ; Identity  $p=0.008$ ; Decentralization-Identity  $p=0.006$ . W tests global goods: Baseline  $p=0.018$ ; Decentralization  $p=0.012$ ; Identity  $p=0.012$ ;

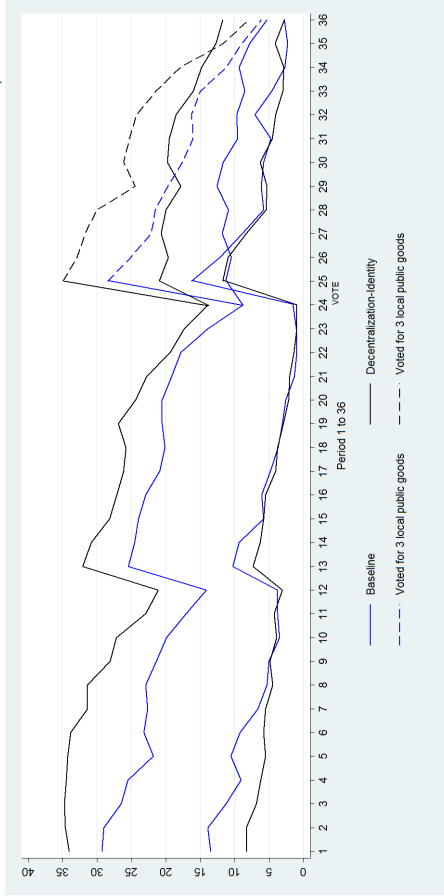
Decentralization-Identity  $p=0.007$ ). Figure 25 also suggests that average individual contributions are the greatest in the Identity-Decentralization and that individuals mostly contributed to local public goods, regardless of the treatment. We analyze the evolution of their average individual contributions through time and by treatments in Table 10 and Figure 26. The three panels of Figure 26 present the individual mean contributions to local and global public goods at each period for each treatment. We compare successively to the Baseline treatment the Decentralization treatment (red lines), the Identity treatment (green lines) and the Decentralization-Identity treatment (black lines). In each panel, to indicate mean contributions when the majority voted for a global group break-up for the last block of 12 periods, we used dashed lines. Table 10 displays the mean contributions and the average percentages of maximum efficiency reached for each category of public goods, both are averaged over each sequence of 12 periods for each global group.



a) Decentralization treatment



b) Identity treatment



c.) Decentralization-Identity treatment

Figure 26: Average individual contributions in the Baseline, Decentralization, Identity and Decentralization-Identity treatments.

Table 10: Summary statistics on contributions over time, by treatment and block of periods

Variables	Treatments			
	Periods	Decentralization	Identity	Decentralization-Identity
Contributions local public goods	1-12	24.6 (10.67)*	24.5 (8.95)	26.7 (8.48)**
	13-24	19.8 (10.78)	20.4 (11.49)	22.2 (10.88)
	25-36 (secession)	15.1 (8.33)	19.1 (7.96)	19.9 (9.15)
	25-36 (no secession)	11.9 (5.26)	11.6 (5.55)	14.3 (6.17)**
Contributions global public goods	1-12	13 (5.05)*	15.5 (4.23)	13.6 (4.95)
	13-24	7.1 (5.67)	9.8 (6.11)*	7.1 (4.03)
	25-36 (no secession)	6.8 (4.15)	7.9 (4.31)	6.16 (4.03)
Average percentage of maximum efficiency reached in local public goods	1-12	42.9%	40.8%	44.83%**
	13-24	32.4%	33.9%	36.7%
	25-36 (secession)	23.1%	31.8%	33.1%
	25-36(no secession)	19.9%	19.3%	23.3%*
Average percentage of maximum efficiency reached in global public goods	1-12	7.2%*	8.6%	7.4%
	13-24	4.5%	5.4%*	4.1%
	25-36 (no secession)	3.8%	4.4%	3.6%

Note: Numbers indicate mean values. Standard deviations are in parentheses. The significance levels of two-tailed Mann-Whitney tests are represented by \*\*\*, \*\*, and \*, with  $p < 0.01$ ,  $p < 0.05$ ,  $p < 0.10$ , respectively in which we compare each treatment to the Baseline treatment. Each bloc of 12 periods gives only one independent observation.

Our results show that in the Decentralization treatment individual contributions are significantly greater for local goods but smaller for global goods in comparison to the Baseline treatment, for the first block of 12 periods. Two-tailed Mann-Whitney tests – MW, hereafter – (with each global group’s contributions averaged over each sequence of 12 periods as an independent observation) indicate that these differences are significantly different at the 10% level (MW test,  $p=0.083$ ) for local goods and for global goods (MW test,  $p=0.054$ ). The Identity treatment (green lines) significantly increased individual contributions to global public goods in the second part of the game (between periods 13 and 24) (MW  $p=0.028$ ). Lastly, Mann-Whitney tests reveal that individual contributions to local public goods are significantly greater at the 5% level in the Decentralization-Identity treatment, in the first block of 12 periods. It also indicated that individual contributions are greater for local public goods in the last block of the game when the majority voted against the break-up of the global group.

To analyze the determinants of contributions, we estimated OLS models using random effects on our panel of 144 local groups over the 36 periods. Table 11 and 12 present the estimated coefficients of the determinants of the individual aggregated contributions to local public goods and to global public goods, respectively. Standard errors are clustered at the local level since local groups are fixed throughout the session. In both tables, model (1) considers the data from the Decentralization treatment, and models (2) and (3) the data from the Identity treatments.

The independent variables of the model include dummies for treatments (the Baseline is the reference category). A dummy variable is included for each one of the treatments. The dummy variables take value 1 if the Decentralization, the Identity or the Decentralization-Identity treatment was administered, and 0 otherwise. To control for the order effect we added a supplementary dummy variable that takes value 1 when the experimental session started with three local public goods. As additional independent variables we added the contributions from the previous period of the local and global group members, respectively. The variables “*Others contributions to LPG<sub>t-1</sub>*” and “*Others contributions to GPG<sub>t-1</sub>*” contain the contributions in the previous period for, respectively, the two other and the eight other group members. Finally, in all models, the independent variables include a time trend and various mean individual characteristics of group members. The latter consists of subjects’ age, gender and mean wealth level.

Table 11: Determinants of individual total local contributions

	(1) Decentralization	(2) Identity	(3) Decentralization Identity
Decentralization	5.472 ** (1.782)	- -	- -
Identity	- -	-1.935 (1.787)	- -
Decentralization-Identity	- -	- -	5.181** (2.205)
Start with 3 LPG	-1.098 (2.190)	-0.817 (2.231)	-0.922 (2.194)
Others contributions to LPG t-1	0.091*** (0.188)	0.093 *** (0.186)	0.091*** (0.188)
Others contributions to GPG t-1	-0.025 ** (0.008)	-0.028*** (0.008)	-0.027** (0.008)
Period	-0.752*** (0.128)	-0.777*** (0.129)	-0.766*** (0.129)
Age	0.108 (0.102)	0.086 (0.105)	0.110 (0.095)
Female	1.225 (1.226)	1.020 (1.265)	1.092 (1.241)
Wealth level	-0.581* (0.307)	-0.612* (0.319)	-0.625* (0.046)
Number of observations	5205	5205	5205
Clusters	144	144	144
Wald Chi2	182.11	170.65	190.96
p>chi2	0.0000	0.0000	0.0000
R2	0.1655	0.1489	0.1593

Note: Estimated coefficients of an OLS model are reported. Robust standard errors are clustered at the local group level. \*\*\*, \*\*, \* indicate significance at the 0.01, 0.05, and 0.10 level, respectively.



Table 12: Determinants of individual total global contributions

	(1) Decentralization	(2) Identity	(3) Decentralization Identity
Decentralization	-1.458 (0.949)	- -	- -
Identity	- -	0.311 (0.921)	- -
Decentralization-Identity	- -	- -	-0.660 (0.926)
Start with 3 LPG	3.136** (1.239)	3.026 ** (1.247)	3.047** (1.247)
Others contributions to LPG t-1	0.036 (0.010)	0.002 (0.010)	0.002 (0.010)
Others contributions to GPG t-1	0.085*** (0.007)	0.086*** (0.007)	0.086*** (0.007)
Period	-0.366*** (0.072)	-0.358*** (0.072)	-0.359*** (0.072)
Age	0.188** (0.079)	0.189** (0.081)	0.189** (0.081)
Female	1.231 (0.899)	1.300 (0.908)	1.281 (0.907)
Wealth level	-0.262 (0.215)	-0.254 (0.238)	-0.253 (0.216)
Number of observations	5177	5177	5177
Clusters	144	144	144
Wald Chi2	440.24	432.85	425.65
p>chi2	0.0000	0.0000	0.0000
R2	0.2032	0.2009	0.2012

Note: Estimated coefficients of an OLS model are reported. Robust standard errors are clustered at the local group level. \*\*\*, \*\*, \* indicate significance at the 0.01, 0.05, and 0.10 level, respectively.

The Decentralization and Decentralization-Identity treatments significantly increase individual contributions to local goods. Generally, contributions of the other fellow group members, from the previous period, affect individual total contributions for both categories of public goods. If local group members contributed to local goods in the previous period, this increased individual contributions in the next period for this category of public goods. Additionally, if fellow global group members contributed to global goods, in the preceding period, this both decreased individual contributions for the local goods and increased individual contributions in favor of global goods in the next period. As expected, time affects negatively contributions' levels. Starting the experiment with three local public goods did not affect individual contributions to local goods but significantly increased individual contributions to global goods. Age does not affect local goods' contributions while it positively affects global goods' contributions. The opposite is found for the variable wealth level. It decreases local contributions but does not affect global contributions.

We can summarize the results obtained so far as follows:

**Result 1:** *The Decentralization and Decentralization-Identity treatments both strongly increase contributions to the local public goods.*

### 3.4.2. THE VOTE AND THE BREAK-UP OF THE GLOBAL GROUP

We turn now to the analysis of the outcome of the vote. To investigate the determinants of voting in favor of three local public goods for the last block of 12 periods we estimate Probit models in which the dependent variable takes value 1 if the majority of local groups voted in favor of three local public goods, and 0 otherwise. One local group gives only one observation in these models. As previously, the independent variables of the model include dummies for treatments (the Baseline is the reference category) and when the experimental session started with three local public goods, 0 in all the other cases. In addition, we account for individual mean contributions to local and global public goods as well as for the contributions of the other members at the local and global level, both averaged over the 24 first periods. In all the following models we kept the same mean individual characteristics that are subjects' age, gender and mean wealth level. Table 13 reports marginal effects.

Table 13: Determinants of voting for 3 local public goods

	(1) Decentralization	(2) Identity	(3) Decentralization Identity
Decentralization	-0.092* (0.049)	-	-
Identity	-	-0.336*** (0.038)	-
Decentralization-Identity	-	-	-0.243*** (0.031)
Start with 3 LPG	0.156** (0.052)	0.149*** (0.038)	0.142** (0.047)
Others contributions to LPG t-1	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)
Others contributions to GPG t-1	-0.002** (0.001)	-0.002** (0.002)	-0.003*** (0.007)
Individual contributions to Local PG	0.002 (0.001)	0.002 (0.002)	0.003 (0.002)
Individual contributions to Global PG	-0.001 (0.002)	-0.001 (0.002)	-0.001 (0.002)
Age	0.001 (0.003)	0.002 (0.002)	-0.004 (0.003)
Female	0.076** (0.034)	0.058* (0.032)	0.069** (0.032)
Wealth level	0.009 (0.011)	0.067 (0.009)	0.008 (0.102)
Number of observations	432	432	432
Log-likelihood	-199.12278	-158.70052	-177.84443
p>chi2	0.0000	0.0000	0.0000
R2	0.2958	0.2958	0.2958

Note: Marginal effects of a Probit model in which the dependent variable is probability for a local groupe to vote in favor of 3 local public goods are reported. Robust standard errors are clustered at the local group level. \*\*\*, \*\*, \* indicate significance at the 0.01, 0.05, and 0.10 level, respectively.

The results show that all the treatments, the order in which parts 1 and 2 are played, the contributions of the fellow global group members and, lastly, the subjects' gender affect significantly the vote. All treatments as well as the contributions of the others global group members decrease the probability of voting in favor of three local public goods while starting with three local public goods and being a female subject increases it. The effect of the order in which parts 1 and 2 are played might be explained by the fact that overall contributions decrease through time and consequently they are the highest at the beginning of the game, namely in part 1. If subject experience higher payoffs in the first part of the game, because free riding is less important than in the next part, it seems plausible that these subjects will want to replicate this situation for the last part of the game.

Marginal effects of the Probit model indicate that increasing the number of local public goods decreases the probability of voting for a global group break-up. The implications of the Decentralization treatment might be explained by the following

two reasons. First, even though the local public good has a higher MPCR than the global public good, the global public good has a greater potential payoff since there are 9 potential contributors. In addition, having two or three local public goods do not change the returns that subjects can earn from them. As contributing 2 ECU to each one of the two available local public goods is the same as contributing 4 ECU to one local public good and 0 to the other one. So increasing the number of local public goods by voting in this direction will not result in an increase of the benefits local public goods yield. Additionally, if individual have a preference for local public goods, in this treatment precisely, they are already in an institutional arrangement where the majority of public goods is local while not devoid of global public goods. Thus, keeping both types of public goods allows payoff maximization by having at the same time the public good that has the greatest marginal per capita return and the public good that has the greatest potential payoff. The second argument is the flexibility that keeping both types of goods offers. Indeed, by preserving both types of goods subjects can adapt their strategy according to the public good that has the greatest number of contributors. As local and global public goods are technically substitutable they might be used as strategic variables.

**Result 2:** *The Decentralization treatment decreases the probability of voting in favor of a global group break-up.*

Surprisingly, reinforcing local group identity decreases the probability of voting in favor of three local public goods or in other words in favor of the disassembling of the global group. This result suggests that reinforced local group identity is not sufficient to compensate the cost of losing the global public good and its inherent benefits (a greater potential payoff and greater flexibility in establishing individual strategies over the course of the experiment).

We expected that the Identity treatments would increase the likelihood for a group to secede and that the force driving this decision would be channeled through local contributions. Our argument rested on the reasoning that stronger local identities will support larger contributions to local public goods and thereby increase the probability of local groups to break-up from the global group. In this spirit, we test one supplementary model where we interact the dummy variable that accounts for the Identity treatments with mean contributions (averaged over the 24 first periods) of the other local group members to the local public goods. Our results, reported in Table 14, show that the interaction term is positive and significant at the 10% level. When we estimate specifically the marginal effect of the Identity treatments on other local group members' contributions to local goods we obtain a small but positive and significant estimated coefficient (Table 15). Thus, provided that, local group member are cooperators and contribute to the provision of local public goods the Identity treatments increase the probability of breaking the global group.

Table 14: Interacting the Identity treatments with contributions of fellow local group members

	Identity	Decentralization Identity
Identity	-2.370*** (0.572)	- -
Decentralization-Identity	- -	-2.453*** (0.495)
Start with 3 LPG	0.694*** (0.198)	0.608*** (0.191)
Interaction term: Identity*Others contributions to LPG	0.014* (0.009)	- -
Interaction term: Decentralization-Identity*Others contributions to LPG	- -	0.014* (0.007)
Others contributions to LPG t-1	0.002 (0.005)	0.004 (0.005)
Others contributions to GPG t-1	-0.006** (0.002)	-0.007*** (0.002)
Individual contributions to Local PG	0.011 (0.008)	0.010 (0.007)
Individual contributions to Global PG	-0.004 (0.008)	-0.006 (0.008)
Age	0.005 (0.011)	-0.012 (0.013)
Female	0.302* (0.168)	0.311** (0.145)
Wealth level	0.033 (0.043)	0.035 (0.044)
Number of observations	432	432
Log-likelihood	-154.70175	-176.70603
p>chi2	0.0000	0.0000
R2	0.3044	0.2055

Note: Estimated coefficients of a Probit model in which the dependent variable is probability for a local group to vote in favor of 3 local public goods are reported. Robust standard errors are clustered at the local group level. \*\*\*, \*\*, \* indicate significance at the 0.01, 0.05, and 0.10 level, respectively.

Table 15: Interacting the Identity treatments with contributions of fellow local group members

	Fellow group members' contributions to local public goods	Fellow group members' contributions to local public goods
Without the Identity treatment	0.0006 (0.0016)	- -
With the Identity treatment	0.0013* (0.0007)	- -
Without the Decentralization-Identity treatment	-	0.0011 (0.0013)
With the Decentralization-Identity treatment	-	0.0014* (0.0008)
Number of observations	432	432
Log-likelihood	-154.70175	-176.70603
p>chi2	0.0000	0.0000
R2	0.3044	0.2055

Note: Marginal effects of a Probit model in which the dependent variable is probability for a local groupe to vote in favor of 3 local public goods are reported. Robust standard errors are clustered at the local group level. \*\*\*, \*\*, \* indicate significance at the 0.01, 0.05, and 0.10 level, respectively.

The cost of breaking the global group corresponds to the loss of the global public good. To accept this loss, in addition to the reinforced identity, local group members have to cooperate and contribute to the local public goods. This indicated that collective action will only occur if group member do not free ride on the cooperative behavior of the other members (Hechter and Okamoto 2001).

**Result 3:** *Surprisingly, making identity more salient decreases the probability of voting in favor of a global group break-up.*

**Result 4:** *The Identity treatments increase the probability of voting in favor of a global group break-up only when local group members are cooperators and contribute to the provision of the local public goods.*

### 3.5. Discussion and Conclusion

Separatist movements have frequently appeared in recent current events as a consequence of regions' willingness to become more autonomous. The literature has enumerated different causes driving the decision to secede. Amongst them are the differences in preferences for the different public goods, the degree of economies of scale in the provision of public goods and the importance of local cultures. The literature has also questioned the process of decentralizing political power as an efficient solution to separatist movements. Our contribution lies in the design of an original

experiment that studies the effects of decentralization of public goods provision and of local group identities on the probability of the occurrence of this event.

Our results show that the Decentralization and Decentralization-Identity treatments increase contributions to the local public goods at the detriment of the global public good. Interestingly, the Identity treatment does not affect significantly the level of individual contributions. As regards the vote outcome, our results indicate that the Decentralization treatment decreases the occurrence of the global group break-up also when identity is made more salient. In fact, surprisingly, reinforcing local group identity decreases the likelihood of the global group break-up.

This result is puzzling and in contradiction with our starting hypothesis. Hechter and Okamoto (2001) argue that even if shared interests and dependence within the members of a group exist, collective action will not occur if group members free ride on the cooperative behavior of other members. This is precisely what the results of the last model including an interaction term indicate: provided that local group members cooperate by contributing to the provision of the local public goods strong local identity increases the likelihood for a group to secede. This suggests that free riding encouraged local groups to remain stakeholders of the global group.

One could criticize the method we chose to induce group identity by arguing that it was not sufficiently strong or that we did not account for a sufficient number of dimensions that construct one's identity. While this is possible, we believe that our design was actually a robust way to elicit identity. Chen and Li (2009) and Chakravarty and Fonseca (2010, 2012) study the effect of induced group identity on social preference and public good provision and these authors find a significant effect of identity on behavior. Our design shares similar characteristics and it also features the fact that groups were endogenously created in the Identity treatments. As responding to the preliminary questionnaire conducted subjects to choose implicitly the groups they will belong to. Therefore, we believe that we succeeded to elicit identity.

Yet, as the literature shows, starting with Festinger (1954) and Tajfel et al. (1971), placing individuals in groups and labelling those groups already creates a group identity. This implies that subjects in our experiment had a stratified identity. First, they identified as independent individuals per se, then they identified as members of a local group and, finally, as members of the global group. As a result, they viewed their global group fellows, simultaneously, as in-group members and out-groups members. A global group fellow is an out-group fellow from the local group identity perspective but he is an in-group fellow from the global group identity perspective. We believe this stratified identity might be the key for understanding this puzzling result and in the next step we should study it in depth.

We are aware that the experimental design reported here is a simplification of real-world separatist movements. Nevertheless, we believe that it captures among the multitude of forces leading these movements at least two of them that are: bringing the public goods' supply closer to the localities contributing thereby to the confidence that their interests are better represented but at the cost of efficiency through the loss of economies of scale and, second, the importance of identities. Thus, future research extensions may consider enriching the present experimental design by, for instance, introducing regional disparities in endowment to simulate the presence of natural resources or differences in income distributions.

Another avenue for further research would be to tackle this issue from a different perspective by trying to determine the effects of a partial or total loss of autonomous decision on the probability of exiting or refusing to join a regional unification. The trade-off is between higher efficiency in the provision of public goods provided by the regional unification and the costs of the control loss over policy decisions. As separatist movements aspire to more autonomy this study might assess the price of autonomy in terms of public goods.



## Appendix 1 Instructions (translated from French)

*The following instructions are for the Baseline treatment. We add the instructions that are specific to the Decentralization and Identity treatments in italics into brackets. The instructions for the sessions where we control for the order effect are identical to these instructions we only invert part 1 and part 2. The questionnaire used to form the groups in the Identity treatment is presented at the end of the instructions.*

### General information

We thank you for participating in this experiment in economics. Your payoffs depend on your decisions. It is therefore important that you read the following instructions carefully. Instructions are distributed for your personal use. We thank you for not communicating with other participants during the experiment. During the experiment, we will not talk about Euros but about ECU (Experimental Currency Units). All payoffs will be calculated in ECU. At the end of the experiment, the total number of ECU that you earned will be converted into Euros at the following conversion rate:

$$100 \text{ ECU} = 0.45 \text{ Euro}$$

In addition to this amount, you will receive a show up fee of 5 Euros. All payments will be made in private and in cash in a separate room. Other participants will never know the amount of your payoffs in this experiment.

### Groups' formation

Before the start of the first part, the computer program will form randomly groups composed of 9 people. Each group of 9 people is composed of three sub-groups of 3 people.

**A group of 9 people is called “global group” and a sub-group of 3 people a “local group”.** A global group thus comprises three local groups, A, B and C.

*[Additional instructions for the Identity treatment:*

Each local group of 3 people within a global group is formed according to the proximity of the answers given in a questionnaire that will appear on your screen. The questionnaire consists of four proposals. For each of them, we ask you to tell if you:

- Strongly disagree
- Disagree
- Agree
- Strongly agree

Once the questionnaire is completed by each participant the computer program will use an algorithm to form the local groups according to the proximity of the answers given to these different proposals.

Thus, you will be paired in your local group with two other people in the overall group of 9 that expressed the nearest opinion to yours. You will not know at any time the detailed answers of the other participants; likewise, no one will know the details of your answers.

The two other local groups are composed of participants whose views are less similar to yours but the name of the local group (A, B, C) is independent of the distance with the opinions of your local group (for example, if you are in Group A, the members of group C are not necessarily further from your opinions than the members of group B).

To sum up, each group of 9 people is composed of three sub-groups of 3 people. Groups of 9 people are randomly formed while the sub-groups of 3 are formed using the algorithm. /

Thus, you will be at the same time a member of a local group with 2 other people and a member of a global group that includes your local group and the 6 members of the two other local groups.

The following table illustrates the composition of a global group and its local groups.

Table 16: Composition of a global group and its local groups

Global Group	Local group A	Local group B	Local group C
participant 1	participant 1		
participant 2	participant 2		
participant 3	participant 3		
participant 4		participant 4	
participant 5		participant 5	
participant 6		participant 6	
participant 7			participant 7
participant 8			participant 8
participant 9			participant 9

For example, one participant is a member of both the global group and the local group A. The composition of each group will remain the same throughout the experiment. You will remain paired with the same co-participants in your local group and in your global group in all parts of the experiment. You will never know the identity of your co-participants and your co-participants will never know your identity. All decisions are anonymous.

### Part 1

The first part consists of 12 periods during which you may allocate ECU between multiple accounts. Your payoff in this section is the sum of your earnings in each period.

#### Description of each period

At the beginning of each period, each participant receives 60 ECU. We call this sum the “endowment”. You have to decide how to allocate this endowment between your private account and several public accounts.

You have the choice to allocate the ECU in three public accounts: **two global public accounts and one local public account.** *[This sentence is replaced by the following in the Decentralization treatment: You have the choice to allocate the ECU in three public accounts: **one global public account and two local public accounts.**]*

- The 9 members of the global group may allocate ECU to the global public account G1 and to the global public account G2. The amount of a global public account is the sum of the ECU allocated by you and the other 8 members of the global group to this account.
- Only the 3 members of your local group may allocate ECU to your local public account. The amount of your local public account is the sum of the ECU allocated by you and the two other members of your local group to this account.

Members of the two other local groups to which you do not belong also have their own local public account. The local group A can allocate ECU to the local public account A, the local group B may allocate ECU to the local public account B, and the local group C may allocate ECU to the local public account C.

Thus, you have to decide how much of your 60 ECU you keep on your private account and how much ECU you allocate to:

- The global public account G1 (between 0 and 60 ECU)
- The global public account G2 (between 0 and 60 ECU) *[In the Decentralization treatment this is replaced by: Your local public account (A, B or C) (between 0 and 60 ECU).]*
- Your local public account (A, B or C) (between 0 and 60 ECU).

You must enter a value in each box on your screen. The difference between your endowment 60 ECU and the sum of ECU allocated to each public account remains on your private account. The sum of your ECU allocated to these accounts, public and private, may not exceed 60 ECU.

You will make your decisions as in the screen shown in the next Figure. The consequences of your decisions are explained in detail on the next page.

Once all group members have decided the amount they allocate to the three public accounts, you are informed of:

- The total amount allocated to each global public accounts by the 9 members of the global group (including your allocation) *[In the Decentralization treatment this is replaced by: The total amount allocated to the global public account by the 9 members of the global group (including your allocation).]*
- The total amount allocated to each global public accounts by the 3 members of your local group (including your allocation) *[In the Decentralization treatment this*

Figure 27: Example of a decision screen

*is replaced by:* The total amount allocated to the global public account by the 3 members of your local group./

- The total amount allocated to your local public account by the 3 members of your local group (including your allocation). *[In the Decentralization treatment this is replaced by:* The total amount allocated to your local public accounts by the 3 members of your local group (including your allocation)./

Your screen will also remind you the amount of your allocation to the global public accounts and the local public account and the amount held on your private account. *[This sentence is replaced by the following in the Decentralization treatment:* Your screen will also remind you the amount of your allocation to the global public account and to the local public accounts and the amount held on your private account./ It also shows your gain in that period. You are not informed of the amounts allocated to local public accounts by the two other local groups.

The following Figure reproduces the feedback screen at the end of a period.

Calculation of your payoff

The revenue drawn from a public account is different depending on whether it is a global public account or a local public account:

- The revenue drawn from each global public account represents 20% of the sum of the 9 individual allocations to this global public account, *[This sentence is replaced by the following in the Decentralization treatment:* The revenue drawn from the global public account represents 20% of the sum of the 9 individual allocations to the global public account, /

- The revenue drawn from the local public account represents 50% of the sum of the three individual allocations to the local public account. *[This sentence is replaced by the following in the Decentralization treatment:* The revenue drawn from each

Periode 1 sur 1. Temps restant (en secondes): 0  
Veuillez prendre votre décision, SVP

	COMPTE PUBLIC LOCAL C	COMPTE PUBLIC GLOBAL G1	COMPTE PUBLIC GLOBAL G2
Montant total alloué à chaque compte public global par les 9 membres du groupe global (incluant votre allocation)		34	34
Montant total alloué à chaque compte public par les 3 membres de votre groupe local (incluant votre allocation)	9	9	9
Votre allocation	3	3	3

Montant conservé sur votre compte privé : 51  
 Votre revenu des comptes publics : 18.10  
 Soit  $(60 - 9) + (0.50 * 9) + (0.20 * 34) + (0.20 * 34)$  :

**Votre gain :** 69.10

Figure 28: Example of the feedback screen displayed at the end of a period.

local public account represents 50% of the sum of the three individual allocations to this local public account.]

Your payoff at each period is calculated using the following formula (if you have difficulty understanding these formulas do not hesitate to ask questions):

Table 17: Calculation of the payoff in part 1

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Payoff in a period	=	Your endowment in ECU
<hr/>		
-		Your allocation to the two global public accounts and the local public account
+		20% of the total number of ECU allocated to the global public account G1
+		20% of the total number of ECU allocated to the global public account G2
		<i>[In the Decentralization treatment this sentence is replaced by:</i>
+		50% of the total number of ECU allocated to your local public account (A, B or C)]
+		50% of the total number of ECU allocated to your local public account (A, B or C)

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This formula shows that your payoff at the end of a period consists of two parts:

1) of the ECU that you have kept for yourself (namely your endowment - your allocation to the public accounts)

2) of the sum of the total revenues from both global public accounts and your local public account. *[This sentence is replaced by the following in the Decentralization treatment: of the sum of the total revenues from the global public account and your both local public accounts.]*

Here are some examples.

### Example 1

Suppose that the sum of the allocations of the 3 members of a local group to their local public account is 90 ECU. Suppose also that the sum of the allocations of the 9 members of the global group is 70 ECU to the global public account 1 and 300 ECU to the global public account 2. In this case, the revenue from public accounts is:

$$50\% (90) + 20\% (70) + 20\% (300) = 45 + 14 + 60 = 119 \text{ ECU}$$

[This example is replaced by the following in the Decentralization treatment: Suppose that the sum of the allocations of the 3 members of a local group is 90 ECU to their local public account 1 and 70 ECU to their local public account 2. Suppose also that the sum of the allocations of the 9 members of the global group is 300 ECU to the global public account. In this case, the revenue from public accounts is:

$$50\% (90) + 50\% (70) + 20\% (300) = 45 + 35 + 60 = 140 \text{ ECU}]$$

#### Example 2

Suppose that the sum of the allocations of the 3 members of a local group to their local public account is 60 ECU. Suppose also that the sum of the allocations of the 9 members of the global group is 90 ECU to the global public account 1 and 50 ECU to the global public account 2. In this case, the revenue from public accounts is:

$$50\% (60) + 20\% (90) + 20\% (50) = 30 + 18 + 10 = 58 \text{ ECU.}$$

[This example is replaced by the following in the Decentralization treatment: Suppose that the sum of the allocations of the 3 members of a local group is 60 ECU to their local public account 1 and 90 ECU to their local public account 2. Suppose also that the sum of the allocations of the 9 members of the global group is 50 ECU to the global public account. In this case, the revenue from public accounts is:

$$50\% (60) + 50\% (90) + 20\% (50) = 30 + 45 + 10 = 85 \text{ ECU.}]$$

You always have the option to keep the ECU on your private account or to allocate them to a public account. Each ECU you keep on your private account increases your payoff in the current period by 1 ECU.

If you allocate 1 ECU to a public account, the total allocation of this public account increases by 1 ECU. In this case, your revenue increases by  $50\% \times 1 = 0.5$  ECU if it is a local public account and  $20\% \times 1 = 0.2$  ECU if it is a global public account. Your allocation to a public account also increases the revenue of other members:

- If it is a local public account, the revenue of the two other members of your local group will also be increased by 0.5 ECU each. So, the total revenue of your local group from your local public account will be increased by  $3 \times 0.5 = 1.5$  ECU.
- If it is a global public account, the revenue of the eight other members of the global group will also be increased by 0.2 ECU each. So, the total revenue of the global group from the global public account is increased by  $9 \times 0.2 = 1.8$  ECU.

Similarly, your income increases for each ECU allocated to a global public account by the other members of the group and for each ECU allocated to your local public account by the other members of your local group. For each ECU allocated by another member of your local group or global group, you win 0.5 and 0.2 ECU respectively. However, your income is not affected by the ECU allocated by members of other local groups to their local public account.

**To sum up:**

- You receive an endowment.
- You decide of your allocation to two global public accounts and one local public account. *[This sentence is replaced by the following in the Decentralization treatment: You decide of your allocation to one global public account and two local public accounts.]*
- You are informed of the amount of allocation to each global public account and local public account associated with your local group and your payoff. *[This sentence is replaced by the following in the Decentralization treatment: You are informed of the amount of allocation to the global public account and to each local public account associated with your local group and your payoff.]*

At the end of each period, a new period starts automatically. You receive a new endowment 60 ECU.

—

Please read again these instructions. If you have any question, raise your hand and we will answer to your questions in private. Thank you to fill out the understanding questionnaire that has been distributed. We will come to you to check your answers in private.

**Part 2** *(distributed after completion of Part 1 and the questionnaire)*

The second part consists of 12 periods. Your payoff in this section is the sum of your earnings in each period. The composition of your local group and your global group is the same as in the previous part, but in this part you will only interact with the other two members of your local group.

**Description of each period**

The second part is similar to the first part: at the beginning of each period, each participant receives 60 ECU and has to decide how to allocate this endowment between his private account and three public accounts.

The only difference with the previous part is that the three public accounts are now **three local public accounts**.

Only three members of your local group may allocate ECU to your local public accounts. The amount of the local public accounts is the sum of the ECU allocated by you and the two other members of your local group to these accounts.

Members of the two other local groups to which you do not belong also have their own local public accounts. The local group A may allocate ECU to the local public accounts A1, A2 and A3; the local group B may allocate ECU to the local public accounts B1, B2 and B3; and the local group C may allocate ECU to the local public accounts C1, C2 and C3.

Thus, you need to decide how much of your 60 ECU you keep on your private account and how much you allocate to:

- Your local public account 1 (A, B or C) (between 0 and 60 ECU)

- Your local public account 2 (A, B or C) (between 0 and 60 ECU)
- Your local public account 3 (A, B or C) (between 0 and 60 ECU)

You must enter a value in each box displayed on your screen. The difference between your endowment 60 and the sum of the ECU allocated to each public account remains on your private account. The sum of all your ECU allocated to these accounts, public and private, may not exceed 60 ECU.

Once all group members have decided the amount they allocate to these three public accounts, you are informed of the total amount allocated to each of the three local public accounts by the 3 members of your local group (including your allocation). Your screen will also remind you the amount of your allocation to each local public account and the amount held on your private account. It also shows your payoff in that period. You are not informed of the amounts allocated to local public accounts by the two other local groups.

### Calculation of your payoff

The revenue drawn from each local public account represents 50% of the sum of the 3 individual allocations to this local public account.

Your payoff at each period is calculated using the following formula:

Table 18: Calculation of the payoff in part 2

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Payoff in a period	=	Your endowment in ECU
		- Your allocation to the two global public accounts and the local public account
		+ 50% of the total number of ECU allocated to your local public account (A, B or C)
		+ 50% of the total number of ECU allocated to your local public account (A, B or C)
		+ 50% of the total number of ECU allocated to your local public account (A, B or C)

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This formula shows that your payoff at the end of a period consists of two parts:

- 1) of the ECU that you have kept for yourself (namely your endowment - your allocation to the public accounts)
- 2) of the sum of the total revenues from your local public accounts.

As previously, each ECU you keep on your private account increases your earning in the current period by 1 ECU. If you allocate 1 ECU to a local public account, the total allocation of this public account increases by 1 ECU. In this case, your revenue increases by  $50\% \times 1 = 0.5$  ECU. The revenue of two other members of your local group will also be increased by 0.5 ECU each. Thus, the total revenue of the local group from the local public account will be increased by  $3 \times 0.5 = 1.5$  ECU.

Similarly, your income increases by 0.5 ECU for each ECU allocated to a local public account by other members of your local group. However, your income is not affected by the ECU allocated by members of other local groups to their local public accounts.

At the end of each period, a new period starts automatically. You will receive a new endowment of 60 ECU.

—



Please read again these instructions. If you have any question, raise your hand and we will answer to your questions in private.

### **Part 3** (*distributed after completion of Part 2*)

The third part consists of 12 periods. Your payoff in this section is the sum of your earnings in each period. The composition of your local group and your global group is the same as in the previous parts.

#### **Choice of the available public accounts**

Before the start of the first period, you have to vote to select the nature of the public accounts that will be available for the next 12 periods. You will vote only once in this part. You can choose between two options:

- An option with a local public account and two global public accounts (as in part 1) [*This sentence is replaced by the following in the Decentralization treatment: An option with two local public accounts and one global public account (as in part 1).*]
- An option with three local public accounts (as in Part 2).

**If the option with a local public account and two global public accounts is selected** [*This sentence is replaced by the following in the Decentralization treatment: **If the option with two local public accounts and one global public account is selected***], you will interact at the same time with the 2 other members of your local group and with the members of the other two local groups (i.e. with 8 other people).

**If the option with three local public accounts is selected**, you will only interact with the two other members of your local group.

Once all the members have voted, the computer program calculates the majority choice in each of the three local groups. The option that will be applied to the next 12 periods of the game is the one that was chosen by a **majority of three local groups** within your global group of 9 people.

Before the start of the first period, you are informed of the outcome of the vote in your local group and of the majority choice in the global group. You are not informed about the details of the votes in your local group nor in other groups.

#### **Description of each period**

You receive 60 ECU at the beginning of the period. According to the majority vote, you can allocate the ECU of your endowment either between your private account, a local public account and two global public accounts (according to the rules of Part 1) [*This sentence is replaced by the following in the Decentralization treatment: you can allocate the ECU of your endowment either between your private account, two local public accounts and one global public account (according to the rules of Part 1)*] or between your private account and three local public accounts (according to the rules of Part 2).

—

Please read again these instructions. If you have any question, raise your hand and we will answer to your questions in private.

### Questionnaire for the groups' formation in the Identity treatments

Please read each statement very carefully and evaluate how much you agree or disagree with each one of them.

For each statement, give your answer by checking the box that best describes your opinion.

You can only choose one answer from the following options:

1. Strongly disagree;
2. Disagree;
3. Agreement;
4. Strongly agree.

Statement 1: I enjoy visiting museums of contemporary art.

Statement 2: Surrogate motherhood should be authorized.

Statement 3: I am willing to consume genetically modified food.

Statement 4: I love practicing sports.

*The rest of the instructions is similar to the other treatments.*

## *Conclusion générale*

Les travaux présentés dans cette thèse s'inscrivent dans le domaine des finances publiques et des choix publics. Elle s'articule autour des notions de polarisation idéologique, de décentralisation et de conflit. Ce triptyque est abordé de trois manières différentes utilisant à la fois les outils de l'économétrie et de l'économie expérimentale.

Dans le premier essai, nous avons fait deux contributions à la littérature sur l'impact de la fragmentation politique sur les dépenses publiques. Tout d'abord, nous avons montré que la dispersion idéologique à l'intérieur des partis politiques et entre partis politiques affecte les dépenses publiques. En particulier, la dispersion à l'intérieur des partis est associée à des dépenses publiques plus élevées alors que la dispersion entre partis est associée à moins de dépenses publiques. Un corollaire de cette constatation est que le mode d'organisation et la discipline au sein des partis politiques ont de l'importance. Ce résultat est particulièrement intéressant car la littérature précédente a fait abstraction de la dispersion idéologique au sein des partis. Une implication directe de ce résultat est qu'il est indispensable d'intégrer dans l'analyse de la compréhension des processus de création des budgets publics la dispersion idéologique à la fois entre et à l'intérieur des partis politiques en les considérant comme étant, en soi, des unités fragmentées. Notre deuxième contribution a été de montrer que la dispersion idéologique est particulièrement pertinente pour les dépenses de fonctionnement. Ce résultat s'appuie sur le raisonnement que les échanges de votes sont plus facile à mettre en place pour des projets dont la réalisation est prévue dans un future proche. Par conséquent, les coûts de ces projets augmenteront davantage les futures dépenses de fonctionnement que d'investissement. En effet, les politiciens en Suisse ne sont pas des professionnels, leur mandat sont souvent relativement courts et ont une durée, en règle général, de quatre voire cinq ans. Pour cette raison, un politicien aura moins d'incitation à entrer dans un échange de votes avec un autre politicien pour un projet qui fera l'objet d'un vote dans un futur dépassant son mandat. Il en résulte que, les politiciens, en particulier dans un pays comme la Suisse, mettront en place des accords d'échanges de votes pour s'aider les uns les autres uniquement pour des projets qui ont vocation à être réalisés dans le court terme, soit pendant leur mandat. En termes de dépenses publiques, cela signifie que les conséquences de ces échanges de vote devraient avant tout être reflétées dans des dépenses de fonctionnement plus élevées, et non dans les dépenses d'investissement et c'est ce que nos résultats prouvent.

Le deuxième essai a pour apport principal la réalisation d'une expérience de laboratoire qui étudie comment les individus peuvent se coordonner dans un jeu en deux étapes avec paiements asymétriques. La littérature a montré combien les défaillances de coordination sont fréquentes dans les jeux en une étape et comment la communication peut aider les individus à se coordonner, notamment par la mise en

œuvre de stratégies du *take turn* pour réduire l'inégalité des gains à long terme. La contribution principale faite dans le deuxième essai de cette thèse a été d'étudier si la communication a la même capacité à surmonter les problèmes de coordination dans un jeu en deux étapes où l'équilibre parfait en sous-jeux exige que les deux joueurs fassent des choix opposés aux deux étapes du jeu et acceptent des gains inégaux.

Nos résultats montrent que les défaillances de coordination se produisent dans presque la moitié du temps et que moins d'un cinquième des paires utilisent la stratégie de *take turn* pour réduire l'inégalité des gains qui en résulte à long terme. La communication augmente considérablement la coordination sur l'équilibre parfait en sous-jeux. Ceci résulte du fait que la communication augmente la capacité des sujets à amorcer une stratégie de *take turn* entre eux. La communication est également importante pour le maintien de cette stratégie. Enfin, ne permettre qu'à un seul des deux joueurs d'envoyer des messages à son partenaire n'a aucun effet sur la probabilité d'utiliser la stratégie de *take turn* et sur la coordination sur l'équilibre parfait en sous-jeux. En effet, dans le traitement où la communication a été unidirectionnelle, dans un quart des groupes le joueur qui pouvait envoyer des messages a aussi été celui qui a commencé avec le couple d'options aboutissant au gain d'équilibre inférieur. Ceci qui indique la volonté de ces joueurs de mettre en place une stratégie de *take turn*.

En communiquant entre eux, les sujets ont été en mesure d'établir une stratégie qui leur a permis d'accroître l'efficacité tout en diminuant les écarts de paiements, induits par les gains asymétriques, en échangeant leurs positions relatives d'une manière équitable. Les résultats présentés dans le deuxième essai montrent que la communication est en mesure de résoudre les conflits de coordination, même dans des situations plus complexes que dans les jeux en une étape généralement étudiés jusqu'à présent.

Finalement, le troisième essai a été consacré à l'étude des mouvements séparatistes dont le nombre ne cesse d'augmenter et qui sont une conséquence directe de la volonté des régions à devenir plus autonomes. La littérature a énuméré différentes causes qui motivent cette décision de faire sécession, entre autres, sont listés le degré de proximité entre les préférences des citoyens et la fourniture de biens publics, l'importance des économies d'échelle dans l'offre de biens publics, la différence de répartition du revenu entre régions, mais aussi des raisons socioculturelles telles que les différences entre groupe ethniques ou la langue (Alesina et Spolaore 1997; Bolton et Roland 1997). La contribution du troisième essai réside dans la conception d'une expérience qui permet l'étude de ce phénomène. Plus particulièrement, nous étudions les effets d'une offre décentralisée de biens publics ainsi que de l'identité au sein de groupes locaux sur la probabilité de sécessions dans trois traitements différents qui correspondent à trois contextes sociopolitiques différents.

Nos résultats indiquent que la décentralisation augmente les contributions aux biens publics locaux aux dépens des biens publics globaux. De surcroît, en l'absence d'une identité locale renforcée, ce traitement diminue la probabilité que la majorité vote en faveur d'une séparation du groupe global avec pour conséquence son éclatement. Notre dernier résultat indique que lorsque les membres des groupes locaux sont des coopérateurs en cela qu'ils contribuent aux biens publics locaux, alors renforcer l'identité au niveau local favorise les séparations du groupe global.

Le cœur même de l'économie publique est de comprendre comment les politiques gou-

vernementales affectent l'économie. Les trois essais présentés dans cette thèse de doctorat contribuent à cette réflexion en suivant trois approches différentes desquelles ils apportent les leçons générales suivantes.

Tout d'abord, le premier essai a permis de mettre en évidence l'importance que revêt le mode d'organisation des partis politiques sur le plan budgétaire en démontrant que la polarisation (ou la dispersion idéologique) a un effet significatif sur la dépense publique. Le canal de transmission de la dispersion idéologique au sein des partis politiques à la dépense publique est lié à la discipline à l'intérieur des partis, à la possibilité d'échanger des votes ou encore au degré de professionnalisme des membres du corps législatif. Ceci est particulièrement important dans un contexte où la plupart des pays européens se sont engagés dans des politiques de consolidation budgétaire visant à réduire les déficits publics et à plus long terme leur dette publique. Un de nos projets futurs est d'approfondir cette question en appliquant notre méthodologie aux États américains et en utilisant des données relatives à la dispersion idéologique des deux chambres du Congrès américain (*House of Representatives et Senate*). Le système bipartisan est, en effet, perturbé du côté républicain par l'émergence du *Tea Party*. La base de données de Shor et McCarty (2011) devrait nous permettre de mener à bien cette entreprise.

Ensuite, le deuxième essai a montré que des individus potentiellement en situation de conflit ont tendance à éviter de se faire concurrence en face «*face-to-face*» en se différenciant, en particulier quand une forme de communication est possible. Ce résultat est intéressant car il peut être mis en relation avec la concurrence fiscale. A titre d'exemple ce résultat peut illustrer le fait que des régions cherchent à différencier leurs infrastructures pour éviter de se lancer dans une guerre de subventions pour attirer des entreprises. Ceci peut aussi expliquer l'existence de niches fiscales ou de régimes fiscaux dérogatoires du droit commun qui permettent aux pays ou régions d'éviter de se livrer à une concurrence sur leur taux d'imposition de droit commun qui serait beaucoup plus préjudiciable. Un résultat marquant est que dans ce contexte les individus à qui un avantage informationnel est donné ne vont pas utiliser nécessairement cet avantage afin d'améliorer leur situation. Les résultats du deuxième essai nous apprennent également que les sujets recourent à une stratégie de *take turn* favorisée encore par la communication. Il existe de nombreux exemples de *take turn*. Les cartels de soumission dans le cadre des marchés publics en sont un. Ils fonctionnent selon le principe de la rotation. Une extension naturelle de cet essai pourrait viser à déterminer la frontière à partir de laquelle les effets positifs de la communication sur la résolution des conflits s'estompent. Pour cela, nous pourrions renforcer la difficulté de trouver un consensus dans notre jeu en deux étapes, par exemple, en introduisant un conflit plus marqué dans la deuxième étape du jeu. La structure des gains pourrait être modifiée de telle sorte que l'équilibre parfait en sous-jeux ne corresponde plus à l'optimum social. Enfin, les décisions pourraient devenir partiellement ou totalement irréversibles, afin que l'application de la stratégie de *take turn* devienne plus compliquée.

Finalement, le troisième essai, a contribué à la réflexion sur la capacité de la décentralisation et du fédéralisme à réduire les incitations pour un groupe de faire sécession. Notre étude est pionnière en ce sens qu'elle appréhende cette problématique en faisant usage des méthodes expérimentales. Nos résultats soutiennent que la décentralisation, par le rapprochement de l'offre de biens publics vers les préférences

des citoyens, permet de réduire la probabilité pour un groupe de faire sécession. Ils mettent, également, en évidence la puissance de l'identité à aviver des velléités séparatistes. Ces résultats indiquent que la vague de décentralisation réalisée au cours de ces dernières années dans les pays de l'OCDE est une voie de dialogue pour apaiser les mouvements séparatistes recensés. Les futures extensions possibles de cette recherche peuvent commencer par enrichir ce protocole expérimental, par exemple, par l'introduction de disparités régionales en incluant des dotations initiales différentes entre sujets afin de simuler la présence de ressources naturelles ou des différences de revenus entre régions. Une autre voie d'extension de ce troisième essai est d'aborder cette question par l'angle opposé en essayant de déterminer les effets d'une perte partielle ou totale de prise de décision autonome sur la probabilité de sortir ou de refuser d'adhérer à une unification régionale. Le compromis majeur étant entre les gains d'efficacité en termes de fourniture de biens publics que l'unification régionale procure et les coûts en termes de perte de contrôle sur les décisions politiques. L'objectif de cette étude serait de montrer que la perte de contrôle sur les décisions politiques peut amener les individus à sortir d'une unification régionale ou à refuser d'y adhérer alors même qu'ils gagneraient en termes d'efficacité en restant partie prenante de cette dernière ou en acceptant d'y adhérer. Finalement, pour identifier une facette supplémentaire de l'effet produit des identités minoritaires sur les mouvements séparatistes, un futur protocole expérimental pourrait tester une situation où des groupes locaux hétérogènes englobent une communauté qui est à la fois minoritaire dans un groupe mais majoritaire dans un autre groupe. Ceci refléterait des situations actuelles comme celles de l'Irak, de la Syrie ou de la Turquie où la présence de certaines populations telles que les kurdes ou les chiites est à la fois majoritaires dans un pays mais minoritaires dans un autre.

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