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Université de Lorraine

# Thèse

pour l'obtention du grade de :

Docteur en Sciences Economiques

par

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# Legitimacy and incentives in a hierarchical relationship

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# Résumé de la thèse: Légitimité et incitations dans une relation hiérarchique

Les entreprises sont des institutions dans lesquelles naissent plusieurs interactions économiques entre les agents qui les constituent. Dans la lignée des travaux pionniers de Coase et Williamson, les entreprises peuvent être vues comme des ensemble de contrats qui régulent notamment les relations entre les dirigeants et leur employés (Williamson 2002 ; 1967). Mais les dirigeants ne sont pas toujours capables d'observer l'effort de leurs employés. En effet, les employés auront toujours la possibilité de prétendre qu'un faible niveau de production de leur part n'est pas dû à leur manque d'effort mais à un critère extérieur et à une variable aléatoire au sein de la production. Ce problème de hasard moral a grandement été étudié en théorie des contrats et particulièrement dans le cadre du modèle principal-agent. Le problème pour le principal est de choisir un schéma d'incitation qui suscite un effort de la part de l'agent sachant que le principal ne peut pas observer cette effort (Laffont et Martimort 2009). Classiquement, les schémas d'incitations tels que les incitations monétaires ou la surveillance ont étés étudiés théoriquement mais également dans le champ de l'économie expérimentale (Dickinson et Villeval 2008). Les résultats classiques suggèrent que l'agent recevra un salaire avec de la variabilité : c'est à dire un salaire important en cas de production élevée et un salaire plus bas en cas de production faible. Sinon, une autre solution pour le principal consistera à concevoir des procédures de surveillance pour superviser l'agent qui serait couteuse à mettre en place.

Dans cette thèse, le but général est d'étudier une autre forme d'incitation. Nous nous demanderons si l'autorité d'un dirigeant pourrait être suffisamment importante pour inciter son employé. Dans cette optique nous considérerons le concept d'autorité comme une source informelle d'influence et d'expertise. En effet, l'agent pourrait exercer un

effort important par lui même et « spontanément » c'est à dire sans mécanismes incitatifs classiques et potentiellement plus coûteux, s'il pense que son dirigeant a suffisamment d'autorité. Dans le but d'approfondir cette question, nous nous interrogerons plus particulièrement sur comment la légitimité du dirigeant pourrait renforcer cette autorité et susciter un effort élevé de la part de l'employé. Le Cambridge Dictionary, la légitimité est définie comme la qualité de ce qui est fondé en droit et sur un traitement juste. De manière générale, la légitimité peut être vu comme la caractéristique de ce qui permet de consentement des membres d'un groupe. Par conséquent, notre idée de départ sera de supposer que si un dirigeant requière peu d'incitations monétaires pour motiver ses employés et que ceux-ci travaillent « spontanément », cela sera une conséquence et donc un indicateur, de sa légitimité. Cela signifie que la légitimité du dirigeant sera traitée par définition comme la qualité de ce qui permet le consentement à l'effort de son employé spontanément, c'est à dire sans incitations monétaires ni surveillance. Cela sous entend cependant que nous ignorons dans cette approche d'autre sources potentielles de motivations non monétaires. Maintenant, comment pourrions-nous utiliser la théorie microéconomique pour conceptualiser la légitimité et plus précisément pour conceptualiser la nature du phénomène qui est à l'origine de l'acceptation ou du rejet de la légitimité ? Cette question ontologique est centrale dans notre approche. A notre connaissance, cela n'a jamais été étudié en économie avec des fondements microéconomiques établis.

Faisons une courte revue de plusieurs littératures qui pourraient être liées à cette question de la légitimité. Nous verrons les limites de certaines littératures et cela expliquera nos choix en termes de conceptualisation. Notamment, cela nous permettra d'expliquer quel raisonnement nous a amené à conceptualiser la légitimité et l'acceptation ou le rejet de la légitimité comme nous le faisons dans cette thèse. Comme la légitimité est fortement liée à la notion de justice, une première approche aurait consisté à considérer le comportement de rejet de la l'illégitimité comme étant fondé sur une certaine aversion aux traitements inéquitables. Par exemple, l'agent aurait pu avoir une préférence pour une certaine répartition des richesses et des avantages (diriger pouvant potentiellement être étudié comme un avantage au même titre que recevoir une plus forte rémunération). En économie comportementale, dans la littérature sur l'aversion à l'iniquité, les agents sont supposés avoir dans leur fonction d'utilité une certaine préférence pour une répartition équitable des richesses (Fehr et Schmidt 1999 ; 2000, Knoch et al. 2006), comme ils ont

des préférences pour n'importe quels biens ou services. Ce point de vue impliquera notamment qu'ils préfèreront rendre de l'argent à leurs pairs s'ils pensent qu'ils ont perçus « trop » d'argent selon eux, dans le but de satisfaire leur aspiration à une répartition plus égale des revenus. En suivant ce raisonnement, un agent dans une relation principal-agent pourrait très bien se faire justice lui même en réduisant son effort s'il pense que l'allocation des revenues et des avantages n'est pas assez « juste » à ses yeux. Cependant, nous ne suivrons pas cette approche. Une seconde approche aurait consisté à supposer que le rejet de l'illégitimité pourrait être fondé l'évaluation des performances relatives, sur les effets de pairs et les phénomènes de découragement (Azmat et Iriberri 2010, Kuhnen et Tymula 2012, Gill et Prowse 2012). Kuhnen et Tymula (2012) ainsi que Gill et Prowse (2012) suggèrent que les gens peuvent être motivés par le fait de voir leurs performances classées les unes par rapport aux autres. Cela constitue l'incidence « positive » des effets de pairs en terme d'incitation. Cependant, on a pu observé également un effet « négatif ». En effet, les gens peuvent également être découragés par le fait d'observer une performance élevée de la part d'un de leurs pairs si leur récompense est calculée à partir de leurs performances relatives (Gill et Prowse 2012). Ce résultat suggère qu'un dirigeant très travailleur ou très compétent pourrait créer une émulation avec ses employés ou au contraire les intimider. Si on se replace dans le cadre de notre question de recherche, cela suggèrerait que la légitimité pour être fondée sur les compétences du dirigeant et cela impliquerait également que le phénomène de rejet de l'illégitimité pourrait être expliqué par une absence d'émulation ou de reconnaissance des compétences du dirigeant. Pour expliquer ces résultats, la littérature s'appuie sur le concept théorique de point de référence. En économie comportementale, un point de référence est un certain niveau de performance attendu qui est personnel et intériorisé et qui sert de référence telle que si un agent réalise une performance inférieure, il ressentira une utilité négative tandis que s'il réalise une performance supérieure, il ressentira une utilité positive. Cependant, même si ces concepts d'effet de pairs et de découragement sont des pistes qui pourraient mériter d'être prises en considération pour étudier la question de la légitimité, nous utiliserons une approche microéconomique alternative car nous n'utiliserons pas le concept de point de référence. Une troisième approche, et c'est celle que nous aurons dans cette thèse, est de se référer aux travaux de Bénabou et Tirole sur les « croyances dans un monde juste » (Bénabou et Tirole 2006). Cette approche permet de modéliser le découragement et l'émulation qui pourraient être suscités par l'observation

des performances entre pairs, et particulièrement entre un employé et son dirigeant, sans utiliser le concept de point de référence mais en utilisant l'inférence bayésienne. En effet, Bénabou et Tirole (2006) suggèrent que les gens ont des succès et des échecs économiques dans leur vie mais qu'ils ne savent pas dans quelle mesure ceux-ci sont liés à des facteurs qu'ils contrôlent (comme leurs efforts) ou à des facteurs qui échappent à leur contrôle ou sont hérités (comme être née dans une famille fortunée par exemple). Par conséquent, ils vont seulement assigner une probabilité pour chaque scénario et cela représentera leurs croyances. Cependant, cette croyance ne sera qu'une croyance a priori. Bénabou et Tirole montrent que, par un raisonnement bayésien, les gens réviseront cette croyance et infèreront que s'ils ont perdu, il est plus probable que cela soit due à des facteurs hérités que ce qu'ils croyaient initialement. Par conséquent, ils vont pouvoir ensuite délibérément choisir d'ignorer les « signaux négatifs » pour maintenir une croyance optimiste sur la rentabilité de leurs efforts. Ce comportement qu'ils qualifient de déni est modélisé par un choix cognitif couteux qui consiste à biaiser l'inférence bayésienne en ignorant certaines informations. Cette croyance sur le rendement de leur effort, maintenue optimiste par l'effet du déni, garantira qu'ils seront toujours motivés à travailler dur à l'avenir. Par ailleurs dans leur model cela aura une incidence sur le choix en terme de politique fiscale. En effet, le choix du niveau de fiscalité est modélisé comme un contrat d'assurance tel que les individus devront choisir entre une politique fiscale peu redistributive ou une politique fortement redistributive. Cette dernière étant conçues telle qu'en cas d'échec économique l'effet de la redistribution compensera les pertes de revenu tandis qu'en cas de succès l'agent économique aura à soutenir un effort fiscal supplémentaire. Selon leur théorie, cela impliquera que des personnes optimistes (très sujettes au déni) voteront pour un taux de redistribution très faible et les personnes pessimistes (plus lucides) voteront pour un taux d'imposition fort et une forte redistribution des richesses. Ainsi, le choix de la politique fiscale dépendra du choix de nier ou non les informations négatives suite à un échec économique. Pour étudier la question de la légitimité nous pouvons très bien transposer ce type de raisonnement dans le cadre d'un modèle principal-agent et étudier l'établissement d'un salaire d'incitation plutôt que le taux d'imposition ainsi que les réalisations de l'employé dans l'organisation, ou ses performances scolaires, comme des signaux sur le rendement de son effort.

Par conséquent, le cadre général de notre analyse dans cette thèse est de considérer un jeu à deux périodes : une première période qui représente une compétition entre deux personnes, et une seconde période qui représente une relation hiérarchique entre ces deux personnes sachant que le gagnant de la compétition devient le dirigeant de l'autre. Cela peut représenter une compétition interne bien sur, mais cela peut représenter également les études supérieures qui séparent les étudiants entre élites et subordonnés. Ce cadre nous permet de conceptualiser la légitimité du gagnant comme une croyance qu'un employé a sur le fait que son dirigeant ait pu bénéficié d'un certain avantage au moment du processus de sélection. Cette avantage peut avoir été alloué par népotisme, par favoritisme ou n'importe quel type de traitement inéquitable mais il peut également s'agir d'une compétence supérieure que le dirigeant aurait pu avoir à partir du moment ou cette différence de compétence a été hérité et non acquise. Ainsi, en se comparant à son dirigeant, l'employée pourra en inférer la probabilité qu'il a lui même de posséder un tel avantage. Par ailleurs, il effectuera cette comparaison non seulement pendant la compétition mais également pendant la relation hiérarchique qui suivra une fois qu'il restera employé. Cette avantage rendant l'effort plus efficace, la probabilité d'être avantagé capture le rendement attendu de son effort ainsi que sa motivation ou son consentement à l'effort pendant la relation hiérarchique. Cela nous permet de définir trois type de légitimités :

- Nous définissons la légitimité « procédurale » d'un dirigeant comme le fait que la probabilité qu'il ait bénéficié de favoritisme pour sa promotion soit faible. Si le dirigeant est légitime, cela sera un signal sur le fait que l'employée ne sera pas victime d'un traitement discriminatoire et que son effort sera « justement » récompensé. Cela va donc le motiver à travailler.

- Nous définissons la légitimité « méritocratique » comme le fait que la probabilité qu'un dirigeant possède les compétences de ses employés soit forte. Observer les compétences de son dirigeant deviendra pour l'employé, par comparaison, un signal sur ces propres compétences et cela aura une incidence sur sa motivation.

- Nous définissons la légitimité « aristocratique » comme le fait que la probabilité que le dirigeant possède des compétences de direction soit forte. Dans une approche plus holistique, l'employé pourrait bénéficier de compétences de direction son dirigeant

qu'il n'est pas lui même capable de maitriser et qui auraient une incidence sur le rendement de son effort.

L'acceptation de ses trois légitimités, cette à dire dans notre approche leur capacité à inciter à l'effort, sera différente selon comment ses légitimités enverront un signal à l'employé sur le rendement espéré de son effort. L'enjeu pour l'organisation et pour le dirigeant sera de faire que celui qui échoue à une promotion ignore les informations négatives quant au rendement de son effort ou du moins que ses informations ne soient plus utiles à l'avenir pour le maintenir motivé et « optimiste » sur le rendement de son effort. A la manière de Bénabou et Tirole, cela se traduira par un biais dans le processus d'apprentissage bayésien après la défaite. Cependant, nous ne travailleront pas sur le déni mais nous allons étudier comment l'organisation peut mettre en place des procédures de sélection afin d'atteindre cette objectif, mais également comment le dirigeant peut choisir son niveau d'effort pour atteindre cet objectif. Les deux premiers chapitres sont théoriques tandis que le troisième chapitre utilise la méthodologie expérimentale.

## Chapitre 1 : Qui doit choisir les dirigeants ? Une analyse de la légitimé procédurale

Dans le premier chapitre, notre premier objectif est d'étudier de manière théorique le rôle ambivalent de l'effort pour renforcer ce que nous avons appelé précédemment la légitimité procédurale, c'est à dire la capacité d'un dirigeant ou d'une organisation à limiter les doutes concernant un potentiel favoritisme dont aurait pu bénéficier le gagnant de la compétition. Ainsi nous montrons tout d'abord que si on suppose une substituabilité entre l'effort et l'avantage supposé, c'est à dire un cas ou le favoritisme se traduit par le fait d'être plus indulgent et conciliant vis à vis d'un des compétiteurs, alors l'effort renforcera la légitimité. En effet, dans ce cas, gagner en fournissant un effort indiquera qu'avoir été favorisé est peu probable car autrement la victoire aurait été plus « facile ». Nous montrons ensuite que si en revanche l'avantage perçu agit de manière complémentaire avec l'effort, c'est à dire un cas ou il serait comparable à facteur de production (comme un instrument de travail plus performant ou une information stratégique), alors faire une

forte performance va au contraire trahir le fait d'avoir bénéficié d'un avantage. Un peu comme un sportif dopé qui ferait des performances trop extraordinaires.

Notre deuxième objectif est de nous concentrer sur la question de savoir qui devrait évaluer les concurrents au poste de direction pendant la compétition. Ainsi nous comparons ce que nous appelons une procédure interne, c'est à dire une procédure ou les évaluateurs pendant le tournoi et pendant la relation hiérarchique sont les mêmes, avec une procédure externe, c'est à dire une procédure ou les évaluateurs pendant le tournoi et pendant la relation hiérarchique sont différents. L'objectif final de l'organisation est d'inciter à l'effort pendant la compétition. En effet, cette compétition peut être interprété comme une carrière au sein de la firme et la promotion comme l'aboutissement de cette carrière. Ainsi, si un employé augmente son effort pendant le tournoi cela pourra être interprété comme une adhésion à la firme dans sa globalité. Le rôle de la firme est d'anticiper qu'un climat de suspicion pourrait s'instaurer et essayer de limiter au maximum ses effets en choisissant la bonne procédure de sélection pour maximiser la légitimité procédurale. Nous montrons qu'une procédure externe sera plus efficace pour inciter à l'effort pendant le tournoi. Et cela pour la raison suivante : nous montrons que si on suppose une rationalité bayésienne, gagner la compétition renforcera toujours la croyance du gagnant dans le fait qu'il ait été favorisé. Il se sentira toujours « coupable » en quelque sorte. Ainsi, il croira qu'il est très probable que son employé sera désavantagé à l'avenir et donc peu efficace et peu productif. Dans la procédure interne, cela aura tendance à inhiber l'effort en amont pendant le tournoi, rendant le gain à cas de victoire moins incitatif. En d'autres termes, la procédure interne renforcera la croyance dans l'inefficacité du système de sélection des dirigeants et plus généralement du système de production et d'évaluation de l'organisation. Cette inefficacité perçue se traduit par la croyance dans le fait qu'il existe un biais permanent et persistent dans le jugement de ceux qui évaluent la production. En revanche dans la procédure externe, ce ne sera pas un problème car tout traitement inéquitable présupposé pendant la compétition n'apportera aucune information concernant un potentiel traitement inéquitable à l'avenir.

## Chapitre 2 : Quelle type de compétence renforce la légitimité des dirigeants ?

Le but de ce chapitre est d'étudier de manière théorique comment le choix de la compétence sur laquelle est sélectionné un dirigeant peu être un enjeu décisif pour une organisation. Ainsi, nous construisons un jeu dans lequel une organisation doit choisir entre une procédure méritocratique, qui consiste à sélectionner les dirigeants sur leur capacité à maitriser les taches de leurs employés, et une procédure aristocratique, qui consiste à choisir un dirigeant sur ses compétences de direction. Le but est de savoir quelle légitimité du dirigeant, entre les légitimités méritocratique (acquise par la maitrise des compétences de l'employé) et aristocratique (acquise par la maitrise des compétences de direction), incitera le plus l'employé à l'effort. Par ailleurs, nous étudions aussi le choix de l'effort pendant la compétition et comment les compétiteurs décideront de révéler ou non leurs compétences. Nous pensons notamment que cela pourrait être interprété comme faisant parti d'une stratégie d'affirmation de soi et pourrait expliquer l'émergence de certaine culture de leadership.

Nous montrons que la procédure aristocratique permet au dirigeant d'augmenter son salaire comparé à la procédure méritocratique. L'intuition est que perdre la compétition dans la procédure méritocratique enverra un signal à l'employé sur le fait qu'il est un employé peu compétent tel qu'il sera moins motivé à l'avenir. Il deviendra ainsi plus coûteux à inciter à travailler. Par ailleurs, cela l'incitera à se reposer sur les compétences de son dirigeant et à adopter un comportement de passager clandestin. Dans la procédure aristocratique en revanche, échouer à être promu ne donne pas d'information sur ces compétences en tant qu'employé puisque ce sont les compétences de direction qui ont été évaluées. Par ailleurs, l'employé sera moins incité à se reposer sur les compétences de son dirigeant et à adopter des comportements de passagers clandestins.

Par conséquent, cela implique que dans la procédure méritocratique au moment de la compétition, cela pourrait être dans l'intérêt des compétiteurs de réduire leur effort et cacher leur compétence de sorte à contenir le découragement de leur futur employé et le rendre moins couteux à inciter. Nous pensons que cela peut expliquer comment une culture du leadership fondé sur l'humilité peut émerger dans une organisation alors que dans une procédure aristocratique au contraire c'est une culture de la performance qui risque d'émerger.

Une première interprétation de ce résultat pourrait être l'immobilisme et le vide idéologique dans une campagne interne d'un parti politique par exemple quand il s'agit de choisir un dirigeant. En effet chaque concurrent aura intérêt à ne pas trop investir d'effort dans l'élaboration d'un programme politique (ce qui est une transposition de ce que nous appelons la compétence métier) pour limiter la l'ampleur de sa victoire. Un programme politique qui aurait été très fortement approuvé aurait envoyé un signal au perdant que ses propres idées ne seront plus prises en compte à l'avenir et il deviendra ainsi peu coopératif. D'une certaine manière, une victoire écrasante serait trop clivante et contreproductive. Il y a également une autre interprétation possible de notre résultat si on interprète le tournoi comme l'éducation supérieure qui départage les individus entre élites et subordonnés. En effet, notre résultat suggère qu'une culture égalitaire émergera dans les entreprises ou le recrutement se fait sur la base d'études professionnalisantes, conçues pour former aux taches « métier ». La conséquence serait que ces formations favoriseraient l'échec scolaire ou l'émergence de formation courtes car les étudiants seraient peu enclins à travailler intensément ou pour une période d'étude longue compte tenu de la faible rémunération en cas de victoire. Tandis que si les entreprises recrutent sur la base d'études généralistes, la perspective pour les étudiants d'être peu être propulsés rapidement à des postes de direction avec une forte rémunération sera très incitative et favorisera le choix d'un effort élevé et d'un engagement dans des études de longues durées.

## Chapitre 3 : Le coût caché des procédures de promotion au mérite.

Dans le troisième chapitre nous avons une approche expérimentale pour tester certains des résultats du deuxième chapitre. Le but est de tester la disposition de l'employé à accepter les inégalités de salaire entre lui et son dirigeant en fonction de la procédure de sélection de son dirigeant. Nous étudions notamment la procédure méritocratique que nous avons étudiée de manière théorique dans le chapitre 2. La disposition de l'employé à accepter les inégalités est capturée par le salaire minimum que l'employé demandera pour exercer un haut niveau d'effort plutôt qu'un faible niveau d'effort.

Pour traiter de ce problème nous avons conçu une expérience avec deux étapes qui ré-

pliquent les principales caractéristiques du cadre générale du deuxième chapitre excepté que nous n'utilisons pas de taches réelles. Pendant la première étape du jeu deux concurrents sont en compétition et on leur demande d'investir dans un projet d'investissement qui peut être soit un projet de qualité (très rentable) soit un projet de mauvaise qualité (peu rentable). Le projet est alloué de manière aléatoire au début de l'expérience de telle sorte qu'ils ne connaissent pas la qualité de leur projet. On leur demande avant et après le tournoi de déclarer leur croyance dans le fait de détenir le projet de mauvaise qualité. La deuxième étape du jeu est une procédure BDM ou le perdant du tournoi doit déclarer le salaire minimum qu'il est prêt à accepter pour un investir un montant élevé d'argent plutôt qu'un montant faible d'argent (seuls deux niveaux d'investissement sont réalisables). Pour capturer l'effet des différentes procédures, nous avons conçu deux traitements. Dans le traitement 1 (procédure 1), le perdant doit investir dans le même projet d'investissement que celui qui lui a été attribué dans la première étape du jeu. En revanche dans le traitement 2 (procédure 2), le perdant se voit attribuer un nouveau projet d'investissement après sa défaite, de manière aléatoire également, et doit investir dans ce projet dans la deuxième étape du jeu.

Dans ce protocole, le projet d'investissement représente une production, le niveau d'investissement représente un effort et la qualité du projet représente une compétence. Par conséquent, le traitement 1 peu être interprété comme une procédure méritocratique car pour gagner le tournoi les concurrents doivent révéler une compétence qui est celle qui sera demandé au perdant après le tournoi une fois qu'il devient employé. Ainsi, cela représente la compétence de l'employé.

Nous montrons que quand les agents gardent le même projet après l'échec (T1), ils sont beaucoup plus pessimistes quant au fait de posséder le projet de qualité. Cela est dû à un effet purement bayésien. Alors que quand on leur alloue un nouveau projet (T2), cela fait l'effet d'un « nouveau départ » et ils sont beaucoup plus optimistes sur le fait d'avoir le bon projet. On montre aussi que plus l'agent est pessimiste quant au fait d'avoir le bon projet, plus il demandera un salaire élevé. Cela implique qu'en moyenne dans le traitement 1, quand les agents conservent le même projet, ils demandent un plus gros salaire que dans le traitement 2, quand ils reçoivent un nouveau projet. Nous pensons que ce résultat confirme certaines des prédictions du chapitre 2 et pourrait remettre en cause peu être l'efficacité des procédures de sélection méritocratiques.

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# General introduction

Firms are institutions in which grow several economic interactions between agents that constitute them. Following the pioneer work of Coase and Williamson, firms can be seen as a node of contracts that regulates notably the relationship between managers and their employees (Williamson 2002; 1967). But employers are not always able to observe their employees' efforts. Indeed, the employee will always be able to pretend that a small level of production is not due to his lack of effort but due to an external criteria and a stochastic variable into the production. This problem of moral hazard has been largely studied in contract theory and particularly in the framework of the principal-agent model. The issue is for the principal to choose an incentive scheme that induces high effort from the agent given that the principal cannot observe this effort (Laffont and Martimort 2009). Classically, incentive schemes such as monetary incentive or monitoring have been studied theoretically but also in the field of experimental economics (Dickinson and Villeval 2008). Classical results suggest that the agent will receive a wage with variability: that is a wage higher in case of high production and a lower wage in case of low production. Otherwise, another solution for the principal would consist in designing a costly monitoring procedure to supervise the agent.

In this thesis, the general aim is to study another form of incentive. We will wonder if the *authority* of an executive might be sufficiently strong to incentivize the agent. For this purpose we will consider in this thesis the concept of authority as an informal source of influence and expertise. Indeed, the agent could exert high effort by himself "spontaneously" without classical, and potentially more costly, incentive mechanism if he believes his executive has enough *authority*. In order to deepen this issue, we will wonder more specifically how the *legitimacy* of the executive might bolster this *authority* and induce high effort from the agent. In Cambridge Dictionary, the legitimacy is defined as the quality of what is founded in law or founded in fair treatment. And more generally speaking the legitimacy could be seen as the quality of what allows the consent of members of a group. As a consequence, our starting idea will be to assume the fact that if a principal

requires very low cost incentives mechanism in spite of unobservable effort of the agent (and the existence of moral hazard) it will be a consequence, and thus an indicator, of his legitimacy. It means that the legitimacy of a leader will be treated by definition as the quality that allows a consent to effort spontaneously from his employee without monetary incentive or monitoring. It implies that this approach ignores potential other sources of non monetary motivations not related to our object of study. Now how could we use microeconomics theory to conceptualize *legitimacy* and more specifically the *nature* of the phenomenon that is at the origin of the acceptance or the rejection of legitimacy? This ontological issue is central in our approach. To our knowledge, it has never been studied in economics with established microeconomics foundation.

Let us make a short review of several literatures that might be related to this issue of legitimacy. We will see the limits of some literature and it will explain our choices in terms of conceptualization. Notably, it will allow us to explain what reasoning brought us to conceptualize legitimacy and the acceptance or the rejection of legitimacy like we do in this thesis. As legitimacy is closely linked with the concept of fairness, a first approach would consist in considering the behavior of rejection of illegitimacy as being based on an aversion to unfair treatment. For example, the agent could have a social preference for a certain wealth distribution. In behavioral economics literature on *inequity aversion*, agents are assumed to have in their utility functions a certain preference for equitable allocation of wealth (Fehr and Schmidt 1999; 2000, Knoch et al. 2006), like they would have for any regular goods or services. This point of view will imply notably that they will prefer to give back money to peers in order to satisfy their aspirations to more equal incomes. Following this reasoning, an agent in a principal-agent relationship could perfectly dispense justice on his own behalf by decreasing his effort if he thinks the allocation of revenues is not "fair" enough for him. We will not follow this approach.

A second approach would consist in assuming that the rejection of illegitimacy could be based on relative performance evaluation, peer effect and discouragement (Azmat and Iriberri 2010, Kuhnen and Tymula 2012, Gill and Prowse 2012). Kuhnen and Tymula (2012) and Gill and Prowse (2012) suggest that people may be motivated by seeing their performances ranked. This is the "positive" impact of peer effect in terms of incentive. However, a "negative" impact has been observed as well. People on the contrary might be discouraged by observing a high performance from their peers if their rewards are based on

relative performance (Gill and Prowse 2012). These results suggest that a very competent or hard worker executive could create emulation and thus motivate his employees or on the contrary intimidate them. This would imply that the legitimacy would be based on the competence of the executive and it could also imply that the phenomenon of rejection of illegitimacy could be seen as an absence of emulation or an absence of recognition of the executive's competence. To explain those results, the theoretical foundation is the concept of *reference point*. In behavioral economic literature, a reference point is an expected performance such that if an agent deviates above he will feel a psychological positive utility whereas if he makes an inferior performance he will feel a negative utility. However, even though the concepts of peer effect and discouragement are avenues that could be worth exploring for treating the issue of legitimacy, we will use an alternative microeconomics approach because we will not use the concept of reference point.

A third approach, and this is the approach that we will have in this thesis, is to refer to the work of Benabou and Tirole on "belief in a just word" (Benabou and Tirole 2006). This approach allows to model the discouragement and emulation after observing the performance of a peer, and particularly the executive, without using reference point but using the tool of bayesian inference. Indeed, Benabou and Tirole (2006) suggest that people may have economics success or failure during their lifes but they do not know to what extent it is due to controllable variables (like their efforts) or due to inherited factors (like being born in a wealthy family). As a consequence they only assign a probability on it that represents the *a priori* belief they have. Benabou and Tirole (2006) show that, by bayesian inference people will infer that if they fail, it is more likely that their failures are due to inherited factor than what they *a priori* believed. As a consequence they may deliberately choose to ignore "bad signals" to maintain an optimistic belief about the return of their efforts. This deny, is modeled by a costly cognitive choice that consists in skewing the bayesian inference by ignoring some information. This optimistic belief in the return of their efforts will guarantee that they will be still motivated to work hard in the future anyway. Furthermore in their model, the tax policy is modeled as an insurance contract such that: in case of economic failure, a redistributive tax policy will compensate the loss of income but in case of economic success the contributor will have to bear an additional tax burden. It implies that very optimistic people will vote a low tax rate and accept less redistribution of wealth because they do not anticipate that economic failure is very likely. On the contrary, those who do not deny bad news will have a more pessimistic belief

about the return of their efforts. As a consequence they will choose a high tax rate and a strong redistribution of wealth. To study legitimacy issues, we can perfectly transpose this reasoning in a principal-agent framework and study the establishment of incentive wages instead of tax rates and the achievements of employees and executives in the workplace for instance, or their education backgrounds, as signals on the return of their efforts.

As a consequence, our approach in this thesis is to consider a simple situation constituted by two stages: a first stage where an organization designs a competition with two opponents competing to become the executive of one another and a second stage which is the hierarchical relationship in itself. It can represent an internal competition or in can be high education that parts students between elites and subordinates within the organization. This framework allows us to conceptualize the legitimacy of the winner as a belief an employee has about the fact his executive owns a certain kind of asset. The belief may be about an asset that has been allocated by nepotism, favoritism or any kind of unequal treatment but it also could be a belief about the competence of the winner and the incompetence of the looser. This asset makes effort more efficient not only during the competition but also during the hierarchical relationship ex-post. Thus, by comparison the looser will infer his own probability of owning himself this asset during the competition but also the probability he owns this asset after the competition when he remains an employee. This probability of owning himself this asset captures the expected return of his effort and will capture his motivation or his consent to effort. Thus this allow us to define more precisely three concepts of legitimacy:

- A first concept that we denote *procedural legitimacy* implies that the principal will be seen as legitimate if he was promoted through a promotion process with no favoritism. Thus the principal will have a procedural legitimacy if the probability he owns an asset allocated by unfair treatment is "low". Knowing that his executive has a *procedural legitimacy* will send a signal to the employee that himself will not be treated unfairly in the future and that his effort might be "fairly" rewarded. This concept of legitimacy is directly inspired by the work in social psychology on "procedural justice" (Tyler and Blader 2003). This work studies how people may have concern about the fairness of procedures by which decisions are made and allocation of incomes is decided.

- A concept based on competence that we call *meritocratic legitimacy*. It means that the principal will be seen as legitimate if he demonstrates more ability than his employee at the operational task executed by his employee (like accounting skills for an auditor or research skills for a professor for instance). In other word, the one who will become the principal is the "best employee". It corresponds to a legitimacy bolstered by experience and technical knowledge of the profession or the operational task. The agent may compare his own ability to master operational task by comparison with his executive. This might change the expected return of his effort and thus his motivation.

- And finally we study a concept of legitimacy that we denote *aristocratic legitimacy* that assumes that the principal will be seen as legitimate if he has some managerial ability (like administrative skill, commercial skills, communication skills). In a more holistic approach of the organization, the agent might benefit from competences that he is not himself able to master and it may enhance the expected return of his effort as well.

The acceptance of those three legitimacies (*procedural, meritocratic, aristocratic*), that is their abilities to incentivize effort, will be different with respect to how these legitimacies will send a signal to the employee on the expected return of his own effort. This approach suggests that the core of the mechanism of acceptance or rejection of legitimacy is assumed to be based on a cognitive issue and statistical inference and on their consequence on motivation of employees. Indeed, winning or loosing the competition will send a signal such that they will change their beliefs in being favored or in being competent. This will change the expected return of their efforts for the future and thus their motivations to work hard. In the spirit of Benabou and Tirole (2006), the stake for the organization or the executive if they want to maximize the acceptance of legitimacy will be their abilities to make agent "forget bad news", or at least to make "bad news" on the return of his effort obsolete and not relevant for the future effort he will be required. However, contrary to Benabou and Tirole we will not study cognitive strategy of deny as a way to bias bayesian inference, but we will study what kinds of procedures of selection the firm may design and what kinds of strategies of effort the principal can use to reach this objective.

As a consequence, to address the general issue of this thesis, we will define more precisely our approach by answering the following research questions:

- If an organization designs a competition between two opponents such that the winner becomes the executive of the looser, we will study what choice of procedure of selection will bolster the legitimacy of the winner. Namely, we will study what procedure will make obsolete for the looser the negative information learned after defeat on the return of his effort such that he will maintain his motivation intact for the future.

- In the view of the manager, we will study what is the level of effort that he should choose during procedure of promotion to bolster his legitimacy. Namely, we will study which strategy makes defeat a signal with few negative information on the return of the effort of the looser and thus maintains his motivation for the future.

Thus, in our thesis we will conceptualize several procedures of promotion and we will compare their abilities to bolsters the three legitimacies that we have defined previously (*procedural, meritocratic, aristocratic*), that is their abilities to incentivize effort once the competition is over. However, we will also study how they will incentivize effort during the competition itself. It will allow us to study the strategy of effort of the future executive with respect to his legitimacy. We will study four types of procedures:

- An *internal procedure* is a procedure where people in charge of the assessment of opponents are their future colleagues. It means that people in charge of the assessment during the tournament will be the same that people in charge of assessment during the hierarchical relationship.

- An *external procedure* is a procedure where people in charge of the assessment of opponents are external and are different than people that will evaluate after the competition. This captures a more institutionalized process that consist in delegating assessment to human resources departments for example or to establish external contests like civil service entrance examination.

- A *meritocratic procedure* is a procedure where the executive is selected on his ability to master the task of his employee. It corresponds to a process where the executive is selected with respect to his experience of the profession and how he demonstrated he was the most performing employee. But it also can correspond to a professionalizing training designed to meet demands of organizations on operational task.

- An *aristocratic procedure* is a procedure where the executive is selected on his managerial competences. Those training are not design to train to a specific operational task but are more generalist. It corresponds to high education and generalist training in prestigious engineers school or business school for instance. It could also correspond to a process within the organization if the organization designs a probation period when the candidates are evaluated on a task different task than their routine task.

On this basis, the thesis is comprised of three chapters: our two first chapters will be theoretical work. Our last chapter will be an experimental analysis.

In the **first chapter**, our first aim is to study the ambivalent role of effort to bolster what we called previously *procedural legitimacy*, that is his ability to defuse doubt on a potential favoritism that could have benefit the winner. Our second aim will be to focus on the issue of who should be in charge of the assessment of opponents during the competition. As a consequence, we will compare the efficiency of an *internal procedure* (where assessors of the tournament are identical than assessors during the hierarchical relationship), and an *external procedure* (where assessors of the tournament are different than assessors during the hierarchical relationship), to bolster *procedural legitimacy* and to incentivize high effort during the competition. The major assumption in that model is that opponents have an a priori suspicion on the fact that one of them might benefit of preferential treatment (like nepotism or discriminations) even though it might be not based on tangible elements. To capture this suspicion, we assume people assign a probability of owning an certain advantage that enhances the efficiency of their efforts. As a consequence, they will choose their efforts, not only to win the competition, but also to manage the signal their performances could send on an advantage they could have received. The purpose is then to contain suspicion to a minimum. The organization's final objective is to incentivize effort during the tournament. Thus, its role is to anticipate that a climate of suspicion could emerge and try to defuse it by choosing who should be in charge of the evaluation of opponents by implementing the right procedure. Indeed, the tournament can be seen as a productive stage corresponding to a long term career and promotion can be seen as a final reward. The stake for the firm is that the motivation to exert effort during the promotion process could be interpreted as an adhesion to the whole organization in its entirety.

The first result of this chapter is that effort does not necessarily bolster *procedural legitimacy*. If there is a substitutability between effort and the asset, namely a case where the performance required for one opponent could be less demanding, then effort will bolster legitimacy. Indeed, then exerting high effort to win the tournament indicates that being advantaged is unlikely because it would be otherwise very easy to win. On the contrary, if asset is complementary with effort, namely a case when the asset is an input comparable to a mean of production (like more effective working tool or strategic information), then making a high performance will betray the winner and increase suspicion a little bit like a doped sportsman that would make a too extraordinary achievement. A second result is that the looser of the tournament will be indifferent to the *procedural legitimacy* of the winner if we assume substitutability. On the contrary, if we assume complementary, a legitimate executive will be able to decrease the incentive wage he will have to offer to the agent to exert high effort. The intuition is that in case of complementary, being disadvantaged will act as a incompetence that will decrease the marginal efficiency of effort and thus decrease motivation. Finally, our third result is to show that the external procedure will be more efficient to incentivize effort during the tournament. Indeed, we show that if we assume bayesian rationality, winning the competition will always reinforce the belief of the winner that he was favored. In other words, he will always feel "guilty". Then he will believe that it is very likely that his employee will be disadvantaged in the future and thus not very effective. In an *internal procedure* this "cost of illegitimacy" will inhibit effort upstream during the competition as it will make victory much less interesting. Whereas in an *external procedure* this will not be an issue because no information about a potential unfair treatment during the tournament will be relevant in future as the persons in charge of assessment will be different.

The **second chapter** is no longer focused on this issue of who should be in charge of assessment like in the first chapter. The purpose of this chapter is to study how the choice of the nature of the ability on which the executive is selected might be a crucial stake for the firm. The firm has to choose between a *meritocratic procedure*, that consists in choosing leaders for their abilities to outperform their employees at their own task, and an *aristocratic procedure*, that consist in choosing leaders for their abilities to master a managerial task. The purpose is to investigate what kinds of legitimacy between a *meritocratic legitimacy*, bolstered through a *meritocratic procedure*, or an *aristocratic legitimacy*,

bolstered through an *aristocratic procedure*, will be more efficient to incentivize effort after the tournament. But we also study the choices of efforts upstream during the tournament and how opponents choose to demonstrate their abilities. We argue these choices could be part of a leadership strategy.

We show that an *aristocratic procedure* will allow the executive to increase the inequality of wage between him and his employee, compared to a *meritocratic procedure*. The intuition is that loosing the competition in a *meritocratic procedure* will send a signal to the employee that he is an underperforming employee such that he will loose motivation in the future making him very hard and costly to incentivize. Whereas in an *aristocratic procedure*, failing at being promoted does not give information about his ability as an employee because he was required to demonstrate managerial ability during the tournament. Thus we argue an *aristocratic procedure* allows to neutralize the issue of rivalry between an employee and his executive and that an *aristocratic legitimacy* becomes a substitute to variable wage as an incentive.

As a consequence, it implies that in a *meritocratic procedure*, it could be in the interest of opponents to reduce their performances and hide their abilities during the tournament in order to contain the discouragement of their future employees and make him less costly to incentivize. We argue this could explain how a leadership culture of humility could emerge in an organization. Whereas in an *aristocratic procedure*, opponents will be more incentivized to demonstrate their abilities which could imply the emergence of a leadership culture of performance. An interpretation of that result could be notably the emergence of stasis and ideological vacuum in an internal campaign for a political parti when it comes to appoint a leader. Indeed, each opponents could forsake exerting too much effort in elaborating a political program (which would be a transposition of the business ability we have previously discussed) during the tournament to limit the extent of his victory. A political program that would be widely approved by the organization could send a signal to the looser that his own ideas won't be taken into account in the future. He will then become less cooperative. In other words, an outstanding victory will be too much cleaving.

There is also another possible analysis of our results if we interpret the tournament as school education that parts people between elites and subordinates. Indeed, our results suggest that an egalitarian culture could emerge in some industries if their recruitments are based on professionalizing education system designed to train on oper-

ational task. And all the more if they promote people on the basis of their experiences acquired through exerting the operational task. The consequence would be that those trainings would favor academic failures as students would not be interested in working hard because the reward in case of high performance would not be incentivizing. It could also be an incentive to pursue short-term education rather than master degree for instance.

In our **third chapter**, we have an experimental approach to test some results of the second chapter . Our aim is to test empirically if the willingness of employee to accept inequality of wage between him and his executive will depend on the procedure of promotion of his executive. We study notably the *meritocratic procedure* that we have studied theoretically in the second chapter. This willingness to accept inequality is captured by the minimum wage the employee demands to exert a high effort for his executive. To tackle this issue we design an experiment constituted of two stages that replicates coarsely the general framework of second chapter but not using real task effort. During a first stage, two opponents compete and are required to invest in an investment project that can be either a high quality project (which is very profitable) or a low quality project (which is less profitable). The project is allocated randomly at the beginning of the experiment such that they do not know the quality of their projects. We ask them before and after the tournament to declare their beliefs in owning the low quality project. The second stage is an elicitation phase using Becker-DeGroot-Marschak procedure where the looser is asked to declare the minimum wage he would accept to invest again a high amount of money rather than a little amount of money (only two levels of investment are feasible). To capture the effect of different procedures we design two different treatments. In treatment 1 (procedure 1), the looser of the tournament is asked to invest in the same project that the one he was endowed at the beginning of the tournament. Whereas in treatment 2 (procedure 2), the looser is given a new project after his defeat, also randomly allocated, and is required to invest in that project for stage 2. In this experiment, the investment represents a production, the level of monetary investment represents an effort and the quality of the project represents a competence. As a consequence, treatment 1 can be interpreted as a *meritocratic procedure* like we define it in the second chapter because to win the tournament, opponents are required to reveal an ability that will still be required by the looser who remains an employee after the tournament. Thus it represents the employee's ability.

We show that when agent keeps the same project after failure (treatment 1), they are

much more pessimist about owning the high quality project. It is due to a pure bayesian effect after failure. Whereas when they are endowed a new project (treatment 2) it acts as a "fresh start" and they are much more optimistic about owning the high quality project. We also show that the more agents are pessimist about owning the high quality project, the more they will demand a high wage. This imply that on average in treatment 1, when agents keep the same project, they will demand a higher wage that in treatment 2, when they were endowed a new project. We argue this result may challenge the efficiency of a *meritocratic procedure* to make employee accepting inequality of wage and confirms our theoretical prediction in chapter 2.

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# Chapter 1

# Who should select leaders? An analysis of a procedural legitimacy

"Ill-gotten gains never leads to prosperity". Popular proverb

## 1.1 Introduction

The aim of this chapter is to study a form of legitimacy that we denote *procedural legitimacy* not based on competence or performance but assuming that an executive will be seen as legitimate if he was promoted through a competition that guaranteed equality of opportunities (i.e a competition where no opponent benefit of preferential treatment). The stake for the organization is that this king of legitimacy could be an implicit incentive that could be potentially less costly than regular incentive such as variable wage. Indeed, a executive "legitimate" will send a good signal to the employee on the expected return of his effort as he would infer that only effort and not external criteria will count to get rewarded in the organization. This approach is notably justified by the work on "procedural justice" in social psychology (Tyler and Blader 2003) and also in experimental economics (Ku and Salmon 2013, Bolton et al. 2005). This concept states that people care about the fairness of procedures by which decisions are made and allocation of incomes is established. Thus the objective of this chapter is to study how some particular procedures of promotion may bolster or undermine this procedural legitimacy, what will be the consequences in term of implicit incentive, and what would be the consequence for the future leader on the choice of his actual effort as a ex-ante mean to bolster his legitimacy.

To tackle these issues, we build a two-stage game where the first stage is a tournament that parts two candidates for an executive position, and the second stage is the hierarchical relationship strictly speaking where the looser is the employee of the one who has been promoted. The opponent during the tournament choose a effort to produce an outcome and the winner is the one who produces the most. We will assume that opponents have an a priori suspicion that their colleagues could be advantaged (discrimination, nepotism, racism, sexism...) during the tournament. This suspicion is not necessary based on tangible elements but is potentially presupposed. It is modeled by a probability of being advantaged and this probability will be considered as the indicator of the "degree" of procedural legitimacy. Furthermore, the advantage is treated as an asset that enhances the efficiency of effort such that opponents will revise their beliefs in being advantaged by bayesian learning observing effort and performance after the tournament. As a consequence their objectives will be not only to choose efforts in order to win the tournament but also to manage the signal about their potential advantages that their performances could send. Finally, the second stage is modeled as a regular principal-agent relationship: the principal (i.e the winner of the preceding tournament) does not exert effort and proposes a variable wage to incentivize high effort from the agent (i.e the loser). The output is observed at the end and the effort of the agent is of course unobservable.

Regarding the firm (an external player), its objective is to maximize efforts of opponents during tournament by choosing optimally between two procedures of promotion. We denote as "internal procedure" a process where people in charge promotion are the same than people that will assess later the work of the one who will remain employee. It captures a very intuitive promotion process corresponding to what occurs where people are assessed by their peers. The "external procedure" is a procedure where people that assess candidates at the executive position are not the same than people that will evaluate thereafter the employee. It correspond to a more institutionalized process where promotion is delegated to a human resource department for instance or to civil service entrance examination. As a consequence, the firm does not assess directly itself and is not responsible directly for any inequitable treatment. Besides, this inequality of treatment does not occur necessarily but it is just an exogenous suspicion from opponents that the firm has to deal with.

With this framework in place, we get the following main results. The first result does

not focus for now on the issue of the optimal procedure but remains focused on the point of view of opponents strategies and only in the framework of an internal procedure. We show that the role of effort in the first stage is ambivalent to bolster legitimacy. Indeed, if we assume complementarity between effort and the presupposed advantage, namely a case where the advantage is comparable to a mean of production (such as more effective working tool, a strategic information, key contact etc.), then the more effort will be high, the more it will exacerbate the effect of advantage. Thus a high performance will be more suspicious and the one who is advantaged will betray himself. A bit like a sportsman doped that would outperform his opponents too obviously. However, if we assume substitutability between effort and advantage, namely a case where the performance expected for one opponent would be less demanding (such as starting with a head start), then exerting high effort for achieving a high performance indicates on the contrary that being advantaged is unlikely because the advantage would otherwise avoid exerting to much effort.

The second result shows that there is a possible substitution in the second stage between the legitimacy of an executive and the variability of wage which is classically used as an incentive to implement high effort from agent and reduce hazard moral. Which means that a legitimate executive would need to provide less costly monetary incentive relatively to a non legitimate one. However, this result holds only if we assume complementarity between effort and the advantage and not substitutability. Indeed it would imply that the advantage exacerbates the marginal return of effort exactly like would do a competence. Thus the looser of the tournament will demand a higher wage to compensate the fact that in his point of view his chances of success are little regarding he feels disadvantaged. In other words, the principal will have to "payback" the agent to maintain his motivation in some ways.

The third major result is about the issue of the optimal procedure assuming substitutability between effort and advantage. In internal procedures, we show that it is rational in bayesian term that whatever the level of effort achieved by the one who has been promoted, he will always be more confident about being advantaged than before competing. In other words, he will always "feel guilty". He will then anticipate that his agent will be disadvantaged by the firm in the future and that he will be less productive. This is what we call the *cost of illegitimacy* and it will tend to inhibit effort upstream during the competition stage. The solution for the firm would be to establish a procedure that would

neutralize the "negative" effect of bayesian learning by delegating the promotion issue to an independent entity. That would be the purpose of an external procedure. Indeed, in that case, every inequalities of treatment assumed by opponents during the tournament would not bring information about a potential unfair treatment in the future as the assessors will be different people. This changing of assessors would serve as a fresh start. Thus being aware in advance that the cards will be reshuffled after the tournament will highly incentivizing. We believe human resources department and civil service entrance examination are partially designed to serve as a scape goat for this reason. If we interpret stage 1 as a career and promotion before stage 2 as a long term achievement, we can infer that external procedures will favor the general adhesion to the organization and the acceptation of a higher degree of social heterogeneity (in a sense that in our analyze social heterogeneity implies mechanically an *a priori* suspicion) and a higher degree of unequal treatment.

Our main contribution is to develop a theoretical approach on procedures of justice based on theory of incentive, a concept that has been treated - to the best of our knowledge, only in experimental paper. For that reason this work is an attempt to build microeconomics foundations of legitimacy using the theoretical framework of an "unfair" tournament. We deepen the idea of competition with bias used by Bolton et al. (2005), and include it in the theoretical framework of the theory of incentive. We also deepen the idea of Ku and Salmon (2013) that merit is ambivalent to make people accept inequality and we propose a theoretical framework to explain this using the bayesian revision of the belief in being disadvantaged. We also add the idea that the identity of people in charge of assessment will matter to explain behavior when faced to unfairness. That will even constitute the core of an efficient procedure. This approach makes us moving away from the literature that assumes social preference for ideal of justice (Englmaier and Wambach 2010, Cox et al. 2007, Falk and Fischbacher 2006) as our work is only focused on the motivational aspect of unfairness and the incentive issue.[1]

The rest of the chapter is organized as followed. Section 2 will deal with the literature

[1]The work on social preferences for ideal of justice assume that people have a preference in their utility functions for a certain allocation of revenues like they would have a preference for any kind of good or services.

related to our work in this chapter . Section 3 will describe the theoretical framework. Section 4 will deal with results. Section 5 concludes.

## 1.2 Literature

This chapter is related to the following literature. Several experimental papers in economics are directly related to the notion of procedure of justice. Other papers are indirectly related in the sense that they study the link between merit and reward. The results are not always consistent to each other. Ruffle (1998) shows in a dictator game, that the one who was chosen to allocate revenues took into account the merit of the person who receive it. The merit is measured by a score at a test before the experiment. Symmetrically, Cherry et al. (2002) and Hoffman et al. (1994) show that, still in the framework of a dictator game, the one who allocates revenues feels legitimate to divert incomes from the other player if he previously succeeded at a performance test. Cappelen et al. (2007) made the distinction between three fairness ideals: strict egalitarianism, liberal egalitarianism and libertarianism. They study a dictator game where there is a production stage prior to the allocation stage and they find that merit is a subjective concept. It depends on how people weight the importance of random variables and controllable variables in the production. They assumed that controllable variables are the amounts people invest during the production stage whereas random variables are the rates of return of those investments.

Charness and Rabin (2002) and Engelmann and Strobel (2004) show inequity aversion decreases if allocation of incomes increases the global efficiency of the economy.[1] That is to say, a growing inequality is accepted if everyone gets his revenue increased. Bolton et al. (2005) compare a situation with simultaneously unequal distribution, generated by a ultimatum game, and unfair procedures. They study how the receiver rejects the offer of the proposer in several cases: if the proposer can choose himself an unequal distribution or if the income inequality depends on a bias established in advance (to create bias, they use loaded dice) or if it depends on a random criteria. They prove that the case with random criteria is the one which has the less rejection rate whereas the voluntary unfair allocation is highly rejected and the case with the bias is intermediate. Ku and Salmon (2013) show

[1] Inequity aversion is concept whereby people have preferences equitable allocation such that they are willing to pay to reduce inequalities.

that several institutional elements could affect the acceptation of an unreasonable rise of richer people revenue. They part participants into two groups: one is constituted of people that are well endowed (or "favored") at the beginning of the experiment and the other one is less endowed (or "unfavored"). Unfavored participants will be asked to accept or not to give a proportion of their endowments to the favored participants. They are told that this transfer is actually an investment that will finally improve their own revenues but in a smaller proportion than the revenue of participant that were favored. Four situations have been taken into account: in the first case, the favored group selection is random; in the second one, the selection is based on merit; in the third case, the selection is based on belonging in a specific social group; and in the last case, selection rewards uncooperative behavior. The experimental papers of Ku and Salmon (2013) and Bolton et al. (2005) are indeed directly related the theoretical work in social psychology on the procedure of justice.

The theoretical literature is less extensive. Indeed, to the best of our knowledge no papers study, strictly speaking, procedures of justice. However, there are some papers on inequity aversion. Falk and Fischbacher (2006) build a model that explains reciprocity assuming that part of utility function is depending on a "kindness term" that depends on outcome transfer and intention. Cox et al. (2007) propose another model on reciprocity and justice. They define the concept of emotional state as key parameter of the marginal rate of substitution between the payoff of one individual and the payoff of other people. Englmaier and Wambach (2010) study specifically moral hazard in a principal-agent model with inequity aversion. Inequity aversion is adding to the traditional payoff as an extra cost, which is assumed to be increasing and convex with unequal distribution. Most of the theoretical work on iniquity aversion assume that individual has a social preference for justice. They analyze kindness, selfishness, reciprocity and unfairness aversion as a classical trade off between the direct utility of wealth and the negative utility related to unfairness.

## 1.3 Theoretical framework

We consider the following two-stage game. At date 1, an *unfair* tournament occurs between two agents $i$ and $j$. A *fair* competition is assumed to be a competition with no favoritism

of any kind (gender, religion, social network...). We denote $\lambda_i$ as the ex-ante probability for $i$ not to be disadvantaged with $i \in \{1,2\}$ and $\lambda_i \in [0,1]$. It is an *a priori* belief that will be revised. Furthermore $\lambda_j$ is the ex-ante probability $j$ not to be disadvantaged with $j \in \{1,2\}$ and is defined such as $\lambda_j = 1 - \lambda_i$. Both agents share the same beliefs *a priori* such that $i$ observe $\lambda_j$ and reciprocally. Besides the firm observes $\lambda_i$ and $\lambda_j$. It means that the firm is not responsible for any favoritism in particular because its objective is to choose the procedure of promotion not to assess opponents. Its role will be to choose who should be in charge of evaluation rather than assessing strictly speaking as we will explain further. Furthermore, favoritism does not occur necessary in the model but we assume, first, that opponents are *a priori* suspicious about it even though it is not based of real proof or actual fact and, second, that the firm is aware of this suspicion. Theoretically, the favoritism is treated such as a unequal distribution of assets before the competition. It is of course an enrich concept that includes any kind of social capital or information, or any kind of effective working tool. It can be also interpreted as a head start. Being disadvantaged is assumed to reduce the efficiency of effort for the agent who is victim. So, if $\lambda_i = 1$, it means that $i$ has the belief he is completely advantaged and $j$ is completely disadvantaged. Symmetrically, if $\lambda_i = 0$, it means that $i$ has the belief he is completely disadvantaged and $j$ is completely advantaged.

At the end of the first stage, the agent who performed the highest output is promoted by the firm and becomes principal during the second stage. At stage 2 each agent revises his belief of being disadvantaged taking into account the performances and each effort chosen during stage 1. We denote $\lambda_i^{expost}$ this updated belief for player $i$. The second stage is a principal-agent model.

**Definition 1.** The principal is perceived as *legitimate* during the second stage if after the tournament the agent believes the principal won thanks to his effort and not because he was advantaged. Formally, if agent $i$ wins, he will be *legitimate* if after observing the results, it is less likely that he was advantaged than disadvantaged: $\lambda_i^{expost} \leq \frac{1}{2}$. By extension, the lowest $\lambda_i^{expost}$ will be, the more the principal will be seen as *legitimate*.

Two procedures of promotion can be chosen by the firm: an internal and an external procedural. In internal procedures people in charge of assessment during the tournament are the same than people in charge of assessing production in stage 2. As a consequence during stage 2, principal and agent will use their revised beliefs $\lambda_i^{expost}$

such that $\lambda_i^{expost} \neq \lambda_i$. However, in external procedures people in charge of the evaluation during the tournament are different such that an unfair treatment during stage 1 does not give information about a potential unfair treatment in stage 2. Thus principal and agent will use a unrevised belief $\lambda_i^{expost}$ such that $\lambda_i^{expost} = \lambda_i$. The objective of the firm is to maximize effort during the competition by choosing the optimal procedure.

Here is the sequence of the game:

- Stage 1:
  - $i$ and $j$ share the same belief on $\lambda_i$ and $\lambda_j$. The firm observe theses beliefs.
  - The firm choose between an internal or an external procedure without observing efforts in stages 1 and 2.
  - Opponents choose their efforts during the tournament simultaneously.
  - The opponent that makes the best performance is promoted. The firm does not observe efforts but only performances.
  - After the tournament, opponents observe efforts exerted and performance of each other.
- Stage 2:
  - The winner of the tournament offers a variable wage to the loser that will continue to exert a task. Effort of the loser is non contractible and the principal does not work.
  - Effort is exert and the principal, the agent and the firm observe the output.

Now that we have outline the general structure of the model, let us focus on explaining in more details the first stage and the second stage.

### 1.3.1 Stage 1: a tournament with suspicion

Let us first explain the interaction arising at the first stage of the game. We consider that $i$ can exert a costly effort $e_i$ that takes only two values (i.e $e_i \in \{0, 1\}$). Exerting high effort during the first stage implies a high cost $\psi > 0$. It is assumed to be the same for each

opponent $i$. Exerting low effort implies no cost. There are two levels of production $q_i$ such that $q_i \in \{0, 1\}$.

In the case where the high effort is chosen, we define $\pi_1 = P(q_i = 1 \mid e_i = 1 \mid \bar{i})$ as the probability to produce 1 for the $i$ given he exerts the high level of effort and given he has been fully advantaged (formalized by $\bar{i}$). Thus $1 - \pi_1$ is the probability to produce 0. Besides, we define $\underline{\pi}_1 = P(q_i = 1 \mid e_i = 1 \mid \underline{i})$ as the probability to produce 1 for player $i$ given he exerts the high level of effort and given he has been completely disadvantaged (formalized by $\underline{i}$). Thus, $1 - \underline{\pi}_1$ is the probability to produce 0 such as $\pi_1 > \underline{\pi}_1$.

In the case where the low effort is chosen, we define $\pi_0 = P(q_i = 1 \mid e_i = 0 \mid \bar{i})$ as the probability to produce 1 for $i$ given he exerts the low level of effort and given he has been completely <u>not</u> disadvantaged and $1 - \pi_0$ the probability to produce 0. Besides, we define $\underline{\pi}_0 = P(q_i = 1 \mid e_i = 0 \mid \underline{i})$ as the probability to produce 1 for $i$ given he exerts the low level of effort and given he has been completely disadvantaged. $1 - \underline{\pi}_0$ is the probability to produce 0 such as $\pi_0 > \underline{\pi}_0$.

Furthermore it is reasonable to assume that $\pi_1 > \pi_0$ and $\underline{\pi}_1 > \underline{\pi}_0$. Besides we will assume that $\pi_1 - \pi_0 \geq \underline{\pi}_1 - \underline{\pi}_0$ which is a technological assumption. If $\pi_1 - \pi_0 > \underline{\pi}_1 - \underline{\pi}_0$ it means that the advantage make the marginal return of effort more effective which presupposes that the advantage is complementary with effort. It corresponds to an advantage on asset like information, social capital or more effective working tool for instance. Assuming $\pi_1 - \pi_0 < \underline{\pi}_1 - \underline{\pi}_0$ would have mean that advantage would have sabotaged the productivity of effort which is of course not relevant. Finally, the particular case $\pi_1 - \pi_0 = \underline{\pi}_1 - \underline{\pi}_0$ means that the marginal efficiency of effort is constant over being disadvantaged or not. It is interpretable as substitutability between effort and advantage. In that case, advantage is more "obvious" like a head start that make expectation for one opponent less demanding than for the other one for instance.

For simplicity, we note:

$$\pi_{e_i} = P(q_i = 1 \mid e_i \mid \bar{i})$$

And:

$$\underline{\pi}_{e_i} = P(q_i = 1 \mid e_i \mid \underline{i})$$

At the end of stage 1, the winner is the player who produces an output strictly greater

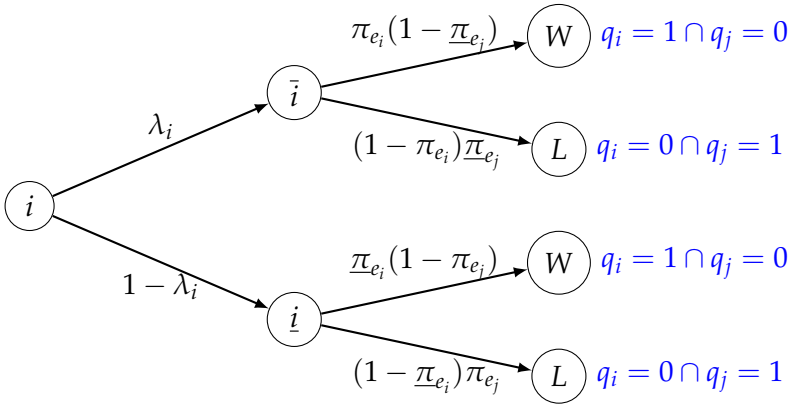



Figure 1.1 – *Conditional Probability Tree for i*

than his opponent. In case of a tie, both agents loose and get zero. At the tournament, each opponent has to choose a level of effort anticipating the strategy of his competitor, and taking into account the probability of being disadvantaged and the expected level of production. As shown in Figure 1.1, the probability of winning and losing of $i$ given he is advantaged are respectively :

$$P(q_i = 1 \cap q_j = 0 \mid (e_i, e_j) \mid \bar{i}) = \pi_{e_i}(1 - \underline{\pi}_{e_j})$$
$$P(q_i = 0 \cap q_j = 1 \mid (e_i, e_j) \mid \bar{i}) = (1 - \pi_{e_i})\underline{\pi}_{e_j}$$

In the same way we get:

$$P(q_i = 1 \cap q_j = 0 \mid (e_i, e_j) \mid \underline{i}) = \underline{\pi}_{e_i}(1 - \pi_{e_j})$$
$$P(q_i = 0 \cap q_j = 1 \mid (e_i, e_j) \mid \underline{i}) = (1 - \underline{\pi}_{e_i})\pi_{e_j}$$

Having characterized the tournament stage, we now turn to the second stage of the game.

### 1.3.2 Stage 2: the hierarchical relationship

*Internal procedure*

In the case of internal promotion procedures, people in charge of assessing opponents during competition are the same that people in charge of assessing the production in stage 2. So winning or loosing competition gives information about the future treatment in stage 2. Thus, both opponents will start stage 2 with a revised belief on been disadvantaged based on a bayesian learning process. Each player will take into account the performance

of himself and his opponent and the effort they both exerted to update their beliefs as effort is observable between each other after the tournament . We mention however that the firm never obverses those efforts but knows that it will be rational from the opponent to update their beliefs.

During stage 2, we have a principal-agent relationship so that if $j$ becomes agent then $\lambda_j$ becomes $\lambda_j^{expost}$. In the interest of clarity, $\lambda_j^{expost}$ will be denoted $\lambda_{j,P}^{e_i,e_j}$: the revised belief that refers to the probability for $j$ of having been advantaged, given he won the tournament and given he exerted effort $e_j$ and $i$ exerted effort $e_i$. Symmetrically, $\lambda_j^{expost}$ will be denoted $\lambda_{j,A}^{e_i,e_j}$ the revised probability of having been advantaged in case of defeat. That is to say if $j$ becomes agent in stage 2 we get:

$$\lambda_{j,A}^{e_i,e_j} = P(\bar{j} \mid (e_i, e_j) \mid q_i = 1 \cap q_j = 0)$$

And if $j$ becomes principal in stage 2 we have:

$$\lambda_{j,P}^{e_i,e_j} = P(\bar{j} \mid (e_i, e_j) \mid q_i = 0 \cap q_j = 1)$$

Furthermore, as both opponents share the same prior belief and observe the same performance and efforts we know that:

$$\lambda_{j,A}^{e_i,e_j} = \lambda_{i,P}^{e_i,e_j} \text{ and } \lambda_{j,P}^{e_i,e_j} = \lambda_{i,A}^{e_i,e_j}$$

Besides we have in case of failure for $j$:

$$\begin{aligned} P(q_i = 1 \cap q_j = 0 \mid (e_i, e_j)) = \lambda_j P(q_i = 1 \cap q_j = 0 \mid (e_i, e_j) \mid \bar{j}) \\ + (1 - \lambda_j) P(q_i = 1 \cap q_j = 0 \mid (e_i, e_j) \mid \underline{j}) \end{aligned}$$

and in case of success:

$$\begin{aligned} P(q_i = 0 \cap q_j = 1 \mid (e_i, e_j)) = \lambda_j P(q_i = 0 \cap q_j = 1 \mid (e_i, e_j) \mid \bar{j}) \\ + (1 - \lambda_j) P(q_i = 0 \cap q_j = 1 \mid (e_i, e_j) \mid \underline{j}) \end{aligned}$$

Then we can write by bayesian inference:

$$\lambda_{j,A}^{e_i,e_j} = \frac{\overbrace{P(q_i = 1 \cap q_j = 0 \mid (e_i, e_j) \mid \bar{j})}^{\text{Probability } j \text{ looses given he was advantaged}}}{\underbrace{P(q_i = 1 \cap q_j = 0 \mid (e_i, e_j))}_{\text{Probability } i \text{ wins}}}$$

$$\lambda_{j,P}^{e_i,e_j} = \frac{\overbrace{P(q_i = 0 \cap q_j = 1 \mid (e_i, e_j) \mid \bar{j})}^{\text{Probability } i \text{ looses given he was advantaged}}}{\underbrace{P(q_i = 0 \cap q_j = 1 \mid (e_i, e_j))}_{\text{Probability } i \text{ looses}}}$$

As established in definition 1, the more $\lambda_{j,A}^{e_i,e_j}$ increases, the more the principal is perceived as *legitimate* by $j$. Indeed, if $\lambda_{j,A}^{e_i,e_j}$ increases it implies mechanically that $\lambda_{i,P}^{e_i,e_j}$ decreases which means it is less likely he was advantaged during the competition. Based on the strategies set during stage 1 we have then four different levels of *legitimacy*: $\lambda_{j,A}^{1,1}, \lambda_{j,A}^{0,1}, \lambda_{j,A}^{1,0}, \lambda_{j,A}^{0,0}$. In case of failure, we have for each couple of strategies $(e_i, e_j) \in \{0,1\}$:

$$\lambda_{j,A}^{1,1} = \frac{\lambda_j(1-\pi_1)\underline{\pi}_1}{\lambda_j(1-\pi_1)\underline{\pi}_1 + (1-\lambda_j)(1-\underline{\pi}_1)\pi_1}$$
$$\lambda_{j,A}^{0,1} = \frac{\lambda_j(1-\pi_1)\underline{\pi}_0}{\lambda_j(1-\pi_1)\underline{\pi}_0 + (1-\lambda_j)(1-\underline{\pi}_1)\pi_0}$$
$$\lambda_{j,A}^{1,0} = \frac{\lambda_j(1-\pi_0)\underline{\pi}_1}{\lambda_j(1-\pi_0)\underline{\pi}_1 + (1-\lambda_j)(1-\underline{\pi}_0)\pi_1}$$
$$\lambda_{j,A}^{0,0} = \frac{\lambda_j(1-\pi_0)\underline{\pi}_0}{\lambda_j(1-\pi_0)\underline{\pi}_0 + (1-\lambda_j)(1-\underline{\pi}_0)\pi_0}$$

And in case of success we have:

$$\lambda_{j,P}^{1,1} = \frac{\lambda_j\pi_1(1-\underline{\pi}_1)}{\lambda_j\pi_1(1-\underline{\pi}_1) + (1-\lambda_j)\underline{\pi}_1(1-\pi_1)}$$
$$\lambda_{j,P}^{0,1} = \frac{\lambda_j\pi_0(1-\underline{\pi}_1)}{\lambda_j\pi_0(1-\underline{\pi}_1) + (1-\lambda_j)\underline{\pi}_1(1-\pi_1)}$$
$$\lambda_{j,P}^{1,0} = \frac{\lambda_j\pi_1(1-\underline{\pi}_0)}{\lambda_j\pi_1(1-\underline{\pi}_0) + (1-\lambda_j)\underline{\pi}_1(1-\pi_0)}$$
$$\lambda_{j,P}^{0,0} = \frac{\lambda_j\pi_0(1-\underline{\pi}_0)}{\lambda_j\pi_0(1-\underline{\pi}_0) + (1-\lambda_j)\underline{\pi}_0(1-\pi_0)}$$

Once we did that we can establish the function of production in stage 2. As in stage 1, the production can only take two value $\overline{S} = 1$ or $\underline{S} = 0$ and is stochastic. Besides the production is only produced by the agent and his effort is not contractible. The principal will offer a variable wage in order to incentivize high effort before the agent exerts effort. In case of high effort exerted in stage 2 we denote $\pi_1^P(\lambda_{j,P}^{e_i,e_j})$ the probability of producing 1 if $j$ is agent and $i$ is principal given that the production is produced only by the agent:

$$\pi_1^P(\lambda_{j,P}^{e_i,e_j}) = \lambda_{j,P}^{e_i,e_j}\pi_1 + (1-\lambda_{j,P}^{e_i,e_j})\underline{\pi}_1 \tag{1.1}$$

Besides we denote $\pi_0^P(\lambda_{j,P}^{e_i,e_j})$ the probability of producing in case of low effort we have:

$$\pi_0^P(\lambda_{j,P}^{e_i,e_j}) = \lambda_{j,P}^{e_i,e_j}\pi_0 + (1-\lambda_{j,P}^{e_i,e_j})\underline{\pi}_0. \tag{1.2}$$

Similarly if $j$ wins and $i$ becomes agent in second stage, we denote $\pi_1^A(\lambda_{i,A}^{e_i,e_j})$ the production produced by $i$ with high effort such that:

$$\pi_1^A(\lambda_{i,A}^{e_i,e_j}) = \lambda_{i,A}^{e_i,e_j}\pi_1 + (1-\lambda_{i,A}^{e_i,e_j})\underline{\pi}_1 \tag{1.3}$$

and we denote $\pi_0^A(\lambda_{i,A}^{e_i,e_j})$ the production produced by $i$ with low effort:

$$\pi_0^A(\lambda_{i,A}^{e_i,e_j}) = \lambda_{i,A}^{e_i,e_j}\pi_0 + (1 - \lambda_{j,P}^{e_i,e_j})\underline{\pi}_0. \tag{1.4}$$

When we will establish the payoff in stage 1 using backward induction we will need to take into account the case when $i$ wins and the case when he looses respectively weighed by the probability of winning and loosing. Indeed, the belief of being disadvantaged will not be the same after loosing or winning such that the expected payoff and the probability of producing the high level of production in stage 2 will not be the same either.

This mechanism of belief reinforcement through bayesian inference is central in this chapter. Indeed if $i$ becomes principal, he could have an interest in the reinforcement of the most positive belief for $j$ that will motivates him to make a higher effort during stage 2. That why choosing his effort during stage 1 could be motivated not only by the interest of winning the tournament but also as an incentive strategy in stage 2 in case he becomes principal. This result will depend on a technological assumption seen in the next section.

Now that we have set the framework in the case of an internal procedure and notably the importance of bayesian inference we will describe an external procedure.

*External procedure*

In an external promotion procedure, the bayesian inference is no longer relevant. It means that people in charge of evaluation in the first stage are different than the one in charge of evaluation in second. As a consequence, winning or loosing the competition does not give information about discrimination in the future and the bayesian inference is not relevant anymore (i.e $\lambda_i^{expost} = \lambda_i$). Except this, the model in case of an external procedure is identical with the model of an internal procedure.

As previously specified the firm does not evaluate strictly speaking neither during the tournament nor the production in stage 2, but its role is to choose who will be in charge of evaluation. Assigning to a human resources department the responsibility of promotion process can be seen as an external procedure for instance. The human resources department will them define some general criterias and will evaluate employees independently of their regular colleagues or executives criterias or preferences. Civil service entrance examination can be also seen as an external procedure. For example it is case for the contest of "Capes" or "Aggrégation du secondaire" in french administration to become

a teacher in high school. Of course, those kind of procedure are not necessary purely external in a sense that it could be completed by a last round like an interview with a future colleague for instance. But this is not necessary an issue for our work in a sense that our work has a normative purpose as well.

Now that we have established the theoretical framework in both stages, the difference between an internal and an external procedure, and notably the importance of bayesian inference, we are going to present our results in the next section.

## 1.4 Results

In this section we will present three major sets of results. In the first subsection, we will focus on the link between effort and procedural legitimacy as we define it in definition 1. We notably analyze how it could bolster or undermine the legitimacy of the winner. The second set of results deals with legitimacy as an incentive in stage 2, and how an agent may have a concern for legitimacy (or on the contrary be indifferent to it). The last set of results focuses on the incentivizing nature in first stage of both procedures (internal or external) that can choose the firm.

### 1.4.1 The ambivalent role of effort to bolster legitimacy

The purpose of this subsection is to study the link between effort and procedural legitimacy and notably how the role of effort can be ambivalent.

As we showed in the last section our theoretical framework suggests four level of legitimacies captured by four posterior beliefs of being disadvantaged after failure with respect to four couples strategies during stage 1: $\lambda_{j,A}^{1,1}, \lambda_{j,A}^{0,1}, \lambda_{j,A}^{1,0}, \lambda_{j,A}^{0,0}$. Now we are going to establish the mathematical conditions for $\lambda_{j,A}^{1,e_j} > \lambda_{j,A}^{0,e_j}$ which means that if $i$ provides high effort instead of a low effort during the tournament and that he finally wins, his opponent $j$ will have a stronger belief in not having been disadvantaged. This would be interpreted as effort bolstering procedural legitimacy as we define it in definition 1. Similarly, we can find the conditions that guarantee $\lambda_{j,A}^{e_i,0} > \lambda_{j,A}^{e_i,0}$ which means that for $j$ loosing by exerting effort will bolster the legitimacy of the winner $i$.

**Proposition 1.1.** *(i) If i becomes the principal in stage 2, having exerted high effort during tournament bolsters his legitimacy that is to say,* $\lambda_{j,A}^{1,e_j} > \lambda_{j,A}^{0,e_j}$*, if and only if* $\frac{\pi_1}{\underline{\pi}_1} < \frac{\pi_0}{\underline{\pi}_0}$*. On the contrary, if* $\frac{\pi_1}{\underline{\pi}_1} > \frac{\pi_0}{\underline{\pi}_0}$*, then exerting high effort undermines legitimacy. However, winning the tournament, whatever his level of effort, undermines his legitimacy that is to say* $\lambda_{j,A}^{e_i,e_j} < \lambda_j$*. (ii) If j becomes agent, having exerted high effort during tournament bolsters legitimacy of the winner, that is to say* $\lambda_{j,A}^{e_i,1} > \lambda_{j,A}^{e_i,0}$*, if and only if* $\frac{\pi_1}{\underline{\pi}_1} < \frac{\pi_0}{\underline{\pi}_0}$ *and* $\pi_1 - \pi_0 = \underline{\pi}_1 - \underline{\pi}_0$*.*

*Proof.* See Appendix A □

The intuition behind theses results are the following. Proposition 1.1 means that when $i$ wins by exerting high effort, whatever the strategy of his opponent, it will reinforce the belief for $j$ that he was advantaged. Intuitively, it means that effort bolsters legitimacy which is very intuitive but verified only under certain conditions. The conditions $\frac{\pi_1}{\underline{\pi}_1} < \frac{\pi_0}{\underline{\pi}_0}$ is interpreted as substitutability between effort and advantage. That is to say, the return of advantage is higher when the effort is low. Effort decreases the return of being advantaged. If we assume a perfect subtituability between the advantage and effort, that is to say if $\pi_1 - \pi_0 = \underline{\pi}_1 - \underline{\pi}_0$, then $\frac{\pi_1}{\underline{\pi}_1} < \frac{\pi_0}{\underline{\pi}_0}$ is verified.

Further, Proposition 1.1 also leads to a very counterintuitive result if we assume the opposite condition $\frac{\pi_1}{\underline{\pi}_1} > \frac{\pi_0}{\underline{\pi}_0}$. This is an assumption of complementarity between effort and favoritism. Indeed, in that case exerting high effort in first stage decreases legitimacy in second stage. Because, effort *exacerbates* the effect of advantage. The effect of being disadvantaged is *worse* if effort of the opponent is high. The intuition is that making a very important performance will betray the one who has been advantaged. A little bit like a sportsman who has been doped and who outperforms too obviously his opponent.

Besides, proposition 1.1 asserts also that $\lambda_{j,A}^{e_i,e_j} < \lambda_j$, which means that loosing competition will always reinforce belief about being disadvantaged whatever the couple of strategies. It means that it is rational to be a "bad looser" whatever the effort exerted by his opponent even though he worked very "hard" and whatever his "merit". It will also be rational to be a bad looser even when loosing without exerting high effort. This result will be particularly useful in the last subsection to establish what procedure between an internal or an external procedure is the more incentivizing to exert high effort during the competition.

Finally, proposition 1.1 also sheds light on the case when $j$ looses the competition by exerting himself a high effort instead of a low effort. This proposition states that the more

he did work, the more it bolsters the legitimacy of the winner of the competition. However, this proposition holds only if we assume substitutability between effort and advantage. It means that for $j$ loosing while he worked hard during the tournament will bolster the legitimacy of the winner. The intuition is that efforts of both opponents have the same effect: the more opponents work the less favoritism counts into the actual performance. So, outperforming the other becomes more related to effort. It is a quit counterintuitive result because one might believe at first that the legitimacy of the winner would have been higher if his effort was higher than the one of his opponent.

What is also interesting in that this last statement holds if we assume $\pi_1 - \pi_0 = \underline{\pi}_1 - \underline{\pi}_0$. The assumption means that the nature of favoritism is linear and does not change the marginal return of effort. This is interpretable as if the opponent who is advantaged would benefit from a head start for instance. It would mean that assessors during the tournament would expect from him a less demanding outcome. This is straightforward that this assumption corresponds well to pure discrimination on gender or ethnical origin for instance. As a consequence, proposition 1.1 means that paradoxically, if discrimination is linear and one opponent benefit from a head start, then loosing the competition by exerting high effort tend to bolster legitimacy of the winner.

Now that we have exposed our first set of results on the ambivalent link between effort and legitimacy, we will in the next subsection focus the analysis on the link between legitimacy and the incentive wage in stage 2 by analyzing notably what conditions will make the agent concerned or indifferent about legitimacy.

### 1.4.2 Legitimacy and wage: concern or indifference of the agent for legitimacy

This subsection is a principal-agent framework. The principal cannot observe the effort of the agent such that effort is not contractible and he needs to offer a variable wage, that will be enough incentivizing and depending on the production observed. Indeed, as the production is stochastic, it is feasible to produce a high level of production while exerting low effort. Thus it could be rational for the agent to exert low effort and expecting receiving the high wage anyway.[1] Similarly to stage 1, the production can take two values $\bar{S} = 1$ or $\underline{S} = 0$ and effort can take only two values 1 and 0 as well.

[1]To read more work on moral hazard and contract theory see Laffont and Martimort (2009).

#### 1.4.2.1 Case without moral hazard

We will start by studying a very simple case where both the agent and the principal are risk neutral and where there is no limited liability constraint. This last assumption means that the principal could offer a negative wage $\underline{t}^*$ in case of low level of production and a positive wage $\bar{t}^*$ in case of high production as an incentive. In that case, the hazard moral is no longer an issue. Indeed, if we take into account the revised belief of effort return and if we denote $\psi_2$ the cost of high effort in stage 2, assuming that for low effort the cost is 0. The program of the principal is:

$$\begin{aligned}
\max_{\bar{t},\underline{t}} \quad & P_P^{e_i,e_j} = \pi_1^A(\lambda_{j,A}^{e_i,e_j})(\bar{S}-\bar{t}) + [1-\pi_1^A(\lambda_{j,A}^{e_i,e_j})](\underline{S}-\underline{t}) \\
s.c. \quad & \pi_1^A(\lambda_{j,A}^{e_i,e_j})\bar{t} + [1-\pi_1^A(\lambda_{j,A}^{e_i,e_j})]\underline{t} - \psi_2 \geq \pi_0^A(\lambda_{j,A}^{e_i,e_j})\bar{t} + [1-\pi_0^A(\lambda_{j,A}^{e_i,e_j})]\underline{t} \qquad (1.5) \\
& \pi_1^A(\lambda_{j,A}^{e_i,e_j})\bar{t} + [1-\pi_1^A(\lambda_{j,A}^{e_i,e_j})]\underline{t} - \psi_2 \geq 0 \qquad (1.6)
\end{aligned}$$

The incentive constraint (equation 1.5) is a constraint such that if it is verified, it will worthwhile for agent to exert high effort rather than low effort with respect to the wage $(\underline{t}, \bar{t})$ proposed by the principal. The participation constraint (equation 1.6) guarantees that exerting a low effort will be still worthwhile for the agent with respect with the wage. The results are very standard in the literature:

$$\begin{aligned}
\underline{t}^* &= -\frac{\pi_0^A(\lambda_{j,A}^{e_i,e_j})}{\Delta\pi(\lambda_{j,A}^{e_i,e_j})}\psi_2 \\
\bar{t}^* &= \frac{1-\pi_0^A(\lambda_{j,A}^{e_i,e_j})}{\Delta\pi(\lambda_{j,A}^{e_i,e_j})}\psi_2
\end{aligned}$$

Those results are found by saturating the incentive constraint and the participation constraint such that resolving the principal program is reduced to a 2 variables linear system of equations . Besides, the variable $\lambda_{i,A}^{e_i,e_j}$ regarding legitimacy and belief in being advantaged is treated as a fixed parameter in stage 2 as it depends on stage 1 behaviors. So, we find directly from the principal program:

$$P_P^{e_i,e_j} = \pi_1^A(\lambda_{j,A}^{e_i,e_j})(\bar{S}-\bar{t}^*) + [1-\pi_1^A(\lambda_{j,A}^{e_i,e_j})](\underline{S}-\underline{t}^*)$$

Which gives a very standard result of contract theory, if we assume $\bar{S}=1$ and $\underline{S}=0$:

$$P_P^{e_i,e_j} = \pi_1^A(\lambda_{j,A}^{e_i,e_j}) - \psi_2$$

With $\pi_1^A(\lambda_{j,A}^{e_i,e_j}) = \lambda_{j,A}^{e_i,e_j}\pi_1 + (1-\lambda_{j,A}^{e_i,e_j})\underline{\pi}_1$ if $i$ becomes the principal. We note that the principal's payoff will increase in $\lambda_{j,A}^{e_i,e_j}$ only because it increases the probability of getting

the high level of production. But $\lambda_{j,A}^{e_i,e_j}$ does not change the cost of delegation $\psi_2$ which is a constant. This is because in this specific case with risk neutrality and no limited liability constraint, there is no informational rent.

**Proposition 1.2.** *In case of risk neutrality and no constraint of limited liability, the legitimacy of the principal decreases the spread between the high wage and the low wage: when $\lambda_{j,A}^{e_i,e_j}$ increases, $\Delta t^* = \bar{t}^* - \underline{t}^*$ decreases if and only if $\pi_1 - \pi_0 > \underline{\pi}_1 - \underline{\pi}_0$.*

*Proof.* See Appendix B □

Following Proposition 1.2, legitimacy is an incentive to high effort and an opportunity for the principal to substitute the wage gap, which is classically use as an incentive.

#### 1.4.2.2 Case with moral hazard

Now we assume there is a limited liability constraint in stage 2 such that the principal cannot offer a negative wage in case of low production. In that case the agent has a positive informational rent and the issue of moral hazard is only partly solved in the standard approach. The program of the principal is then:

$$
\begin{aligned}
\max_{\bar{t},\underline{t}} \quad & \pi_1^A(\lambda_{j,A}^{e_i,e_j})(\bar{S}-\bar{t}) + [1-\pi_1^A(\lambda_{j,A}^{e_i,e_j})](\underline{S}-\underline{t}) \\
s.c. \quad & \pi_1^A(\lambda_{j,A}^{e_i,e_j})\bar{t} + [1-\pi_1^A(\lambda_{j,A}^{e_i,e_j})]\underline{t} - \psi_2 \geq \pi_0^A(\lambda_{j,A}^{e_i,e_j})\bar{t} + [1-\pi_0^A(\lambda_{j,A}^{e_i,e_j})]\underline{t} \\
& \pi_1^A(\lambda_{j,A}^{e_i,e_j})\bar{t} + [1-\pi_1^A(\lambda_{j,A}^{e_i,e_j})]\underline{t} - \psi_2 \geq 0 \\
& \bar{t} \geq 0 \\
& \underline{t} \geq 0
\end{aligned}
$$

With $\bar{t} \geq 0$ and $\underline{t} \geq 0$ the limited liability constraints. For $\bar{S} = 1$, $\underline{S} = 0$ it leads to proposition 1.3:

**Proposition 1.3.** *In case of risk neutrality and limited liability, the equilibrium wage is:*

$$\underline{t}^* = 0$$
$$\bar{t}^* = \frac{\psi_2}{\Delta\pi(\lambda_{j,A}^{e_i,e_j})}$$

*Thus, the agent has a concern for legitimacy, i.e* $\frac{\partial \bar{t}^*}{\partial \lambda_{j,A}^{e_i,e_j}} > 0$*, if* $\pi_1 - \pi_0 > \underline{\pi}_1 - \underline{\pi}_0$*. On the contrary, the agent becomes indifferent to legitimacy, i.e* $\frac{\partial \bar{t}^*}{\partial \lambda_{j,A}^{e_i,e_j}} = 0$ *if* $\pi_1 - \pi_0 = \underline{\pi}_1 - \underline{\pi}_0$*. The informational rent* $P_A = \psi_2 \frac{\pi_0^{e_i,e_j}}{\Delta\pi^{e_i,e_j}}$ *of the agent in stage 2 increases with legitimacy if and only if* $\frac{\pi_1}{\underline{\pi}_1} < \frac{\pi_0}{\underline{\pi}_0}$ *or if* $\pi_1 - \pi_0 = \underline{\pi}_1 - \underline{\pi}_0$*.*

*Proof.* See Appendix C □

First, proposition 1.3 means that $\bar{t}$ is decreasing with legitimacy. Indeed, if principal choose high effort in stage 1, $\Delta\pi(\lambda_{i,A}^{e_i,e_j})$ will increase, so $\bar{t}$ will decrease. This is quit intuitive. If the principal increases his effort in stage 1, the belief for the agent in stage 2 will be more positive (see proposition 1.1) and that will increase mechanically the expected return of effort in stage 2. Legitimacy is then a substitute to monetary incentive implying that the principal may propose a lower wage.

**Definition 2.** We consider the agent as *concerned about legitimacy* if it is possible to increase incentive wage to make him exert high effort to compensate illegitimacy of the principal. By extension, we define agent as *indifferent to legitimacy* if his demanded wage is independent of legitimacy.

This illustrates perfectly the trade-off for the principal before he starts competition in stage 1. Does the cost of high effort in stage 1 worth it if it allows the principal to lower the wage he offers to the agent in stage 2? The technological condition in Proposition 1.3 means that the effort cancel partially the effect of being disadvantaged. Being legitimate (i.e $\lambda_{j,A}^{e_i,e_j}$ at a high level), the principal makes high effort much more worthwhile for the agent in comparison with low effort. In other words, he increases the marginal return of the agent's effort $\Delta\pi(\lambda_{j,A}^{e_i,e_j})$. So, it becomes much more interesting for the agent to exert high effort because this improves much more than low effort the probability of high level of production in a situation with legitimacy compared to a situation with no legitimacy. This is why $\bar{t}$ decreases with legitimacy. But, at the informational rent level, this is compensated by an increase of $\pi_0$. It becomes also, in absolute term this time,

much more interesting to choose low effort because the probability of producing high level of production with low effort increases. As a consequence, the informational rent $P_A = \psi_2 \frac{\pi_0^{e_i,e_j}}{\Delta\pi^{e_i,e_j}}$ increases with legitimacy.

However if we assume $\frac{\pi_1}{\underline{\pi}_1} > \frac{\pi_0}{\underline{\pi}_0}$, the absolute effect of the probability of receiving the high wage while exerting low effort will be lower than the effect of legitimacy on the decreasing of $\bar{t}$. The intuition is that this assumption means a complementarity between effort and favoritism such that advantage will be fully leveraged only if high effort is exerted. So, at the informational rent level, the increasing effect of legitimacy on $\pi_0^{e_i,e_j}$ will be little, whereas it will remain a strong decreasing effect on $\bar{t}$.

What is interesting and very counterintuitive in Proposition 1.3 is that the conditions for reducing the informational rent with legitimacy are exactly the opposite of the condition for increasing legitimacy by effort in Proposition 1.1, respectively $\frac{\pi_1}{\underline{\pi}_1} < \frac{\pi_0}{\underline{\pi}_0}$ and $\frac{\pi_1}{\underline{\pi}_1} > \frac{\pi_0}{\underline{\pi}_0}$. It means that if $\frac{\pi_1}{\underline{\pi}_1} < \frac{\pi_0}{\underline{\pi}_0}$ is verified, effort and advantage are complementary and the effort of principal in stage 1 decreases his legitimacy. Indeed, effort will betray the one who is advantaged by *exacerbating* the effect of the advantage on return (Proposition 1.1). So, if he wants to become legitimate to decrease the informational rent he would have to make low effort and keep low profile. However, if effort cancels partially the effect of being disadvantaged on return (i.e $\frac{\pi_1}{\underline{\pi}_1} > \frac{\pi_0}{\underline{\pi}_0}$), then the principal will increase his legitimacy if he makes high effort in stage 1 but, this legitimacy will increase the informational rent. Thus, exerting low effort during stage 1 becomes the only strategy to decrease informational rent and so whatever the technological assumption.

Assuming $\pi_1 - \pi_0 = \underline{\pi}_1 - \underline{\pi}_0$ so that $\Delta\pi(\lambda_{j,A}^{e_i,e_j}) = \Delta\pi$, means that the surplus of production resulting from exerting high effort during stage 2 is the same whatever the legitimacy of the principal and the strategies of the two agents during stage 1. As we previously explained, the assumption can means favoritism can be seen as a head start, namely an advantage that makes the expectation of the firm for one opponent less demanding.

The payoff of the principal will be:

$$P_P = \pi_1(\lambda_{j,A}^{e_i,e_j}) - \pi_1(\lambda_{j,A}^{e_i,e_j})\frac{\psi_2}{\Delta\pi}$$

and the payoff of the agent will be:

$$P_A = \pi_0(\lambda_{j,A}^{e_i,e_j})\frac{\psi_2}{\Delta\pi}$$

In that case of course, the informational rent increases with legitimacy and so the cost of delegation for the principal. Indeed, $\Delta\pi$ is constant over $\lambda_{i,P}^{e_i,e_j}$ if we assume $\pi_1 - \pi_0 = \underline{\pi}_1 - \underline{\pi}_0$, so the cost of delegation will only depend on $\lambda_{j,A}^{e_i,e_j}$ through $\pi_1(\lambda_{j,A}^{e_i,e_j})$. It means that $\bar{t}$ will not increase but his probability of occurrence will increase. However, this does not mean that the payoff of the principal will decrease with legitimacy. Indeed, as we assumed $P_P > 0$, it necessarily means that $\pi_1^{e_i,e_j}(1 - \frac{\psi_2}{\Delta\pi}) > 0$ and $1 - \frac{\psi_2}{\Delta\pi} > 0$, so the global effect of legitimacy on the cost of delegation will always be compensated by the increase of the expected level of production. Bolstering his legitimacy allows him to increase his payoff more than the payoff of the agent. So, it remains interesting for him to exert low effort. The proposition holds only if we assume the principal is not associated with discrimination and has not more information than looser of the competition about who has been advantaged.

### 1.4.3 Internal *versus* external promotion procedure

In this section we will compare the impact of efforts during the tournament of two different procedures of promotion: an internal and an external procedures. In an internal procedure, people in charge of the evaluation of opponents during the tournament remain the same than people that will evaluate them in the second stage. In external procedure, the organization outsources partially the promotion process such that people that will select the principal are not the same than people in charge of evaluating production in stage 2. Comparing the marginal return of both procedures allows us to elicit which one will be the more incentivizing for exerting high effort. In both cases we will establish a relation between the marginal return of effort and the *a priori* belief in being advantaged.

#### 1.4.3.1 Internal procedure and aversion to "unfair" procedure

The purpose of this subsection is to study the behavior and strategy of $i$ during the tournament with respect to $\lambda_i$. Besides, we particularly focus on the internal procedure which means that we need to take into account the legitimacy consideration in stage 2 through the bayesian inference.

From now we will assume $\pi_1 - \pi_0 = \underline{\pi}_1 - \underline{\pi}_0$ so that $\Delta\pi^{e_i,e_j} = \Delta\pi$ to simplify the following calculations. Agents play a simultaneous game in which they chose the level of effort that maximizes their payoffs. Each couple of strategies $(e_i, e_j) \in \{0,1\}^2$ will lead to

specific $\lambda_{j,P}^{e_i,e_j}$ (in case $i$ wins) and $\lambda_{i,A}^{e_i,e_j}$(in case $i$ looses). It means that for each couple of strategies, the winner of the tournament will have a different *legitimacy*. Besides, assuming $\pi_1 - \pi_0 = \underline{\pi}_1 - \underline{\pi}_0$ implies that we have necessarily $\frac{\pi_1}{\pi_1} \geq \frac{\pi_0}{\pi_0}$. Thus according to proposition 1.1 not only winning by exerting high effort bolsters legitimacy but also loosing by exerting high effort bolsters the legitimacy of the winner. Finally, under assumption $\pi_1 - \pi_0 = \underline{\pi}_1 - \underline{\pi}_0$, bolstering legitimacy is only motivated by a cognitive strategy (i.e a strategy that aims only to reveal or hide information) and not by a monetary incentive strategy. Indeed, this assumption of linearity implies the incentive wage will not vary with legitimacy (proposition 1.1). As a consequence, only the belief of having a high probability of receiving this wage in case of low effort will change. We have:

$$P_i^{e_i,e_j} = P_P^{e_i,e_j} \overbrace{P(q_i = 1 \cap q_j = 0 \mid (e_i, e_j))}^{\text{Probability of winning}} + P_A^{e_i,e_j} \overbrace{P(q_i = 0 \cap q_j = 1 \mid (e_i, e_j))}^{\text{Probability of loosing}} - \psi_{e_i}$$

We denote $P_i^{e_i,e_j}$ the average between the expected payoff $i$ would get if he becomes the principal $P_P^{e_i,e_j}$, weighted by the probability of winning, and the expected payoff he would get if he becomes the agent $P_A^{e_i,e_j}$, weighted by the probability of loosing less the cost of effort $\psi_{e_i} \in \{\psi, 0\}$ during stage 1. The model is solved using *backward induction*.

We will first study in which conditions on the parameters $\lambda_i, \pi_1, \underline{\pi}_1, \pi_0, \underline{\pi}_0$ and $\psi$, expression $P_i^{1,e_j} - P_i^{0,e_j} > 0$ will hold, that is to say that the marginal return of effort is positive. It will mean that $i$ will have an incentive to exert high effort whatever the effort of his opponent. We will secondly study in which conditions the couple of strategies $(e_i, e_j) = (1, 1)$ may become a Nash Equilibrium of the game that is to say $P_i^{1,1} > P_i^{0,1}$ and $P_j^{1,1} > P_j^{1,0}$ may be verified simultaneously.

Using equation (1.1) and equation (1.4), we can now write the global payoff $P_i^{e_i,e_j}$ for $i$ at the beginning of stage 1 for any couple of strategies $(e_i, e_j) \in \{0, 1\}^2$ and $\psi_1$:

$$P_i^{e_i,e_j} = \underbrace{\pi_1^P(\lambda_{j,P}^{e_i,e_j})(1 - \frac{\psi_2}{\Delta\pi})}_{\text{Principal's Payoff}} \overbrace{P(q_i = 1 \cap q_j = 0 \mid (e_i, e_j))}^{\text{Probability of winning}}$$
$$+ \underbrace{\pi_0^A(\lambda_{i,A}^{e_i,e_j})\frac{\psi_2}{\Delta\pi}}_{\text{Agent's Payoff}} \overbrace{P(q_i = 0 \cap q_j = 1 \mid (e_i, e_j))}^{\text{Probability of loosing}} - \psi_{e_i}$$

Establishing a relation between $P_i^{1,e_j} - P_i^{0,e_j}$ and $\lambda_i$ is actually a non trivial problem because several effects are bounded and depend on the ex-ante exogenous parameters of

favoritism. Indeed, agents could have interest to actually be discriminated if they anticipate that in case of victory, the performance of the agent in second stage could be very high. Indeed, an agent who has low chances to be discriminated will be more productive. The stake is to determine the conditions that guarantee that the opportunity of taking advantage of favoritism in the first stage would outweigh the legitimacy consideration in second stage.

We denote $r_i^{e_j}$ as the marginal return of high effort for $i$ given he was fully advantaged ($\lambda_i = 1$) and given $j$ exerts effort $e_j$ such that:

$$r_i^{e_j} = \overbrace{(\pi_1 - \pi_0)(1 - \underline{\pi}_{e_j}) \quad \underbrace{\underline{\pi}_1(1 - \frac{\psi_2}{\Delta\pi})}_{\text{Payoff if } i \text{ is principal}}}^{\text{Marginal return if } i \text{ is principal and advantaged}} + \overbrace{(\pi_0 - \pi_1)\underline{\pi}_{e_j} \quad \underbrace{\pi_0 \frac{\psi_2}{\Delta\pi}}_{\text{Payoff if } i \text{ is agent}}}^{\text{Marginal Return if } i \text{ is agent and advantaged}}$$

Besides, we denote $\underline{r}_i^{e_j}$ as the marginal return of high effort for $i$ given he was fully disadvantaged ($\lambda_i = 0$) and given agent $j$ makes effort $e_j$ such that:

$$\underline{r}_i^{e_j} = \overbrace{(\underline{\pi}_1 - \underline{\pi}_0)(1 - \pi_{e_j}) \quad \underbrace{\pi_1(1 - \frac{\psi_2}{\Delta\pi})}_{\text{Payoff if } i \text{ is principal}}}^{\text{Marginal return if } i \text{ is principal and disadvantaged}} + \overbrace{(\underline{\pi}_0 - \underline{\pi}_1)\pi_{e_j} \quad \underbrace{\underline{\pi}_0 \frac{\psi_2}{\Delta\pi}}_{\text{Payoff if } i \text{ is agent}}}^{\text{Marginal Return if } i \text{ is agent and disadvantaged}}$$

Then we look for the conditions that guarantee $P_i^{1,e_j} - P_i^{0,e_j}$ is positive.

**Lemma 1.1.** *$P_i^{1,e_j} - P_i^{0,e_j} > 0$ if and only if $(r_i^{e_j} - \underline{r}_i^{e_j})\lambda_i + \underline{r}_i^{e_j} - \psi > 0$*

*Proof.* See Appendix D □

Lemma 1.1 means there is a linear relation between the marginal return of effort and $\lambda_i$. If $r_i^{e_j} - \underline{r}_i^{e_j}$ is positive it means the more $i$ will believe he is advantaged the more he will increase his effort. His interest is to be granted with preferential treatment and that his opponent is disadvantaged. It means that the negative effect of being advantaged on the payoff in second stage due to legitimacy consideration will never outweigh the positive effect during the first stage. However, if $r_i^{e_j} - \underline{r}_i^{e_j}$ is negative it means that the more $i$ will believe he is advantaged the more he will decrease his effort. This case is the opposite case: the interest of $i$ is then to be disadvantaged. It means that the legitimacy consideration in second stage will always outweigh the effect on the first stage.

**Lemma 1.2.** *$P_i^{1,e_j} - P_i^{0,e_j} > 0$ if and only if:*

- $\lambda_i > \hat{\lambda}_i$ *with* $\hat{\lambda}_i = \frac{\psi - \underline{r}_i^{e_j}}{r_i^{e_j} - \underline{r}_i^{e_j}}$
- $r_i^{e_j} > \psi > \underline{r}_i^{e_j}$
- $\pi_1 + \underline{\pi_0} > 1$

*Proof.* See Appendix E □

Lemma 1.2 gives the conditions that guarantee $i$ will exert high effort whatever the effort of his opponent $e_j$. The major parameter to interpret in lemma 1.2 is the parameter $\hat{\lambda}_i$ which is the threshold to exert high effort for $i$. It is the minimum belief in being advantaged to accept to compete. It remains a function of the effort of the opponent $j$ such that $\hat{\lambda}_i = \hat{\lambda}_i(e_j)$. It can be interpreted as the degree of aversion to "unfair" procedure of promotion for $i$. We can also interpret $(1 - \hat{\lambda}_i)$ as a degree of adhesion to the promotion procedure. Besides, if we conceptualize the second stage as a long term career achievement and first stage as the career itself, we can interpret also $(1 - \hat{\lambda}_i)$ as an adhesion to the organization in its entirety. Thus, following this idea, the more $(1 - \hat{\lambda}_i)$ will increase the more people will accept to be a part of the organization because in the long run they think it is more likely that effort will lead to a promotion. And so even though they are suspicious on being perhaps discriminated.

The other conditions are more technical. Let us focus on the first condition on $\psi$: $\underline{r}_i^{e_j} < \psi$. If we refer to the equation in lemma 1.1 it means that the surplus of payoff exerting high effort when being fully disadvantaged is negative because the marginal return in that case does not compensate the cost of effort. Thus, it becomes necessary to be a minimum optimistic about being advantage to exert high effort. The second condition $r_i^{e_j} > \psi$ means that being advantaged brings a return that more than compensates the cost of effort.

Finally, the condition $\pi_1 + \underline{\pi_0} > 1$ is the condition for $r_i^1 - \underline{r}_i^1 > 0$ to hold. Indeed, we have:

$$\begin{aligned} r_i^{e_j} - \underline{r}_i^{e_j} =& \Delta\pi \Big[ (1 - \underline{\pi}_{e_j})\underline{\pi}_1 - (1 - \pi_{e_j})\pi_1 \Big] (1 - \frac{\psi_2}{\Delta\pi}) \\ &+ \Delta\pi \Big[ \pi_{e_j}\underline{\pi}_0 - \underline{\pi}_{e_j}\pi_0 \Big] \frac{\psi_2}{\Delta\pi} \end{aligned} \tag{1.7}$$

Now, if we look at equation (1.7), $r_i^{e_j} - \underline{r}_i^{e_j}$ will be positive if $(1 - \underline{\pi}_{e_j})\underline{\pi}_1 - (1 - \pi_{e_j})\pi_1$ remains always superior to $\underline{\pi}_{e_j}\pi_0 - \pi_{e_j}\underline{\pi}_0$. That is to say the marginal probability of getting the principal payoff $1 - \frac{\psi_2}{\Delta\pi}$ is high enough to compensate the fact that the marginal probability of getting the agent wage $\frac{\psi_2}{\Delta\pi}$ is negative. We argue this is verified if $\pi_1 > 1 - \underline{\pi_0}$ holds. This will be verified notably if $\underline{\pi}_0 > \frac{1}{2}$. We interpret this as the production to be "easy" in a sense that even with low effort and discrimination it is still more likely to complete the task than to fail.

Now we are going to study the condition that guarantee the couple of strategies $(1, 1)$ could be a Nash Equilibrium.

**Proposition 1.4.** *The couple of strategies when both agents make high effort during stage 1 is a Nash Equilibrium that is to say* $P_i^{1,1} - P_i^{0,1} > 0$ *and* $P_j^{1,1} - P_j^{1,0} > 0$ *if and only if:*

- $1 - \lambda_i^* > \lambda_i > \lambda_i^*$ *with* $\lambda_i^* = \frac{\psi - \underline{r}_i^1}{r_i^1 - \underline{r}_i^1}$
- $r_i^1 > \psi > \underline{r}_i^1$
- $\pi_1 + \underline{\pi_0} > 1$

Proposition 1.4 means that high effort could be chosen by both agents and is a Nash Equilibrium under certain conditions. It is quit intuitive that we cannot find a dominant strategy equilibrium directly with lemma 1.2 because we would need opponents to be perfectly symmetric (except on their beliefs $\lambda_i$ and $\lambda_j$ where $\lambda_i \neq \lambda_j$ ). And this is not true if opponent chooses a different strategy because $r_i^1 \neq r_j^0$ and $\underline{r}_i^1 \neq \underline{r}_j^0$. However the couple of strategies $(e_i, e_j) = (1, 1)$ guarantees this symmetry. As both opponent are totally identical and choose the same strategy, it leads to $r_i^1 = r_j^1$ and $\underline{r}_i^1 = \underline{r}_j^1$. Besides, they share the same belief such that $\lambda_j = 1 - \lambda_i$. Thus it is straightforward using lemma 1.1 that $P_j^{1,1} - P_j^{1,0} > 0$ leads to $(r_i^{e_j} - \underline{r}_i^1)(1 - \lambda_i) + \underline{r}_i^1 - \psi > 0$ which leads to proposition 1.4.

Similarly to lemma 1.2, the major parameter to interpret is the threshold $\lambda_i^*$. As $\hat{\lambda}_i$ in lemma 1.2 is a function of the effort of the opponent $j$ such that $\hat{\lambda}_i = \hat{\lambda}_i(e_j)$, we denote $\lambda_i^* = \hat{\lambda}_i(1)$ the threshold to exert high effort for $i$ given the effort of the opponent $j$ is high. If we assume that opponents are naturally suspicious such that belonging to specific social group based on ethnic origin or religion, or differences in gender for instance, lead necessary to discrimination, then the spread $[1 - \lambda_i^*; \lambda_i^*]$ can be an indicator of accepted social heterogeneity. The more the spread will be high, the more the two opponents will

tend to "accept" competition in spite of discrimination, in a sense that they will exert high effort anyway.

Now that we have established that the marginal return of effort in an internal procedure is a linear relation with respect to the *a priori* belief in being discriminated we will focus on the marginal return in an external procedure.

#### 1.4.3.2 External procedures and the cost of illegitimacy

Now we are going to study a case where people who evaluate the performance of opponents and who design the procedure of selection are *not* the same people who will evaluate the performance of the agent in the second stage once the principal is chosen. The purpose of this subsection will be to compare the marginal return between the two procedures to establish which one is the more incentivizing to exert high effort.

The consequence in external procedures is that the bayesian inference becomes useless for the agent. Learning information about having been discriminated or not during competition does not highlight what will occur in the future once becoming an employee. As a consequence we will assume at the beginning of the second stage that $\lambda_{i,A}^{e_i,e_j} = \lambda_i$ (i.e the belief of being advantaged in second stage remains the same than in first stage because only due to exogenous factors). Thus, except the absence of bayesian inference, the payoff of $i$ will be similar than in the internal procedure because the function of production and the assessing technology are assumed to be identical. This allows us to denote $E_i^{e_i,e_j}(\lambda_i)$ the payoff of $i$ in the first stage such that:

$$\begin{aligned} E_i^{e_i,e_j}(\lambda_i) =& \pi_1^P(\lambda_j)(1 - \frac{\psi_2}{\Delta\pi})P(q_i = 1 \cap q_j = 0 \mid (1, e_j)) \\ &+ \pi_0^A(\lambda_i)\frac{\psi_2}{\Delta\pi}P(q_i = 0 \cap q_j = 1 \mid (1, e_j)) - \psi \end{aligned}$$

To facilitate understanding we will also denote from now $E_i^{1,e_j}(\lambda_i) - E_i^{0,e_j}(\lambda_i) = \Delta E_i(\lambda_i)$ and $P_i^{1,e_j} - P_i^{0,e_j} = \Delta P_i(\lambda_i)$. In this subsection we will establish the sign of $\Delta P_i(\lambda_i) - \Delta E_i(\lambda_i)$ with respect to $\lambda_i$ which will allow to understand what procedure is the more incentivizing to exert effort. The method is divided in 3 steps. The first step is to establish the value of $\lambda_i$ such that $\Delta P_i(\lambda_i)$ and $\Delta E_i(\lambda_i)$ are equal. The second step is to focus on $\Delta E_i(\lambda_i)$ and to find that it is concave with respect to $\lambda_i$. The last step is to use the result of lemma 1.1

and lemma 1.2 of the last subsection to conclude on the sign of $\Delta P_i(\lambda_i) - \Delta E_i(\lambda_i)$.

We will now focus on establishing the value of $\lambda_i$ such that $\Delta P_i(\lambda_i) = \Delta E_i(\lambda_i)$. It is straightforward that $E_i^{e_i,e_j}(0) = P_i^{e_i,e_j}(0)$ and $E_i^{e_i,e_j}(1) = P_i^{e_i,e_j}(1)$ because if $\lambda_i = 0$ then $\lambda_i^{e_i,e_j} = 0$ and if $\lambda_i = 1$ then $\lambda_i^{e_i,e_j} = 1$. It is intuitive because if $\lambda_i = 1$ for instance, it means that there is no more uncertainty on being discriminated *a priori* and the competition does not bring new information. Thus the learning mechanism is not relevant. And if $\lambda_i = 0$, it is absolutely sure in the eyes of opponents that $i$ will be discriminated such that the outcome of the tournament will not bring new information either. As a consequence we already know that in both case where there is no initial uncertainty (in $\lambda_i = 0$ and $\lambda_i = 1$) on being discriminated, the payoff in both procedures (and of the marginal payoff) will be identical.

**Lemma 1.3.** *$\Delta E_i(\lambda_i)$ is concave for $\lambda_i \in (0,1)$ if $(1 - \frac{\psi_2}{\Delta\pi}) > \frac{\psi_2}{\Delta\pi}$.*

*Proof.* See Appendix F □

We can now establish the shape of $\Delta E_i(\lambda_i)$. Lemma 1.3 means that the relation between $\lambda_i$ and the marginal return of effort is not linear but concave contrary to the case of an internal procedure. Actually $\Delta E_i(\lambda_i)$ is a second degree polynomial with a negative coefficient (figure 1.2). This lead directly to lemma 1.4.

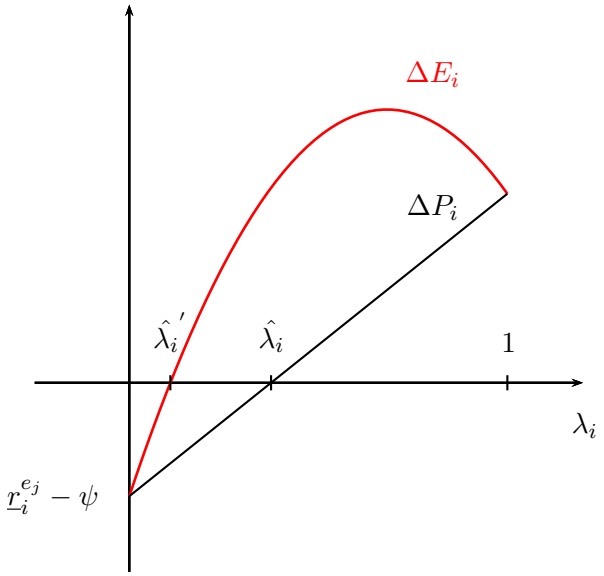



Figure 1.2 – *Marginal return of effort for both procedures with respect to $\lambda_i$*

**Lemma 1.4.** *There is a value of $\lambda_i$ denoted $\hat{\lambda_i}'$ such that $\Delta E_i(\hat{\lambda_i}') = 0$ if $r_i^{e_j} > \psi > \underline{r}_i^{e_j}$ is satisfied. It means that there is a threshold below which the belief about being advantaged will be not incentivizing.*

Lemma 1.4 means that there is minimum value for $\lambda_i$ denoted $\hat{\lambda_i}'$ enough to incentivize high effort in an external procedure. As we can see in figure 1.2, this is guaranteed by the fact we know that $E_i^{e_i,e_j}(0) < 0$ and that $E_i^{e_i,e_j}(1) > 0$ since $r_i^{e_j} > \psi > \underline{r}_i^{e_j}$ Indeed this last condition guarantees in lemma 1.2 that $P_i^{e_i,e_j}(0) < 0$ and $P_i^{e_i,e_j}(1) > 0$. Thus as we know that $E_i^{e_i,e_j}(0) = P_i^{e_i,e_j}(0)$ and $E_i^{e_i,e_j}(1) = P_i^{e_i,e_j}(1)$, it implies $E_i^{e_i,e_j}(0) < 0$ and $E_i^{e_i,e_j}(1) > 0$.

Hence, as we can see in figure 1.2, knowing that $E_i^{e_i,e_j}(0) = P_i^{e_i,e_j}(0)$ and $E_i^{e_i,e_j}(1) = P_i^{e_i,e_j}(1)$ and that $\Delta E_i(\lambda_i)$ is concave (lemma 1.3) guarantee that it will always be superior to $\Delta P_i(\lambda_i)$ for $\lambda_i \in (0,1)$ because $\Delta P_i(\lambda_i)$ is linear. That leads directly to proposition 1.5.

**Proposition 1.5.** *Relatively to external procedures, internal procedures:*

- *incentivizes opponents to decrease their efforts that is to say: $\Delta E_i(\lambda_i) > \Delta P_i(\lambda_i)$ is always verified for any $\lambda_i$.*
- *makes agent more averse to discrimination that is to say: $\hat{\lambda_i}' < \hat{\lambda_i}$.*

Proposition 1.5 means that opponents will always have a higher marginal payoff in the case of an external procedure. It means the external procedure will be more incentivizing to exert high effort. Comparing the two procedures allows us to highlight what is related exclusively to a learning behavior. Indeed, the biased probability of winning due to discrimination is identical in the two procedures and the function of production in second stage is identical as well. Thus the only difference is the existence or the absence of the learning process. As a consequence, understanding proposition 1.1 allows us to highlight the underlying mechanism in proposition 1.5. And, according to proposition 1.1 we get $\lambda_{i,A}^{e_i,e_j} < \lambda_i$. It means that even though effort is a way in internal procedures to defuse doubt on his legitimacy for the principal, it will be never be enough to entirely neutralize the effect of failure on the bayesian learning. In other words, the looser will always remain a "bad looser" whatever the intensity of the effort of his opponent (and his "merit") and the winner will always remain a "good winner" in a sense that he will always have more doubt about his own legitimacy after winning the competition even thought he put a high effort to win. In some ways, defeat will always make the looser more suspicious and victory will always make the principal feel more "guilty" whatever their efforts if they

have bayesian rationality. It is interesting because we could expect that internal procedural would be more incentivizing as a high effort could dispel doubt about unfair treatment. But actually, this effect will not be sufficient if we assume bayesian rationality as suspicion and "guilt" will always be more significative after the tournament.

Hence in the *internal procedure*, as the proverb goes: "ill-gotten gains never leads to prosperity". Namely, there is a endogenous mechanism of "redressing injustice". Winning the tournament makes the principal believe he was more advantaged in the short term during the tournament than he previously though. But this advantage will be no longer useful and will even become a burden for him as he symmetrically receives information about how the new agent will be discriminated in the future and then will be less productive. That is the illegitimacy entails no extra incentive cost but has only a straightforward effect on the efficiency of the effort of the agent because his effort will not be valued by the firm. As a consequence, the consideration for his own legitimacy is captured by this expected cost that we can consider as the cost of his illegitimacy. In other words, he supports the liability of preferential treatment he received. In external procedures, this liability disappears as the changing of assessors becomes a "fresh start" for the agent. Thus the principal will perfectly benefit from his potential advantage during the tournament without assuming the responsibility in second stage, and it will be liberating as he will actually have no information about a potential unfair treatment for the agent in the future. The person in charge of assessment in an external procedure will be a scape goat in some ways. This explain why an external procedure will be more incentivizing. In some ways, the neutrality of an external procedure is appreciated and incentivizing for a future principal because it allows to "clear his conscience" in case of victory. In other words, it makes him believe that this unfair treatment will not be supported anymore by the looser of the tournament. The future principal knows in advance that even though he could have been advantaged in the first place, card will be reshuffled in the future and his agent may be treated fairly.

So, the benefit of neutrality is not where we could expect it to be. Neutrality of external procedures is not incentivizing because people would have a higher *a priori* belief about being advantaged. Indeed, in internal procedures it is assumed that they do not know either if they could be disadvantaged *a priori* such that they will have the same *a priori* belief in both procedures. However, the neutrality of external procedures will offer to the winner the opportunity to have the belief that his opponent will have a fresh start and

could be totally fairly rewarded by the organization in the future. So, he will not support the cost of his illegitimacy as the unfair treatment will possibly occur only once. This expected cost of illegitimacy is of course a perceived cost as it is based on a subjective prior belief that is not necessarily based on tangible elements.

The direct consequence is that agent will be more averse to discrimination in internal procedure as he will be less incentivized by being potentially advantaged. Indeed, $\hat{\lambda_i}' < \hat{\lambda_i}$ means the threshold for exerting high effort will be higher. To some extent, discrimination "counts twice" in the internal procedure and this is why it is less acceptable in the view of opponents. Whereas, in the external procedure, stage 2 is a fresh start for the looser of the competition and it ensures the future principal from not supporting the cost of his illegitimacy. Like in the last subsection, we can also interpret $1 - \hat{\lambda_i}'$ as a degree of adhesion to the external procedure. If we interpret the promotion at the beginning of the second stage as a long run career achievement, and first stage as career itself we can interpret $1 - \hat{\lambda_i}'$ as a degree of adhesion to the whole organization. As a consequence proposition 1.5 implies that an external procedure will favor adhesion to the organization in its entirety.

It is important to understand that discrimination does not occur necessarily in the model. But we only focus on the point of view of opponents that have an *a priori* suspicion that can be reinforced or not after the competition even though this resentment could be totally false. As a consequence, the issue for choosing the procedure of promotion is to anticipate that a climate of suspicion could emerge even though it could not necessary be founded on real proof, and to try to defuse it. Mostly, the issue for the firm is to anticipate that opponents have interest in seeing themselves legitimate in case of victory and do not want to assume the cost of their illegitimacies in the future.

Yet, a promotion process designed by a human resources department could be seen as an external procedure in as sense that employee would not be evaluated by their actual colleagues. Thus, we argue that for this reason such departments could be designed to become a scape goat and channel all the resentment after the failures of opponents. The same reasoning could be applied for internal contest for civil servant in public administration. This way the climate of suspicion would be defused. Furthermore the opponent

will know that in case of victory they will not have to assume the liability of a potential unfair treatment and thus the cost of their illegitimacies.

Furthermore, we also can assume that opponents choose themselves the procedure of promotion. This way we could talk about an endogenous choice of procedure. Then they will choose an external procedure instead of an internal procedure which is a choice that can be interpreted as deny. Indeed, it would mean choosing to hide oneself information about a potential unfair treatment that could occur within the organization after the promotion. It reveals that it would be more efficient for opponents not to discover information about having been discriminated by their colleagues.

## 1.5 Conclusion

This chapter investigates how to build microeconomics foundation of the concept of procedural legitimacy. A concept that to best of our knowledge has not been treated in a theoretical approach. The major contribution is to use bayesian approach instead of unfairness aversion to explain submission, choice of effort and reaction to unfairness.

In our work, we define the legitimacy of a leader through the fairness of the procedure of selection that promoted him. As a consequence, the indicator of legitimacy is the probability of having been advantaged during this promotion process. This probability will be revised such that the performance observed during the promotion process can send a signal on a potential advantage received. We argue that the role of effort to bolster this kind of legitimacy will depend on technological assumption. In case of substitutability between effort and advantage (i.e a case where the advantage is interpreted as a difference in the performance expected for one opponent relatively to the other), effort bolsters legitimacy. But paradoxically, in case of complementarity (i.e a case when the advantage is interpreted as an asymmetric allocation of a mean of production that one opponent could benefit to the detriment of other such as a more effective working tool or a key contact ), effort reveals advantage and then undermines legitimacy. Indeed, in that case, a high performance will betray the advantaged received a little bit like a sportsman who has been doped and makes an extraordinary but suspicious achievement.

However, this legitimacy does not necessary have an impact on behavior in response to "unfair" allocation of incomes after the promotion during the hierarchical relationship. Indeed we show that after the promotion, once an agent sees his former opponent be-

coming his executive, then he could be indifferent to legitimacy issue in a sense that he will not demand a higher wage if his executive is perceived as non legitimate. This result holds in case of substitutability between effort and advantage but it will not hold if we assume complementarity. It is quit intuitive because in that case, advantage will interact with effort like a competence would do. Thus in the eyes of a suspicious agent, as the remuneration is conditional on high performance, his chances of being rewarded will be very low. He will then demand a higher wage to compensate that.

The last result of this chapter is to show how the role of procedures of selection will be a crucial stake for the firm if its objective is to implement high effort during the promotion process. We compare the marginal return of two types of procedures: an internal procedure where people in charge of evaluate opponents during the tournament are the same that people that will assess the production of the one who will remain employee thereafter, and an external procedure where the assessors change between the tournament and the hierarchical relationship. Thus, in our approach the firm is not responsible for any favoritism and the suspicion of opponents may be based on non tangible fact or totally fictive. Intuitively, we could expect that an internal procedure would be more incentivizing because being aware that their future employees will still be evaluated in the future by the same people could be an incentive to dispel doubts on their potential advantages. Indeed, one might think that after the competition, the winner will have to deal with the consequences of the signal his performance could have sent about his potential advantage. Thus in this internal procedure framework, exerting high effort could be a strategy to demonstrate he was not advantaged making the internal procedure a very incentivizing procedure.

Actually our finding is the opposed: we show that it is the external procedure that will be more incentivizing. This result depends on the inability of effort to bolster legitimacy (or dispel doubts) if we assume bayesian rationality. Indeed, we show that loosing the competition will always make the looser more suspicious about having been disadvantaged that he was before the competition and so whatever the effort exerted by both opponents. Symmetrically, the winner will always be more confident about being advantaged, that is in some ways, he will always feel more "guilty", and so whatever his level of effort. Thus, the winner will have mechanically more information about how his agent will be more likely to be disadvantaged in the future and then be less productive. This will tend to inhibit effort upstream during the tournament as it makes the fact of

winning much less profitable. In an external procedure this behavior does not occur because presupposed unequal treatment during the tournament will not give information on a potential unfair treatment in the future because the assessors will change. In other words, being aware in advance that the cards will be reshuffled after the competition will be highly motivating.

This theoretical framework gives an indicator of sensibility to "unfair" treatment. We define it as the minimum belief in being advantaged that will be sufficient to incentivize effort. We show that in an external procedure this threshold will be lower than in an internal procedure. It means that in external procedures relatively to internal procedures, more suspicious opponents will accept to compete in spite of their suspicion. We can also interpret it as an indicator of the acceptable degree of social heterogeneity in an organization. Indeed, if we assume that opponents are very pessimistic and that social heterogeneity lead mechanically to an *a priori* suspicion of unequal treatment, then the external procedure guarantees a higher adhesion the organization (in a sense that it is more likely opponent will compete anyway).

As a consequence our results suggest that it would be in the interest of the organization to delegate promotion to an independent entity such as human resources department or to promote people through independent contests with independent assessors. Those institutions will serve as a scape goat. We argue that contests for civil servant in public administration for instance, like Capes or Aggregation du secondaire which are contest to become teacher in high school in french administration are design partially for this reason.

A possible extension to our model would be to complicate the objective of the firm by adding uncertainty on competence. Then there would be two sources of uncertainty simultaneously: unfair treatment and competence. In that case, it would be perhaps interesting to assume that internal procedures assess better the competence that external procedures such that there would be a trade off for the firm. Should the firm prefer to defuse suspicion by choosing an external procedure or to favor pure economic choice by choosing an internal procedure? The issue would not be trivial as a worse assessment of competence in the external procedure could be compensated by a higher motivation in an external procedure that potentially could reveal more competence as well.

# Appendix

## A/ Proof Proposition 1.1

- First let us focus on the case $i$ wins. Indeed, $\lambda_{j,P}^{1,e_j} > \lambda_{j,P}^{0,e_j}$ leads by successive equivalence to:

$$\frac{\lambda_j(1-\pi_{e_j})\underline{\pi}_1}{\lambda_j(1-\pi_{e_j})\underline{\pi}_1+(1-\lambda_j)(1-\underline{\pi}_{e_j})\pi_1} > \frac{\lambda_j(1-\pi_{e_j})\underline{\pi}_0}{\lambda_j(1-\pi_{e_j})\underline{\pi}_0+(1-\lambda_j)(1-\underline{\pi}_{e_j})\pi_0}$$
$$\frac{\underline{\pi}_1}{\lambda_j(1-\pi_{e_j})\underline{\pi}_1+(1-\lambda_j)(1-\underline{\pi}_{e_j})\pi_1} > \frac{\underline{\pi}_0}{\lambda_j(1-\pi_{e_j})\underline{\pi}_0+(1-\lambda_j)(1-\underline{\pi}_{e_j})\pi_0}$$
$$\frac{1}{\lambda_j(1-\pi_{e_j})+(1-\lambda_j)(1-\underline{\pi}_{e_j})\frac{\pi_1}{\underline{\pi}_1}} > \frac{1}{\lambda_j(1-\pi_{e_j})+(1-\lambda_j)(1-\underline{\pi}_{e_j})\frac{\pi_0}{\underline{\pi}_0}}$$

This leads $\frac{\pi_1}{\underline{\pi}_1} < \frac{\pi_0}{\underline{\pi}_0}$ because each term of this inequation is decreasing function. Finally we have $\frac{\pi_1}{\pi_1} > \frac{\pi_0}{\pi_0}$.

- Now let us focus on the case when $i$ looses. Indeed, $\lambda_{i,A}^{1,e_j} > \lambda_{i,A}^{0,e_j}$ leads by successive equivalence to:

$$\frac{\lambda_i(1-\pi_1)\underline{\pi}_{e_j}}{\lambda_i(1-\pi_1)\underline{\pi}_{e_j}+(1-\lambda_i)(1-\underline{\pi}_1)\pi_{e_j}} > \frac{\lambda_i(1-\pi_0)\underline{\pi}_{e_j}}{\lambda_i(1-\pi_0)\underline{\pi}_{e_j}+(1-\lambda_i)(1-\underline{\pi}_0)\pi_{e_j}}$$
$$\frac{1-\pi_1}{(1-\pi_1)\left[\lambda_i\pi_{e_j}+(1-\lambda_i)\frac{1-\underline{\pi}_1}{1-\pi_1}\pi_{e_j}\right]} > \frac{1-\pi_0}{(1-\pi_0)\left[\lambda_i\pi_{e_j}+(1-\lambda_i)\frac{1-\underline{\pi}_0}{1-\pi_0}\pi_{e_j}\right]}$$
$$\frac{1}{\lambda_i\pi_{e_j}+(1-\lambda_i)\frac{1-\underline{\pi}_1}{1-\pi_1}\pi_{e_j}} > \frac{1}{\lambda_i\pi_{e_j}+(1-\lambda_i)\frac{1-\underline{\pi}_0}{1-\pi_0}\pi_{e_j}}$$

This is verified if $\frac{1-\underline{\pi}_1}{1-\pi_1} > \frac{1-\underline{\pi}_0}{1-\pi_0}$ because term of the inequation are a increasing function. By successive equivalence we have:

$$\frac{1-\underline{\pi}_1}{1-\pi_1} > \frac{1-\underline{\pi}_0}{1-\pi_0}$$
$$(1-\underline{\pi}_1)(1-\pi_0) > (1-\underline{\pi}_0)(1-\pi_1)$$
$$1-\underline{\pi}_1-\pi_0+\underline{\pi}_1\pi_0 > 1-\underline{\pi}_0-\pi_1+\underline{\pi}_0\pi_1$$
$$\underline{\pi}_0-\underline{\pi}_1+\underline{\pi}_1\pi_0 > \pi_0-\pi_1+\underline{\pi}_0\pi_1$$

It is verified if $\underline{\pi}_0-\underline{\pi}_1 = \underline{\pi}_0-\underline{\pi}_1$, that is to say $\underline{\pi}_1-\underline{\pi}_0 = \underline{\pi}_1-\underline{\pi}_0$, and if $\underline{\pi}_0\pi_1 > \underline{\pi}_1\pi_0$ that is to say if $\frac{\pi_1}{\underline{\pi}_1} < \frac{\pi_0}{\underline{\pi}_0}$.

- $\lambda_{j,P}^{e_i,e_j} < \lambda_j$

  By successive equivalence we have:

$$\frac{\lambda_j(1-\pi_{e_j})\underline{\pi}_{e_i}}{\lambda_j(1-\pi_{e_j})\underline{\pi}_{e_i}+(1-\lambda_j)(1-\underline{\pi}_{e_j})\pi_{e_i}} < \lambda_j$$

$$\frac{\lambda_j(1-\pi_{e_j})\underline{\pi}_{e_i}-\lambda_j(1-\pi_{e_j})\underline{\pi}_{e_i}\lambda_j-\lambda_j(1-\lambda_j)(1-\underline{\pi}_{e_j})\pi_{e_i}}{\lambda_j(1-\pi_{e_j})\underline{\pi}_{e_i}+(1-\lambda_j)(1-\underline{\pi}_{e_j})\pi_{e_i}} < 0$$

$$\frac{(1-\pi_{e_j})\underline{\pi}_{e_i}-\lambda_j(1-\pi_{e_j})\underline{\pi}_{e_i}-(1-\underline{\pi}_{e_j})\pi_{e_i}+\lambda_j(1-\underline{\pi}_{e_j})\pi_{e_i}}{\lambda_j(1-\pi_{e_j})\underline{\pi}_{e_i}+(1-\lambda_j)(1-\underline{\pi}_{e_j})\pi_{e_i}} < 0$$

  The denominator is always positive. Let us find conditions that guarantee the numerator is negative. By successive equivalence it leads to:

$$(1-\pi_{e_j})\underline{\pi}_{e_i}-\lambda_j(1-\pi_{e_j})\underline{\pi}_{e_i}-(1-\underline{\pi}_{e_j})\pi_{e_i}+\lambda_j(1-\underline{\pi}_{e_j})\pi_{e_i} < 0$$

$$(1-\pi_{e_j})\underline{\pi}_{e_i}(1-\lambda_j)-(1-\underline{\pi}_{e_j})\pi_{e_i}(1-\lambda_j) < 0$$

$$(1-\pi_{e_j})\underline{\pi}_{e_i}-(1-\underline{\pi}_{e_j})\pi_{e_i} < 0$$

  $(1-\pi_{e_j})\underline{\pi}_{e_i} < (1-\underline{\pi}_{e_j})\pi_{e_i}$ is always verified because $\pi_{e_i} > \underline{\pi}_{e_i}$ and $1-\pi_{e_j} < 1-\underline{\pi}_{e_j}$. Thus $\lambda_{j,P}^{e_i,e_j} < \lambda_j$ is always verified.

**B/ Proof Proposition 1.2**

$$\Delta t^* = \bar{t}^* - \underline{t}^*$$

$$\Delta t^* = \frac{\psi_2}{\Delta\pi^{e_i,e_j}}(-\pi_0^{e_i,e_j}+1+\pi_0^{e_i,e_j})$$

$$\Delta t^* = \frac{\psi_2}{\Delta\pi^{e_i,e_j}}$$

Besides we know that:

$$\pi_1^{e_i,e_j} = \lambda_j^{e_i,e_j}\pi_1 + (1-\lambda_j^{e_i,e_j})\underline{\pi}_1$$

$$\pi_1^{e_i,e_j} = \lambda_j^{e_i,e_j}(\pi_1-\underline{\pi}_1)+\underline{\pi}_1$$

And

$$\pi_0^{e_i,e_j} = \lambda_j^{e_i,e_j}(\pi_0-\underline{\pi}_0)+\underline{\pi}_0$$

And

$$\Delta\pi^{e_i,e_j} = \lambda_j^{e_i,e_j}[(\pi_1-\underline{\pi}_1)-(\pi_0-\underline{\pi}_0)]+\underline{\pi}_1-\underline{\pi}_0$$

Thus, $\Delta\pi^{e_i,e_j}$ increases and $\Delta t^*$ decreases when $\pi_1-\pi_0 > \underline{\pi}_1-\underline{\pi}_0$.

### C/ Proof Proposition 1.3

- As $\underline{t} \geq 0$ the limited liability constraint we infer that the first best wage in case of low production,i.e $-\frac{\pi_0}{\Delta\pi(\lambda_{j,A}^{e_i,e_j})}\psi_2$, will not be implementable. Thus $\underline{t}^* = 0$. Hence, it is straightforward that saturating the incentive constraint and integrating $\underline{t} = 0$ we have: $\Delta\pi(\lambda_{j,A}^{e_i,e_j})\bar{t} - \psi_2 = 0$ wich leads to $\bar{t}^* = \frac{\psi_2}{\Delta\pi(\lambda_{j,A}^{e_i,e_j})}$.

- Let us find the change of direction of $\bar{t}^*$ with respect to $\lambda_{j,A}^{e_i,e_j}$ that we denote for the sake of clarity $\lambda$. We have:

$$\bar{t}^* = \frac{\psi_2}{\lambda(\pi_1 - \pi_0) + (1-\lambda)(\underline{\pi}_1 - \underline{\pi}_0)}$$
$$\bar{t}^* = \frac{\psi_2}{\lambda\Big[(\pi_1 - \pi_0) - (\underline{\pi}_1 - \underline{\pi}_0)\Big] + (\underline{\pi}_1 - \underline{\pi}_0)}$$

  Thus if $\pi_1 - \pi_0 > \underline{\pi}_1 - \underline{\pi}_0$ it is straightforward that $\bar{t}^*$ decreases with $\lambda$. Besides, if if $\pi_1 - \pi_0 = \underline{\pi}_1 - \underline{\pi}_0$ then $\bar{t}^*$ is independent of $\lambda$

- Let us find the change of direction of the informational rent that we denote $P_A$:

  We got an expected payoff for the agent ex-ante:

$$P_A = \pi_1^{e_i,e_j}\bar{t} + (1 - \pi_1^{e_i,e_j})\underline{t} - \psi_2$$

  That leads to a simple expression of the informational rent:

$$P_A = \psi_2 \frac{\pi_0^{e_i,e_j}}{\Delta\pi(\lambda_{j,A}^{e_i,e_j})}$$

  Let us find the change of direction of $P_A$ with $\lambda$. Indeed, since $\pi_0^{e_i,e_j} = \lambda(\pi_0 - \underline{\pi}_0) + \underline{\pi}_0$ and $\Delta\pi(\lambda_{j,A}^{e_i,e_j}) = (\Delta\pi - \underline{\Delta\pi})\lambda + \underline{\Delta\pi}$ with $\underline{\Delta\pi} = \underline{\pi}_1 - \underline{\pi}_0$, we have:

$$\frac{\partial P_A}{\partial\lambda} = \frac{\psi_2(\pi_0 - \underline{\pi}_0)\Big[(\Delta\pi - \underline{\Delta\pi})\lambda + \underline{\Delta\pi}\Big] - \psi_2\Big[\lambda(\pi_0 - \underline{\pi}_0) + \underline{\pi}_0\Big](\Delta\pi - \underline{\Delta\pi})}{\Big[(\Delta\pi - \underline{\Delta\pi})\lambda + \underline{\Delta\pi}\Big]^2}$$

  The denominator is positive, thus let us focus on the sign of the numerator that we

denote $N$:

$$N > 0 <=> \psi_2 \Big[ (\pi_0 - \underline{\pi}_0)(\Delta\pi - \underline{\Delta\pi})\lambda + \underline{\Delta\pi}(\pi_0 - \underline{\pi}_0) - \lambda(\pi_0 - \underline{\pi}_0)(\Delta\pi - \underline{\Delta\pi}) - \underline{\pi}_0(\Delta\pi - \underline{\Delta\pi}) \Big] > 0$$

We simplify by $(\pi_0 - \underline{\pi}_0)(\Delta\pi - \underline{\Delta\pi})\lambda$ :

$$N > 0 <=> \psi_2 \Big[ \underline{\Delta\pi}(\pi_0 - \underline{\pi}_0) - \underline{\pi}_0(\Delta\pi - \underline{\Delta\pi}) \Big] > 0$$

We simplify by $\psi_2$ and develop:

$$N > 0 <=> \underline{\Delta\pi}\pi_0 - \underline{\Delta\pi}\underline{\pi}_0 - \underline{\pi}_0\Delta\pi + \underline{\pi}_0\underline{\Delta\pi} > 0$$

We simplify by $\underline{\pi}_0\underline{\Delta\pi}$ :

$$N > 0 <=> \underline{\Delta\pi}\pi_0 - \underline{\pi}_0\Delta\pi > 0$$

We develop $\Delta\pi$ and $\underline{\Delta\pi}$ and by successive equivalence we have :

$$N > 0 <=> \underline{\pi}_1\pi_0 - \underline{\pi}_0\pi_0 - \underline{\pi}_0\pi_1 + \underline{\pi}_0\pi_0 > 0$$

$$N > 0 <=> \underline{\pi}_1\pi_0 > \underline{\pi}_0\pi_1$$

$$N > 0 <=> \frac{\pi_0}{\underline{\pi}_0} > \frac{\pi_1}{\underline{\pi}_1}$$

Thus, to conclude, $\frac{\partial P_A}{\partial \lambda} > 0$ if and only if $\frac{\pi_0}{\underline{\pi}_0} > \frac{\pi_1}{\underline{\pi}_1}$ is verified.

- Let us find the change of direction of $P_A$ with $\lambda$ if we assume $\pi_1 - \pi_0 = \underline{\pi}_1 - \underline{\pi}_0$. Then $P_A = \pi_0^{e_i,e_j}\frac{\psi_2}{\Delta\pi}$ where $\frac{\psi_2}{\Delta\pi}$ is constant. Then we have:

$$\frac{\partial P_A}{\partial \lambda} > 0 <=> (\pi_0 - \underline{\pi}_0)\frac{\psi_2}{\Delta\pi} > 0$$

Which is always verified.

### D/ Proof Lemma 1.1

Let us prove that: $P_i^{1,e_j} > P_i^{0,e_j}$ if and only if $(r_{i,ND}^{\cdot,e_j} - r_{i,D}^{\cdot,e_j})\lambda_i + r_{i,D}^{\cdot,e_j} - \psi > 0$

We have:

$$P_i^{1,e_j} = \pi_1^P(\lambda_{j,P}^{1,e_j})(1 - \frac{\psi_2}{\Delta\pi})P(q_i = 1 \cap q_j = 0 \mid (1, e_j)) + \pi_0^A(\lambda_{i,A}^{1,e_j})\frac{\psi_2}{\Delta\pi}P(q_i = 0 \cap q_j = 1 \mid (1, e_j)) - \psi$$

and

$$P_i^{0,e_j} = \pi_1^P(\lambda_{j,P}^{0,e_j})(1 - \frac{\psi_2}{\Delta\pi})P(q_i = 1 \cap q_j = 0 \mid (0, e_j)) + \pi_0^A(\lambda_{i,A}^{0,e_j})\frac{\psi_2}{\Delta\pi}P(q_i = 0 \cap q_j = 1 \mid (0, e_j))$$

with $\pi_1^P(\lambda_{j,P}^{e_i,e_j}) = \lambda_{j,P}^{e_i,e_j}\pi_1 + (1-\lambda_{j,P}^{e_i,e_j})\underline{\pi}_1$ and $\pi_0^A(\lambda_{i,A}^{e_i,e_j}) = \lambda_{i,A}^{e_i,e_j}\pi_1 + (1-\lambda_{i,A}^{e_i,e_j})\underline{\pi}_1$ for all $e_i \in \{0,1\}$.

Besides with have:

$$\lambda_{j,P}^{e_i,e_j} = \frac{P[q_i = 1 \cap q_j = 0 \mid (e_i,e_j) \mid \bar{j}]}{P(q_i = 1 \cap q_j = 0 \mid (x,e_j))}$$

and

$$1-\lambda_{j,P}^{e_i,e_j} = \frac{P[q_i = 1 \cap q_j = 0 \mid (e_i,e_j) \mid \underline{j}]}{P(q_i = 1 \cap q_j = 0 \mid (e_i,e_j))}$$

and

$$\lambda_{i,A}^{e_i,e_j} = \frac{P[q_i = 0 \cap q_j = 1 \mid (e_i,e_j) \mid \bar{i}]}{P(q_i = 0 \cap q_j = 1 \mid (e_i,e_j))}$$

and

$$1-\lambda_{i,A}^{e_i,e_j} = \frac{P[q_i = 0 \cap q_j = 1 \mid (e_i,e_j) \mid \underline{i}]}{P(q_i = 0 \cap q_j = 1 \mid (e_i,e_j))}$$

Thus this leads to:

$$\begin{aligned}
P_i^{1,e_j} = &\Big[\pi_1 P[q_i = 1 \cap q_j = 0 \mid (1,e_j) \mid \bar{j}] \\
&+ \underline{\pi}_1 P[q_i = 1 \cap q_j = 0 \mid (1,e_j) \mid \underline{j}]\Big] \frac{1-\frac{\psi_2}{\Delta\pi}}{P(q_i = 1 \cap q_j = 0 \mid (1,e_j))} P(q_i = 1 \cap q_j = 0 \mid (1,e_j)) \\
&+ \Big[\pi_0 P[q_i = 0 \cap q_j = 1 \mid (1,e_j) \mid \bar{i}] \\
&+ \underline{\pi}_0 P[q_i = 0 \cap q_j = 1 \mid (1,e_j) \mid \underline{i}]\Big] \frac{\frac{\psi_2}{\Delta\pi}}{P(q_i = 0 \cap q_j = 1 \mid (1,e_j))} P(q_i = 0 \cap q_j = 1 \mid (1,e_j)) \\
&- \psi
\end{aligned}$$

that is to say:

$$\begin{aligned}
P_i^{1,e_j} = &\Big[\pi_1\lambda_j\underline{\pi}_1(1-\pi_{e_j}) + \underline{\pi}_1(1-\lambda_j)\pi_1(1-\underline{\pi}_{e_j})\Big](1-\frac{\psi_2}{\Delta\pi}) \\
&+ \Big[\pi_0\lambda_i(1-\pi_1)\underline{\pi}_{e_j} + \underline{\pi}_0(1-\lambda_i)(1-\underline{\pi_1})\pi_{e_j}\Big]\frac{\psi_2}{\Delta\pi} \\
&- \psi
\end{aligned}$$

Symmetrically we have for $e_i = 0$

$$
\begin{aligned}
P_i^{0,e_j} = & \Big[\pi_1 P[q_i = 1 \cap q_j = 0 \mid (0, e_j) \mid \bar{j}] \\
& + \underline{\pi}_1 P[q_i = 1 \cap q_j = 0 \mid (0, e_j) \mid \underline{j}]\Big] \frac{1 - \frac{\psi_2}{\Delta\pi}}{P(q_i = 1 \cap q_j = 0 \mid (0, e_j))} P(q_i = 1 \cap q_j = 0 \mid (0, e_j)) \\
& + \Big[\pi_0 P[q_i = 0 \cap q_j = 1 \mid (0, e_j) \mid \bar{i}] \\
& + \underline{\pi}_0 P[q_i = 0 \cap q_j = 1 \mid (1, e_j) \mid \underline{i}]\Big] \frac{\frac{\psi_2}{\Delta\pi}}{P(q_i = 0 \cap q_j = 1 \mid (0, e_j))} P(q_i = 0 \cap q_j = 1 \mid (0, e_j))
\end{aligned}
$$

That is to say:

$$
\begin{aligned}
P_i^{1,e_j} = & \Big[\pi_1 \lambda_j \underline{\pi}_0 (1 - \pi_{e_j}) + \underline{\pi}_1 (1 - \lambda_j) \pi_0 (1 - \underline{\pi}_{e_j})\Big](1 - \frac{\psi_2}{\Delta\pi}) \\
& + \Big[\pi_0 \lambda_i (1 - \pi_0) \underline{\pi}_{e_j} + \underline{\pi}_0 (1 - \lambda_i)(1 - \underline{\pi}_0) \pi_{e_j}\Big] \frac{\psi_2}{\Delta\pi}
\end{aligned}
$$

Let us focus now on $P_i^{1,e_j} > P_i^{0,e_j}$. We know $\lambda_j = 1 - \lambda_i$ and $\pi_1 - \pi_0 = \underline{\pi}_1 - \underline{\pi}_0 = \Delta\pi$. Then we have:

$$
\begin{aligned}
P_i^{1,e_j} - P_i^{0,e_j} > 0 <=> & \Big[\pi_1 [\lambda_j \underline{\pi}_1 (1 - \pi_{e_j}) - \lambda_j \underline{\pi}_0 (1 - \pi_{e_j})] \\
& + \underline{\pi}_1 [(1 - \lambda_j) \pi_1 (1 - \underline{\pi}_{e_j}) - (1 - \lambda_j) \pi_0 (1 - \underline{\pi}_{e_j})]\Big](1 - \frac{\psi_2}{\Delta\pi}) \\
& + \Big[\pi_0 [\lambda_i (1 - \pi_1) \underline{\pi}_{e_j} - \lambda_i (1 - \pi_0) \underline{\pi}_{e_j}] \\
& + \underline{\pi}_0 [(1 - \lambda_i)(1 - \underline{\pi_1}) \pi_{e_j} - (1 - \lambda_i)(1 - \underline{\pi}_0) \pi_{e_j}]\Big] \frac{\psi_2}{\Delta\pi} \\
& - \psi > 0 \\
P_i^{1,e_j} - P_i^{0,e_j} > 0 <=> & \Big[\pi_1 \lambda_j (1 - \pi_{e_j}) \Delta\pi + \underline{\pi}_1 (1 - \lambda_j)(1 - \underline{\pi}_{e_j}) \Delta\pi\Big](1 - \frac{\psi_2}{\Delta\pi}) \\
& + \Big[\pi_0 \lambda_i (1 - \pi_1 - 1 + \pi_0) \underline{\pi}_{e_j} + \underline{\pi}_0 [(1 - \lambda_i)(1 - \underline{\pi_1} - 1 + \underline{\pi}_0) \pi_{e_j}\Big] \frac{\psi_2}{\Delta\pi} \\
& - \psi > 0
\end{aligned}
$$

Thus that leads to:

$$
\begin{aligned}
P_i^{1,e_j} - P_i^{0,e_j} > 0 <=> & \Big[\pi_1 (1 - \lambda_i)(1 - \pi_{e_j}) \Delta\pi + \underline{\pi}_1 \lambda_i (1 - \underline{\pi}_{e_j}) \Delta\pi\Big](1 - \frac{\psi_2}{\Delta\pi}) \\
& + \Big[ - \pi_0 \lambda_i \underline{\pi}_{e_j} \Delta\pi - \underline{\pi}_0 (1 - \lambda_i) \pi_{e_j} \Delta\pi\Big] \frac{\psi_2}{\Delta\pi} \\
& - \psi > 0
\end{aligned}
$$

We can now separate the part that is relative to the case when $i$ is discriminated from the part relative to the case when $i$ is advantaged:

$$\begin{aligned} P_i^{1,e_j} - P_i^{0,e_j} > 0 <=> & \left[\Delta\pi(1-\lambda_i)(1-\pi_{e_j})\pi_1(1-\frac{\psi_2}{\Delta\pi}) - \Delta\pi(1-\lambda_i)\pi_{e_j}\underline{\pi}_0\frac{\psi_2}{\Delta\pi}\right] \\ & + \left[\Delta\pi\lambda_i(1-\underline{\pi}_{e_j})\underline{\pi}_1(1-\frac{\psi_2}{\Delta\pi}) - \Delta\pi\lambda_i\underline{\pi}_{e_j}\pi_0\frac{\psi_2}{\Delta\pi}\right] \\ & - \psi > 0 \end{aligned}$$

We now have a linear relation with respect to $\lambda_i$:

$$\begin{aligned} P_i^{1,e_j} - P_i^{0,e_j} > 0 <=> & (1-\lambda_i)\overbrace{\left[(\underline{\pi}_1-\underline{\pi}_0)(1-\pi_{e_j})\pi_1(1-\frac{\psi_2}{\Delta\pi}) - (\underline{\pi}_1-\underline{\pi}_0)\pi_{e_j}\underline{\pi}_0\frac{\psi_2}{\Delta\pi}\right]}^{\underline{r}_i^{e_j}} \\ & + \lambda_i\underbrace{\left[(\pi_1-\pi_0)(1-\underline{\pi}_{e_j})\underline{\pi}_1(1-\frac{\psi_2}{\Delta\pi}) - (\pi_1-\pi_0)\underline{\pi}_{e_j}\pi_0\frac{\psi_2}{\Delta\pi}\right]}_{r_i^{e_j}} \\ & - \psi > 0 \end{aligned}$$

To conclude we have:

$$P_i^{1,e_j} > P_i^{0,e_j} <=> (r_i^{e_j} - \underline{r}_i^{e_j})\lambda_i + \underline{r}_i^{e_j} - \psi > 0$$

**E/ Proof Lemma 1.2**

Let us find conditions that guarantee:

$$P_i^{1,e_j} - P_i^{0,e_j} > 0 <=> \lambda_i > \frac{\psi - \underline{r}_i^{e_j}}{(r_i^{e_j} - \underline{r}_i^{e_j})}$$

Start from lemma 1.1 it is straightforward if $r_i^{e_j} - \underline{r}_i^{e_j} > 0$ is verified and if $r_i^{e_j} > \psi > \underline{r}_i^{e_j}$ holds. Let find conditions that guarantee $r_i^{e_j} - \underline{r}_i^{e_j} > 0$.

$$\begin{aligned} r_i^{e_j} - \underline{r}_i^{e_j} > 0 <=> & \left[(\pi_1-\pi_0)(1-\underline{\pi}_{e_j})\underline{\pi}_1(1-\frac{\psi_2}{\Delta\pi}) - (\pi_1-\pi_0)\underline{\pi}_{e_j}\pi_0\frac{\psi_2}{\Delta\pi}\right] \\ & - \left[(\underline{\pi}_1-\underline{\pi}_0)(1-\pi_{e_j})\pi_1(1-\frac{\psi_2}{\Delta\pi}) - (\underline{\pi}_1-\underline{\pi}_0)\pi_{e_j}\underline{\pi}_0\frac{\psi_2}{\Delta\pi}\right] > 0 \\ r_i^{e_j} - \underline{r}_i^{e_j} > 0 <=> & (1-\underline{\pi}_{e_j})\underline{\pi}_1(1-\frac{\psi_2}{\Delta\pi}) - \underline{\pi}_{e_j}\pi_0\frac{\psi_2}{\Delta\pi} \\ & - (1-\pi_{e_j})\pi_1(1-\frac{\psi_2}{\Delta\pi}) + \pi_{e_j}\underline{\pi}_0\frac{\psi_2}{\Delta\pi} > 0 \end{aligned}$$

That leads to the following equation:

$$r_i^{e_j} - \underline{r}_i^{e_j} > 0 <=> \left[(1-\underline{\pi}_{e_j})\underline{\pi}_1 - (1-\pi_{e_j})\pi_1\right](1-\frac{\psi_2}{\Delta\pi}) + \left[\pi_{e_j}\underline{\pi}_0 - \underline{\pi}_{e_j}\pi_0\right]\frac{\psi_2}{\Delta\pi} > 0$$

We find $\pi_{e_j}\underline{\pi}_0 - \underline{\pi}_{e_j}\pi_0 \leq 0$. Indeed it is equivalent to $\frac{\pi_{e_j}}{\underline{\pi}_{e_j}} \geq \frac{\pi_0}{\underline{\pi}_0}$ which is always true for $e_j = 0$ and true for $e_j = 1$ because of the assumption of substitutability between effort and favoritism.

As a consequence, and because $(1-\frac{\psi_2}{\Delta\pi}) > \frac{\psi_2}{\Delta\pi}$, we need to find conditions that guarantee $(1-\underline{\pi}_{e_j})\underline{\pi}_1 - (1-\pi_{e_j})\pi_1 \geq -\pi_{e_j}\underline{\pi}_0 + \underline{\pi}_{e_j}\pi_0$. This leads by successive equivalence:

$$(1-\underline{\pi}_{e_j})\underline{\pi}_1 - (1-\pi_{e_j})\pi_1 \geq -\pi_{e_j}\underline{\pi}_0 + \underline{\pi}_{e_j}\pi_0 <=> \underline{\pi}_1 - \underline{\pi}_{e_j}\underline{\pi}_1 - \pi_1 + \pi_{e_j}\pi_1 + \pi_{e_j}\underline{\pi}_0 - \underline{\pi}_{e_j}\pi_0 \geq 0$$
$$<=> \underline{\pi}_1 - \pi_1 - \underline{\pi}_{e_j}(\underline{\pi}_1 + \pi_0) + \pi_{e_j}(\underline{\pi}_0 + \pi_1) \geq 0$$

Yet, $\underline{\pi}_1 + \pi_0 = \underline{\pi}_0 + \pi_1$ because $\underline{\pi}_1 - \underline{\pi}_0 = \pi_1 - \pi_0$. Thus we can write:

$$\underline{\pi}_1 - \pi_1 + (\pi_{e_j} - \underline{\pi}_{e_j})(\underline{\pi}_0 + \pi_1) \geq 0$$

Yet,$\pi_1 - \underline{\pi}_1 = \pi_{e_j} - \underline{\pi}_{e_j}$. Indeed, if $e_j = 1$ it is straightforward and if $e_j = 0$ the expression is $\underline{\pi}_1 - \pi_1 = \pi_0 - \underline{\pi}_0$ which is equivalent to $\underline{\pi}_1 - \underline{\pi}_0 = \pi_1 - \pi_0$. Thus we have:

$$\underline{\pi}_1 - \pi_1 + (\pi_{e_j} - \underline{\pi}_{e_j})(\underline{\pi}_0 + \pi_1) \geq 0 <=> -1 + \underline{\pi}_0 + \pi_1 \geq 0$$

As a consequence $r_i^{e_j} - \underline{r}_i^{e_j} > 0$ holds if $\underline{\pi}_0 + \pi_1 \geq 1$ is verified. To conclude:

$$P_i^{1,e_j} - P_i^{0,e_j} > 0 <=> \lambda_i > \frac{\psi - \underline{r}_i^{e_j}}{(r_i^{e_j} - \underline{r}_i^{e_j})}$$

is verified and if $r_i^{e_j} > \psi > \underline{r}_i^{e_j}$ and $\underline{\pi}_0 + \pi_1 \geq 1$ hold.

### F/ Proof lemma 1.3

Let us prove that $\Delta E_i(\lambda_i)$ is concave while $\lambda_i \in (0,1)$. We have:

$$E_i^{1,e_j}(\lambda_i) = \pi_1^P(\lambda_j)(1-\frac{\psi_2}{\Delta\pi})P(q_i = 1 \cap q_j = 0 \mid (1,e_j)) + \pi_0^A(\lambda_i)\frac{\psi_2}{\Delta\pi}P(q_i = 0 \cap q_j = 1 \mid (1,e_j)) - \psi$$

$$E_i^{1,e_j}(\lambda_i) = \left[\pi_1(1-\lambda_i) + \underline{\pi}_1\lambda_i\right](1-\frac{\psi_2}{\Delta\pi})\left[\lambda_i\pi_1(1-\underline{\pi}_{ej}) + (1-\lambda_i)\underline{\pi}_1(1-\pi_{e_j})\right] + \left[\pi_0\lambda_i + \underline{\pi}_0(1-\lambda_i)\right]\frac{\psi_2}{\Delta\pi}\left[\lambda_i(1-\pi_1)\underline{\pi}_{e_j} + (1-\lambda_i)(1-\underline{\pi}_1)\pi_{e_j}\right] - \psi$$

Then, for a low effort we have:

$$E_i^{0,e_j}(\lambda_i) = \Big[\pi_1(1-\lambda_i) + \underline{\pi}_1\lambda_i\Big](1-\frac{\psi_2}{\Delta\pi})\Big[\lambda_i\pi_0(1-\underline{\pi}_{ej}) + (1-\lambda_i)\underline{\pi}_0(1-\pi_{e_j})\Big] + \Big[\pi_0\lambda_i + \underline{\pi}_0(1-\lambda_i)\Big]\frac{\psi_2}{\Delta\pi}\Big[\lambda_i(1-\pi_0)\underline{\pi}_{e_j} + (1-\lambda_i)(1-\underline{\pi}_0)\pi_{e_j}\Big]$$

Then we can write the marginal return:

$$\begin{aligned}\Delta E_i(\lambda_i) =& \Big[\pi_1(1-\lambda_i) + \underline{\pi}_1\lambda_i\Big](1-\frac{\psi_2}{\Delta\pi})\Big[\lambda_i\Delta\pi(1-\underline{\pi}_{ej}) + (1-\lambda_i)\Delta\pi(1-\pi_{e_j})\Big] \\ &+ \Big[\pi_0\lambda_i + \underline{\pi}_0(1-\lambda_i)\Big]\frac{\psi_2}{\Delta\pi}\Big[\lambda_i(1-\pi_1-1+\pi_0)\underline{\pi}_{e_j} \\ &+ (1-\lambda_i)(1-\underline{\pi}_1-1+\underline{\pi}_0)\pi_{e_j}\Big] - \psi \\ \Delta E_i(\lambda_i) =& \Big[(\underline{\pi}_1-\pi_1)\lambda_i + \pi_1\Big](1-\frac{\psi_2}{\Delta\pi})\Big[\lambda_i\Delta\pi(1-\underline{\pi}_{ej}) + (1-\lambda_i)\Delta\pi(1-\pi_{e_j})\Big] \\ &+ \Big[\lambda_i(\pi_0-\underline{\pi}_0) + \underline{\pi}_0\Big]\frac{\psi_2}{\Delta\pi}\Big[-\lambda_i\Delta\pi\underline{\pi}_{e_j} - (1-\lambda_i)\Delta\pi\pi_{e_j}\Big] - \psi \\ \Delta E_i(\lambda_i) =& \Big[(\underline{\pi}_1-\pi_1)\lambda_i + \pi_1\Big](1-\frac{\psi_2}{\Delta\pi})\Big[\lambda_i\Delta\pi(1-\underline{\pi}_{ej}-1+\pi_{e_j}) + \Delta\pi(1-\pi_{e_j})\Big] \\ &+ \Big[\lambda_i(\pi_0-\underline{\pi}_0) + \underline{\pi}_0\Big]\frac{\psi_2}{\Delta\pi}\Big[\lambda_i\Delta\pi(-\underline{\pi}_{e_j}+\pi_{e_j}) - \Delta\pi\pi_{e_j}\Big] - \psi\end{aligned}$$

Thus we can now develop the expression:

$$\begin{aligned}\Delta E_i(\lambda_i) =& \Big[(\underline{\pi}_1-\pi_1)(\pi_{e_j}-\underline{\pi}_{e_j})\Delta\pi\lambda_i^2 + (\underline{\pi}_1-\pi_1)\Delta\pi(1-\pi_{e_i})\lambda_i \\ &+ \Delta\pi(\pi_{e_j}-\underline{\pi}_{e_j})\pi_1\lambda_i + \Delta\pi\pi_1(1-\pi_{e_j})\Big](1-\frac{\psi_2}{\Delta\pi}) \\ &+ \Big[(\pi_0-\underline{\pi}_0)(\pi_{e_j}-\underline{\pi}_{e_j})\Delta\pi\lambda_i^2 + (\pi_0-\underline{\pi}_0)\Delta\pi\pi_{e_i}\lambda_i \\ &+ \Delta\pi(\pi_{e_j}-\underline{\pi}_{e_j})\underline{\pi}_0\lambda_i - \Delta\pi\underline{\pi}_0\pi_{e_j}\Big]\frac{\psi_2}{\Delta\pi} - \psi\end{aligned}$$

We can now focus on the sign of the coefficient in front of the squared term $\gamma = (\underline{\pi}_1 - \pi_1)(\pi_{e_j} - \underline{\pi}_{e_j})\Delta\pi(1-\frac{\psi_2}{\Delta\pi}) + (\pi_0-\underline{\pi}_0)(\pi_{e_j}-\underline{\pi}_{e_j})\Delta\pi\frac{\psi_2}{\Delta\pi}$:

$$\begin{aligned}\gamma =& \Delta\pi(\pi_{e_j}-\underline{\pi}_{e_j})\Big[(\underline{\pi}_1-\pi_1)(1-\frac{\psi_2}{\Delta\pi}) + (\pi_0-\underline{\pi}_0)\frac{\psi_2}{\Delta\pi}\Big] \\ <=>\ \gamma =& \Delta\pi(\pi_{e_j}-\underline{\pi}_{e_j})\Big[-(\pi_1-\underline{\pi}_1)(1-\frac{\psi_2}{\Delta\pi}) + (\pi_0-\underline{\pi}_0)\frac{\psi_2}{\Delta\pi}\Big]\end{aligned}$$

We know that $(\pi_1 - \underline{\pi}_1) = (\pi_0 - \underline{\pi}_0)$ so we have:

$$\gamma = \Delta\pi(\pi_{e_j}-\underline{\pi}_{e_j})(\pi_1-\underline{\pi}_1)\Big[-(1-\frac{\psi_2}{\Delta\pi}) + \frac{\psi_2}{\Delta\pi}\Big]$$

Thus the sign of $\gamma$ depends exclusively on variable from second stage. By assumption $(1 - \frac{\psi_2}{\Delta\pi}) > \frac{\psi_2}{\Delta\pi}$ which means that the wage of the principal will be superior to the wage of the agent in second stage. So $\gamma$ is negative and $\Delta E_i(\lambda_i)$ is concave as $\Delta E_i(\lambda_i)$ will be represented by an inverted parabola.

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# Chapter 2

# Which kind of ability bolsters legitimacy?

> Then Jesus added, "I can guarantee this truth: A prophet isn't accepted in his hometown." Luke 4:24 (GW) The Bible

## 2.1 Introduction

This chapter deals with the choice of the ability on the basis of which an executive should be selected to bolster his legitimacy optimally. The trade-off for the firm is to know if it should favor a "business" ability, that is required for the employee and that is very technical (like accounting skills in a audit firm, a researcher skills for a professor...), or a "managerial" ability which is specific to the executive function but not necessary hard to acquire (like general knowledge, or administrative abilities...). The stakes for the firm are plural. First, choosing the right procedure would be a way to make leaders more accepted by their subordinates and as a consequence it could be a way to legitimate high inequality of remuneration between them. Second, the firm could want to reveal a competence through the promotion process that will maximize production. Finally, the stake could be to create an enthusiastic atmosphere before the promotion in itself, where every employees are incentivized to work hard and reveal competence (the promotion seen as a final step and as a final reward may have a significant impact on the motivation before the promotion itself). Furthermore, in the eyes of a future executive, the ability assessed by the firm will also become a major stake for himself as it could influence the

level of competence he needs to reveal during a promotion process. We argue it could become part of a leadership strategy.

Let us explain more extensively the two legitimacies treated in this chapter and the procedures of selection of executives supposed to bolster them. First, selecting on business ability is what we call a *meritocratic procedure* and leads to choose as leader the best employee or the one who has the best employee 's ability. It will then bolsters what we call a *meritocratic legitimacy*. It could be a very intuitive way to promote people within a department in a organization using past achievement and CV as criterias of promotion. It would then suggest that in spite of hierarchy, the professional and education profile among workers are quite homogenous within the department as every employee have almost the same profession. But this selection process could also represent education and more specifically short and professionally oriented courses, designed to meet specific demands of companies focused on operational tasks. On the contrary, favoring managerial ability is what we call an *aristocratic procedure* and would bolster an *aristocratic legitimacy*. It could suggest one or several probation stages when an employee is given a chance to demonstrate a different ability beyond his routine task that requires business ability. It could be also some-thing more institutionalized such as internal contest for civil servant in public administration for instance. High education and selection through generalist trainings in prestigious universities could be seen also as an *aristocratic procedure* in a sense that it places people upstream in the hierarchy and contrary to professionalizing courses those trainings often teach general knowledge that is not specifically related to the operational task. Furthermore, we note that within a firm *meritocratic procedures* are potentially less costly than *aristocratic procedures* as it is feasible to assess business ability through a productive task whereas assessing managerial ability will mobilize staff on a non productive task which could generate an opportunity cost.

To modelize this, we assume a preliminary tournament before a production stage. Before the tournament the firm chooses which ability it wants to assess. Opponents and the firm don't know abilities of opponents with certainty but they only have an *a prior* belief about it which is common knowledge. Winning or loosing will reveal information and both opponents will revise by bayesian inference their initial beliefs about being competent or not on the ability that the firm has chosen to evaluate. However, the belief on the ability that is not assessed will remain unchanged. The winner will then become the principal in stage 2. This stage is captured by a principal agent framework with a function

of production comprised of three tasks. Both of them are completed by the principal: the first task requires a very technical business ability and a second task requiring a managerial skill that is easier to master. Lastly, the third task is a business task completed by the employee. The two business tasks are substitutable to each other which means that the work of one team member can compensate the failure or repair the mistake of the other. In contrast, the managerial task is complementary with the other two tasks. It means that in spite of its ease, it is crucial for the production. We also assume that among the two substitutable tasks that require business ability, the one the principal is in charge of is harder (i.e requires more ability to be completed) than the one the employee completes. It justifies *a priori* that we should wonder about the necessity of selecting leaders on their business abilities. The efforts of the principal in both tasks is not modeled such that only his ability will count for the production. His strategic decision is to propose a wage to the agent to incentivize high effort from him. We argue this function of production captures a situation, in consulting and audit firm notably or also more generally in small teams, where the executive continues to be part of the operational process of production but is assigned harder tasks while he also has to supervise the work of others and master some management task. It can also capture the situation of a political leader that needs to manage a party but also needs to propose a political program and embody an ideological current (which would be a transposition of the business task we mention previously).

With this framework we get the following result. The first result is that the *aristocratic procedure* allows to make the agent accept a higher inequality of wage between him and his principal compared to *meritrocratic procedure*. The reason is that in the *meritocratic procedure*, after failure, the agent will be discouraged because he will have to execute the same task that the one which made him lose the tournament. In other words, becoming agent means implicitly being an "incompetent" employee. Thus, to maintain the income incentivizing it will be necessary to propose a higher wage to compensate the fact that in the eyes of the agent, his chances of making a high production are weak. Besides, this procedure will incentivize free riding behavior as the agent will tend to rely on the principal business ability. These issues will not appear in the *aristocratic procedure* because the selection task is not the same than the task completed by the agent thereafter. Thus, the production stage is seen as a fresh start where the motivation remains unaffected.

The second result is that during the tournament the *meritocratic procedure* incentivizes

less to exert high effort than the *aristocratic procedure*. Indeed, we demonstrate that whatever the efforts of their opponents, the marginal return of effort of both opponents in the *meritocratic procedure* will be lower. The intuition is that opponents have interest to make a low performance during the tournament to contain to a minimum the discouragement of their opponents in order to offer them a wage as small as possible in the future. That is why they will reduce their efforts.

The third result is that for the firm it will be optimal to select the executive on managerial ability if it wants to maximize production in the second stage. First of all, the intuition is that revealing competence in business ability for the principal implies revealing also incompetence for the agent. Thus the net effect on the global production will be modest. Whereas selecting on managerial ability avoids this issue. As the managerial task is assumed complementary, increasing managerial ability would favor a fertile ground for the other tasks of the team to be productive simultaneously. Besides, as the *aristocratic procedure* is more incentivizing during tournament, it allows to reveal more competence at the equilibrium. Thus the production in stage 2 is guaranteed to be higher in second stage in the aristocratic procedure precisely because this procedure allows to reveal more competence.

This model suggests several applications. If we interpret the first result, it sheds new light on the mechanism of the rejection of authority and particularly the rejection by the peers. It suggests that for a subordinate, seeing some one else with "comparable" competence, or even social belonging, becoming promoted as his executive would be lived as a humiliation and it will entail an non-cooperative behavior. On the contrary some one with a different profile, with a non comparable competence, will be accepted because his promotion would preserve the pride of the subordinate and it would neutralize rivalry's issues. As a consequence, if we interpret competence as an identity or a social belonging, it would suggest that an organization with social class (in a sense that each social class would be defined by a common competence shared among members) would entail more submission to authority than an egalitarian organization. It also suggests that hierarchy *between* professions, notably established with aristocratic procedures such as high education, would be much more accepted that hierarchy *within* a profession, which would be established with meritocratic procedures.

The second result can be interpreted such that a *meritocratic procedure* will favor the

emergence of a culture of humility whereas an *aristocratic procedure* will favor a culture of performance. Indeed in a *meritocratic procedure*, opponents will be incentivized to reduce their efforts to hide their strengths in order to preserve the self-confidence of their future team partners. On the contrary in *aristocratic procedures* the perspective of being propelled to the top of the hierarchy with very competitive remuneration without any monetary concessions will incentivize a demonstration of strength. This strategy of humility could be seen also as a leadership strategy that would aim to favor an *identification mechanism*. Indeed, observing the promotion of some one with an ability very close to his own ability would give to the agent good hope for his future achievement as an employee. On the contrary, in *aristocratic procedures*, the strategy of demonstration of strength could be seen as a totally opposite leadership strategy based on a *differentiation mechanism* that would aim to favor the image of the leader as an exceptional and rare being. Indeed, he will be able to make "extraordinary" achievement that a regular employee would not be able to achieve. It will be reassuring and so without making the employee feel humiliated.

The second result suggests also that among the procedure of selection, a high education system based on generalist training will be more efficient to reveal ability than a system based on professionally oriented courses, designed to train on business tasks. This is because the reward in case of success is much more incentivizing than in professionalizing courses. It suggest that in some industry or in some profession where meritocratic procedures are chosen through professionalizing courses, an egalitarian culture would emerge that would lead to a more egalitarian allocation of income between executives and employees. As a consequence, it suggests that professionalizing courses would favor more academic failure than generalist trainings (as victory would be much less incentivizing).

Finally, we believe the second result could explain a situation of blockage and stasis in a fratricidal struggle notably for instance ideological vacuum in a political party when it comes to appoint a leader for a future national election. Indeed, we can interpret the signal at the end of the tournament not only as information about a competence, but also as information on the subjective preference of the organization on a project or an idea. Thus, the model can capture a situation where two persons compete to become the leader of a party and have different political programs (which is a transposition of the business task that we have discussed previously) but they have the *a priori* belief that both programs have equally chances to be favored by the organization (which is a transposition

of the uncertainty on business ability). Loosing the competition will send a signal that their political programs will not be taken into account and valued by the organization.[1] In the perspective of new national elections the loser might demand higher concession on ministerial position to support the new leader during the campaign. Anticipating that, rivals might have interest in forsaking the strategy of investing effort in their political programs. The organization might anticipate that and choose another criteria based on their personalities and their ways of governing (which is a transposition of managerial abilities). This could imply notably ideological vacuum during internal campaign for primary election in a political parti.

The originality and contribution of this work is to focus on the side effect of tournament by focusing on the point of view of the looser and the incentive issue that it implies. Thus, we focus on the consequence of failure as a mechanism to reveal incompetence whereas career concern literature focus on the consequence of success in demonstrating competence (Gibbons 1996, Gibbons and Murphy 1992, Jeon 1996, MacLeod 2007). As a consequence, the winner of the competition could then have to assume the failure of his opponent as a burden, as some thing very costly in term of incentive. With the same bayesian framework, we have an opposite result than classical career concern insight in a sense that opponents may have no interest in revealing high ability during the tournament. Besides our work shed a new light on issue of merit (effort) as a criteria that legitimate inequality of wage treated notably by the literature on unfairness aversion and procedural justice (Bolton et al. 2005, Ku and Salmon 2013).[2] Indeed, because we focus on the idea of comparability and rivalry, effort will be seen as a reasonable source of legitimacy if it does not imply a humiliation in the view of the person not promoted. Thus effort will then allow to legitimate a higher inequality of remuneration.

The rest of the chapter is organized as follows. Section 2 deals with the literature. Section 3 describes the theoretical framework and section 4 will explore the results. Finally, section 5 concludes.

[1]The assessment of political programs could also be delegated to electors like in a primary election for instance.

[2]Papers on unfairness aversion deal with how people might have a preference for equiteable allocation of revenues. Papers on procedural justice study how people might care about the procedure by which the allocation of incomes and power are decided

## 2.2 Literature

As mentioned above, the issue of this work is related to the literature on career concern and reputation (Gibbons 1996, Gibbons and Murphy 1992, Jeon 1996, MacLeod 2007). Gibbons (1996) deals with how agents could accept to exert very high effort in the short term without reward, in order to reveal competence and expect a higher reward in the future. Jeon (1996) uses this same idea but shows that it would be efficient for an organization to mix young worker and old workers in the same team. Indeed, as competence of both team partners are complementary, the competence previously revealed by the old worker would exacerbate the performance of the young worker and help revealing his ability in a sense that it would make the signal of the assessing technology less noisy.

Bar-Isaac and Deb (2014) deals with how a firm could be faced to consumers with heterogenous preferences with respect to quality and how her optimal strategy will not be necessary to maximize quality. Each consumer may have different expectation in term of quality and this creates different market segments. If the firm cannot discriminate by price, increasing her quality will make her capture less of the surplus of some of the segment that requires less quality. Even though it does not deal about competence directly the unknown quality can be revealed by an action through a bayesian inference such that the theoretical framework are comparable to ours. Besides the issue is close to our work because it points out the idea that the reputation is a coarse notion that deserves to be studied in more details because not necessary objective. In our work, we focus on what kind of reputation is the more efficient between an ability already required from the subordinate or a new ability specific to the executive responsibility.

Our work is also related to Benabou and Tirole's work on "belief in a just world" (Benabou and Tirole 2006). Their paper deals with how deny of "bad new" may make people agree with less redistributive taxes. It also explains how on the contrary lucid and pessimist people will choose a more redistributive tax rate. Deny in this paper is treated as a cognitive choice (i.e a costly decision about treatment of information) of hiding one's self negative information received about how effort will be rewarded in the future. It is assumed that people do not know with certainty to what extent economics success is due to personal effort and controllable actions or due to external factors inherited. Failure tends then to reinforce by bayesian inference the belief that they effort will not be "fairly" rewarded, namely that external factors are more important. Deny will consist in hiding

oneself "bad" information to limit this bayesian inference. Our work does not deal specifically with deny because opponents do not choose to hide themselves information however the aristocratic procedure makes the learning on the ability assessed by the tournament completely pointless. Thus, the effect on neutralizing the bayesian inference will be identical. The behavior of submitting to authority (or accepting a very low wage) depends on how "bad news" (i.e. loosing the tournament), are not taken into account and for this it is very comparable to the behavior of choosing a low tax rate in the paper by Benabou and Tirole.

Besides, our work is related to the literature on fairness and inequitey aversion (Bolton et al. 2005, Englmaier and Wambach 2010, Falk and Fischbacher 2006, Falk et al. 2008, Fehr et al. 2013, Fehr and Schmidt 1999; 2000, Schurter and Wilson 2009). The "procedure of justice" has already been the object of many experimental papers (Bolton et al. 2005, Ku and Salmon 2013). They show that the role of merit (measured in their experiment by a performance at a test) is ambivalent as a criteria of acceptation of inequality of incomes. Ruffle (1998) studies a dictator game is which there is a previous stage where participants passed a test. He shows that the proposer takes into account the performance of the one who received his proposal to choose the amount he wish to give. Cherry et al. (2002) study how dictators tend to give less equiteable share to recipients if they have themselves pass a previous test that put them in a good rank position. Ku and Salmon (2013) decide to separate participants into two categories: the advantaged ones (i.e participants who receive a high endowment) and the disadvantaged one (i.e participants who receive a low endowment). They study the willingness of the disadvantaged people to transfer money to the advantaged one with respect to the procedure of selection chosen in the experiment that split participants. They show notably that the merit of advantaged people did not make disadvantaged people accepting a higher monetary transfer (in one of their treatments they select participants to belong the advantaged group by measuring their performances at a test).

## 2.3 Theoretical framework

We consider a two-stage game. The first stage is a tournament between two opponents such that the winner will become the principal and the looser will become the agent

in the second stage. The second stage is a principal-agent framework with a working principal where three tasks are completed simultaneously. There are two similar tasks: one completed by the principal and the other by the agent, and a last task which is different and only exerted by the principal. Regarding the contribution of the principal in the global output, only his abilities in each of his task counts and we do not formalize his effort. As we only want to focus on the moral hazard in the side of the agent and not on the effort of the principal, the effort of the principal is ignored and not modeled to avoid to complicate the analysis unnecessarily. On the contrary, the contribution of the agent will depend on his ability and on his effort. But his effort is not contractible. Thus, the principal has to choose the wage he will give to the agent, while the agent has to choose his level of effort.

The firm can choose two different procedures of selection. The assessment technology is exogenous such that the choice will be about what kind of ability required for the principal (for each of his task) is more efficient to choose. The firm does not observe the effort of opponents during the tournament and the effort of the agent, thus the objective will be to maximize production in stage 2 and to incentivize maximum effort during tournament.

Here is the sequence of the game in stage 1:

- The firm and the opponents share a common *a priori* belief about the abilities of the competitors.
- The firm choose between the two procedures of selection (aristocratic or meritocratic)
- The tournament begins and opponents choose their efforts simultaneously
- The opponents observe the effort chosen and the performances achieved by each other. The firm only observes the performance and promotes as the principal. the opponent that makes the highest performance.
- The opponents make a bayesian inference to revise their beliefs on competitor abilities. Thus the posterior belief is common between competitors as well.

Here is the sequence of the game in stage 2:

- The principal proposes a variable wage with respect to the performance of the team

(agent and principal) without being able to observe agent's effort but having a revised belief on their respective abilities.

- Agent choses his effort with respect to the wage proposed by the principal, having a revised belief on their respective abilities.
- The performance of the team is observed. The payments of both the principal and the agent occur.

### 2.3.1 Stage 1: a tournament that can assess two different competences

The first stage is a tournament that selects opponents for the position of agent and principal in the second stage. There are two types de competences that can be evaluated: a managerial competence necessary to complete the managerial task $m_i \in \{0,1\}$ such that $\gamma_i$ is the probability to own the high level of competence; and a business competence necessary to complete the business task $b_i \in \{0,1\}$ such that $\lambda_i$ is the probability to own the high level of competence. To evaluate consists in determining $m_i$ or $b_i$ which can be interpreted as grades. We denote $(\pi^{\gamma}_{e_i}, \underline{\pi}^{\gamma}_{e_i})$ the probabilities of completing the managerial task whereas $i$ has the high competence or the low competence given his level of effort $e_i$. Symmetrically, we denote $(\pi^{\lambda}_{e_i}, \underline{\pi}^{\lambda}_{e_i})$ the probabilities of completing the business task whereas $i$ has the high competence or the low competence given his level of effort $e_i$. It means that if we evaluate managerial skills we have $P(m_i = 1 \mid e_i) = \gamma_i \pi^{\gamma}_{e_i} + (1-\gamma_i)\underline{\pi}^{\gamma}_{e_i}$ and if we evaluate business skills we have $P(b_i = 1 \mid e_i) = \lambda_i \pi^{\lambda}_{e_i} + (1-\lambda_i)\underline{\pi}^{\lambda}_{e_i}$. The organization cannot evaluate simultaneously the two competences such that it will have to chose on what task to assess the future principal. This assumption is made for tractability. Besides, it allows to avoid some eviction between the two tasks that could have occurred otherwise.

**Definition 3.** We define as an *aristocratic procedure* the fact of selecting principal on managerial ability and *aristocratic legitimacy*, the nature of legitimacy acquired by revealing such managerial ability.

**Definition 4.** We define as a *meritocratic procedure* the fact of selection principal on business ability and *meritocratic legitimacy*, the nature of legitimacy acquired by revealing such business ability.

First, we assume that the opponents have *ex ante* the same beliefs in both competences such that $\gamma_i = \lambda_i$ and they share the same belief with the firm about who is advantaged or not before the competition such that $\lambda_i = 1 - \lambda_j$ and $\gamma_i = 1 - \gamma_j$. Second, we assume that the assessing technology during first stage is identical whatever the competence evaluated such that $(\pi^{\gamma}_{e_i}, \underline{\pi}^{\gamma}_{e_i}) = (\pi^{\lambda}_{e_i}, \underline{\pi}^{\lambda}_{e_i})$. As a consequence we will have $P(m_i = 1 \mid e_i) = P(b_i = 1 \mid e_i)$. Thus, winning or loosing the competition will give the same information about owning the competence whatever the type of competence that is evaluated because the "quality" of the tournament's evaluation is assumed identical. This assumption is a technical hypothesis designed to make the comparison between the two procedures more tractable because relying only on second stage expected payoff.

For convenience, from now we will denote $q_i$ the production level for any task such that $q_i \in \{m_i, b_i\}$ and $x_i$ the probability of owning the competence required such that $x_i \in \{\gamma_i, \lambda_i\}$. Besides, we will denote $(\pi_{e_i}, \underline{\pi}_{e_i})$ the probabilities of succeed with high or low competence whatever the task such that $\pi_{e_i} \in \{\pi^{\gamma}_{e_i}, \pi^{\lambda}_{e_i}\}$ and $\underline{\pi}_{e_i} \in \{\underline{\pi}^{\gamma}_{e_i}, \underline{\pi}^{\lambda}_{e_i}\}$. For the purpose of future results, we assume complementarity between competence and effort such that:[1]

$$\begin{cases} \pi_{e_i} = e_i\theta_H + \epsilon \\ \underline{\pi}_{e_i} = e_i\theta_L + \epsilon \end{cases} \tag{2.1}$$

We assume of course that $\theta_H > \theta_L$ with $\theta_H$ the high ability such that $P(\theta = \theta_H) = x_i$, and $\theta_L$ the low ability such that $P(\theta = \theta_L) = 1 - x_i$. Besides, $\epsilon$ is a parameter that follow a Bernoulli distribution commonly known by both opponents and the firm. It guarantees $\pi_0 > 0$ and $\underline{\pi}_0 > 0$. Thus $\epsilon$ represents the probability of producing $q_i = 1$ given $e_i = 0$ and guarantees that even without putting high effort the competition remains random such winning or loosing the competition is still a noisy signal. We also assume $\theta_H > 0$ and $\theta_L > -\epsilon$ which means that $\theta_L$ can be negative but always superior to $-\epsilon$ to guarantee that $\underline{\pi}_{e_i} > 0$. Assume $\theta_L$ negative would mean it would be an incompetence that sabotage effort.

The winner of the tournament will be the one who completes the task whereas his opponent does not. Thus we have $P(q_i = 1 \mid e_i) = x_i\pi_{e_i} + (1 - x_i)\underline{\pi}_{e_i}$ and for $i$ the

[1] Assuming complementarity between competence and effort is a technical assumption necessary to justify in further results that completing the task by exerting high effort will reveal competence.

probability of winning $P_W(e_i)$ and the probability of loosing $P_L(e_i)$ are:

$$P_W(e_i) = P\Big[q_i = 1 \cap q_j = 0 \mid (e_i, e_j)\Big] = x_i \pi_{e_i}(1 - \underline{\pi}_{e_j}) + (1 - x_i)\underline{\pi}_{e_i}(1 - \pi_{e_j})$$
$$P_L(e_i) = P\Big[q_i = 0 \cap q_j = 1 \mid (e_i, e_j)\Big] = x_i(1 - \pi_{e_i})\underline{\pi}_{e_j} + (1 - x_i)(1 - \underline{\pi}_{e_i})\pi_{e_j}$$

Both opponents can observe the effort $(e_i, e_j) \in \{0, 1\}^2$ of each other only after the tournament and observe the result of the tournament as well. Thus, they can make a bayesian inference to learn about their relative ability with respect to their victories or defeats. By applying bayesian rule, we denote $\hat{x}_{i,v} = \hat{x}_{i,v}(e_i, e_j)$ the ex-post belief in case of victory with $\hat{x}_{i,v} \in \{\hat{\lambda}_{i,v}, \hat{\gamma}_{i,v}\}$, and $\hat{x}_{i,d} = \hat{x}_{i,d}(e_i, e_j)$ the ex-post belief in case of defeat with $\hat{x}_{i,d} \in \{\hat{\lambda}_{i,d}, \hat{\gamma}_{i,d}\}$:

$$\hat{x}_{i,v} = \frac{x_i \pi_{e_i}(1 - \underline{\pi}_{e_j})}{x_i \pi_{e_i}(1 - \underline{\pi}_{e_j}) + (1 - x_i)\underline{\pi}_{e_i}(1 - \pi_{e_j})}$$
$$\hat{x}_{i,d} = \frac{x_i(1 - \pi_{e_i})\underline{\pi}_{e_j}}{x_i(1 - \pi_{e_i})\underline{\pi}_{e_j} + (1 - x_i)(1 - \underline{\pi}_{e_i})\pi_{e_j}}$$

Applying bayesian rule if $i$ wins and if the firm chooses to evaluate on managerial ability we will have $\hat{\gamma}_{i,v} \neq \gamma_i$ and $\hat{\lambda}_{i,v} = \lambda_i$. On the contrary, if the firm chooses to evaluate on business ability we will have $\hat{\gamma}_{i,v} = \gamma_i$ and $\hat{\lambda}_{i,v} \neq \lambda_i$. These constitutes the formalization of the consequence of the firm's decision.

### 2.3.2 Stage 2: a hierarchical relationship with a working executive

In second stage, by convention we assume opponent $i$ has won the tournament and becomes the principal and opponent $j$ becomes the agent. We define the function of production which is totally different than the function of production in first stage except that the competence evaluated during tournament is still required during stage 2. This assumption is quite intuitive because otherwise the tournament would not constitute a relevant signal for the firm. Three tasks are exerted but only two competences are required and only one of them is evaluated during the tournament. Each of the three tasks can only take two values: 1 if it is completed and 0 otherwise:

- Task 1 ($T_1$) is a task exerted by the principal $i$ which is related to a managerial competence. We denote the probability to complete the task: $P(T_1 = 1) = a\hat{\gamma}_{i,v} + \underline{a}(1 - \hat{\gamma}_{i,v})$ where $(\underline{a}, a)$ are the low and high managerial competence and $\hat{\gamma}_{i,v}$ is the

ex-post probability of having this competence after the tournament. For convenience we assume $\underline{a} = 0$. As we previously specified, only the ability of the principal counts in the second stage and his effort does not count in the function of production.

- Task 2 ($T_2$) is also a task exerted by the principal $i$ but it is this time related to a business competence. We denote the probability to complete the task: $P(T_2 = 1) = b\hat{\lambda}_{i,v} + \underline{b}(1 - \hat{\lambda}_{i,v})$ where $(\underline{b}, b)$ are the low and high business competence and $\hat{\lambda}_{i,v}$ is the ex-post probability of having this competence. For convenience we also assume $\underline{b} = 0$. As in task 1 the effort of the principal is not taken into account.

- Task 3 ($T_3$) is a task exerted by the agent $j$ and is related to business competence as well. We denote the probability to complete the task: $P(T_3 = 1) = \pi_{d_j}\hat{\lambda}_{j,d} + \underline{\pi}_{d_j}(1 - \hat{\lambda}_{j,d})$ where $(\underline{\pi}_{d_j}, \pi_{d_j})$ are the high and low business competence given a level of effort $d_j \in \{0, 1\}$ and $\hat{\lambda}_{j,d}$ is the probability of having this competence. As $\hat{\lambda}_{i,v} = 1 - \hat{\lambda}_{j,d}$ we have $P(T_3 = 1) = \pi_{d_j}(1 - \hat{\lambda}_{i,v}) + \underline{\pi}_{d_j}(\hat{\lambda}_{i,v})$ As a contrary to precedent tasks we assume $\underline{\pi}_{d_j} > 0$.

We assume that $\underline{\pi}_{d_j} > 0$ because otherwise they would not be any moral hazard in the side of agent during stage 2. However, for simplicity we will assume there is no hazard moral in the side of the manager which allow us to assume $\underline{a} = 0$ and $\underline{b} = 0$. We also assume that $a < b$ which means that the business task exerted by the principal is more "technical" that the managerial task in a sense that it is more sensitive to competence. Eventually we assume also that $b > \pi_{d_j} - \underline{\pi}_{d_j}$ which means that the business task of the principal is more "technical" than the task of the agent. These two assumptions are important because they justify *a priori* that executive could be selected on business competence.

Then we define the function of production $S \in \{0, 1\}$ as follows:

$$\begin{cases} S = 1 \text{ if } T_1 = 1 \text{ and } T_2 = 1 \\ \qquad \text{or } T_1 = 1 \text{ and } T_3 = 1 \\ S = 0 \text{ otherwise} \end{cases} \tag{2.2}$$

This function of production describe in expression (2.2) means that T2 and T3 are similar and substitute to each other, whereas T1 is complementary to those two tasks. It means it is important that at least one of the two business tasks is completed with the managerial task. It captures the idea that any mistake in T2 or T3 can be compensated or corrected by the work of the other. Whereas, T1 is crucial anyway. Then we have:

$$P(S=1) = P(T_1=1)P(T_2=1) + P(T_1=1)P(T_3=1)$$

Then it leads to:

$$P(S=1 \mid d_j) = a\hat{\gamma}_{i,v}\left[b\hat{\lambda}_{i,v} + \pi_{d_j}(1-\hat{\lambda}_{i,v}) + \underline{\pi}_{d_j}\hat{\lambda}_{i,v}\right]$$

## 2.4 Results

This section is divided into three subsections. The first subsection aims to determine what choice of procedure will be the more efficient to maximize the production in second stage. This issue is related to what procedure maximizes global welfare as the production is fully shared between the principal and the agent. The second subsection deals with what king of legitimacy allows to decrease monetary incentive by the principal by being a substitute to variable wage to implement high effort. The third subsection deals with the issue for the firm in first stage: what kind of procedures is more incentivizing during the tournament. The stake will be to make or not to make a demonstration of strength for competitors to bolster their legitimacies.

### 2.4.1 The nature of legitimacy and the efficiency of production

In this section we find conditions that guarantee that an *aristocratic procedure* is more efficient to maximize production in second stage. As the second stage is a principal agent-framework, the production is fully distributed between the principal and the agent such that maximizing the production means implicitly maximizing the global welfare as well. Thus, we focus on a first stage choice for the firm with respect to the equilibrium in second stage assuming that the principal has proposed an incentive wage sufficient to implement high effort from the agent. This backward induction approach allows us to assume that the agent will exert high effort.

As a consequence we must study on a preliminary approach, the influence of the choice of procedures on the beliefs. After the tournament, both opponents observe the level of efforts chosen. Thus, they will revise their beliefs on their abilities with respect to their efforts and performances.

**Lemma 2.1.** *Winning the tournament reinforces the belief in having high ability and this effect is stronger if high effort is exerted:* $\hat{x}_{i,v}(1, e_j) > \hat{x}_{i,v}(0, e_j) > x_i$. *However, loosing the tournament reinforces the belief in having low ability and this effect is stronger if high effort is chosen:* $\hat{x}_{i,d}(1, e_j) < \hat{x}_{i,d}(0, e_j) < x_i$.

*Proof.* See Appendix A □

Lemma 2.1 means that whatever the procedure, winning the competition reinforce the belief in being competent and so even more if high effort has been exerted. Besides it means that loosing the competition reinforces the belief in being incompetent and so even more when exerting high effort. This is due the complementarity between effort and competence. The more the performance is high the more it reveals that a high competence was necessary because competence exacerbates the effect of effort.

**Lemma 2.2.** *The firm has the choice between two procedures. In the aristocratic procedure, at the the end of the tournament both opponents share the following beliefs:*

- *in case of victory* $\hat{\gamma}_{i,v} > \gamma_i$ *and* $\hat{\lambda}_{i,v} = \lambda_i$ *but also* $\hat{\gamma}_{i,v} > \lambda_i$
- *in case of defeat* $\hat{\gamma}_{i,d} < \gamma_i$ *and* $\hat{\lambda}_{i,d} = \lambda_i$ *but also* $\hat{\gamma}_{i,d} < \lambda_i$.

*In the meritocratic procedure they will share the following beliefs:*

- *in case of victory* $\hat{\lambda}_{i,v} > \lambda_i$ *and* $\hat{\gamma}_{i,v} = \gamma_i$ *but also* $\hat{\lambda}_{i,v} > \gamma_i$
- *in case of defeat* $\hat{\lambda}_{i,d} < \lambda_i$ *and* $\hat{\gamma}_{i,d} = \gamma_i$ *but also* $\hat{\lambda}_{i,d} < \gamma_i$.

Lemma 2.2 means that choosing an *aristocratic procedure* reinforces the beliefs that the winner owns the managerial competence and the looser does not. However, it preserves the prior belief in having the business ability unaffected. It means that the looser of the competition does not receive a negative signal on his ability to be a competent agent in the future. Whereas, in the *meritocratic procedure* the looser will demonstrate it is less likely he owns the business competence than he previously though. This can be interpreted as a loss of self-confidence if we define self-confidence as the belief in owning a high competence.

Now, let us denote $\Pi^{\gamma}_{j,1} = P(S = 1 \mid d_j = 1)$ the production in second stage in case of an *aristocratic procedure* when agent exerts high effort and $\Pi^{\lambda}_{j,1}$ in case of a *meritocratic*

*procedure*. The stake for the firm is to choose a procedure that maximizes production in second stage (as already mentioned, we will see further in the chapter that the firm also have the objective of incentivizing high effort during the tournament). In other word the purpose is to reveal what king of competence the selection procedure should reveal. For now we assume $b > \pi_{d_j} - \underline{\pi}_{d_j}$ which means that the business task of the principal is more "technical" and hard to complete than the task of the agent in a sense that it is more sensible to ability. It means it is *a priori* in the interest of the firm that the principal has more business ability than his agent because it increases the probability that at least one of the the two business tasks (T2 or T3) will be completed. We also assumed that $b > a$ which means that the managerial task is easier than the business task. Those two assumptions imply that it could be *a priori* efficient to select the principal on his business ability.

We get:

$$\Pi^{\gamma}_{j,1} > \Pi^{\lambda}_{j,1} <=> a\hat{\gamma}_{i,v}\Big[\lambda_i(b + \underline{\pi}_1 - \pi_1) + \pi_1\Big] > a\gamma_i\Big[\hat{\lambda}_{i,v}(b + \underline{\pi}_1 - \pi_1) + \pi_1\Big]$$
$$<=> \hat{\gamma}_{i,v}\lambda_i(b + \underline{\pi}_1 - \pi_1) + \hat{\gamma}_{i,v}\pi_1 > \gamma_i\hat{\lambda}_{i,v}(b + \underline{\pi}_1 - \pi_1) + \gamma_i\pi_1$$

As $\lambda_i = \gamma_i$ it is straightforward that:

$$\Pi^{\gamma}_{j,1} > \Pi^{\lambda}_{j,1} <=> (\hat{\gamma}_{i,v} - \hat{\lambda}_{i,v})\gamma_i(b + \underline{\pi}_1 - \pi_1) + (\hat{\gamma}_{i,v} - \gamma_i)\pi_1 > 0$$

As $\hat{\gamma}_{i,v} - \gamma_i > 0$ according to lemma 2.2, $\Pi^{\gamma}_{j,1} > \Pi^{\lambda}_{j,1}$ will be verified if and only if $\hat{\gamma}_{i,v} \geq \hat{\lambda}_{i,v}$. Namely, the production will be higher with the *aristocratic procedure* if and only if this procedure allows to reveal a higher or an equal level of ability than the *meritocratic procedure*. However, if the *aristocratic procedure* reveals less ability in the first stage it will not be always verified that this procedure maximizes production in the second stage.

**Proposition 2.1.** *To maximize the production in second stage, the firm will choose the aristocratic procedure, that is* $\Pi^{\gamma}_{j,1} > \Pi^{\lambda}_{j,1}$*, even though the business task of the principal is more technical than the business task of the agent,* $b > \pi_{d_j} - \underline{\pi}_{d_j}$*, and more technical than the managerial task,* $b > a$*. This result holds if and only if at the equilibrium the aristocratic procedure reveals an equal or superior level of ability than the meritocratic procedure that is* $\hat{\gamma}_{i,v} \geq \hat{\lambda}_{i,v}$*.*

Nothing at the moment allows us to know which procedure will reveal more ability in equilibrium. This point will be treated in the last subsection. But it is interesting to

understand that the objective of production in second stage is conditioned by the incentive issue of procedure in the first stage. Indeed, the choice of the procedure will change the effort of opponents during the first stage such that they will not reveal the same ability and nothing guarantees that in equilibrium $\hat{\gamma}_{i,v} = \hat{\lambda}_{i,v}$.

However, for the sake of the global interpretation of this result, let us assume for one moment that $\hat{\gamma}_{i,v} = \hat{\lambda}_{i,v}$ is verified. The intuition behind proposition 2.1 would be that bolstering $\hat{\lambda}_{i,v}$ increases the expected efficiency of the principal in task 2 but reduces the expected efficiency of agent in task 3. Even though the task 2 of the principal is more technical and sensible to ability by assumption, the global effect on production of the competition is mitigated by the information the opponent gets about the incompetence of the agent. Let us remind that there are two possibilities to produce a high level of production: completing T1 (managerial task) and T2 (business task of the principal) *or* completing T1 and T3 (business task of the agent). Thus, bolstering $\hat{\lambda}_{i,v}$ increases the chances that T1 and T2 are completed, however it decreases the likelihood that T1 and T3 to be completed. Whereas, this eviction effect will not occur by bolstering $\hat{\gamma}_{i,v}$, as T1 is complementary to the other tasks. As a consequence bolstering $\hat{\gamma}_{i,v}$ increases simultaneously the chances that T1 and T2 are completed and that T1 and T3 are completed.

Now, it is quite intuitive that this result will also holds if $\hat{\gamma}_{i,v} > \hat{\lambda}_{i,v}$. Indeed, it is quite intuitive that if the effect of an increase of $\hat{\gamma}_{i,v}$ is more efficient because it counts twice, that is all the more the case if this increase is superior to the increase of $\hat{\lambda}_{i,v}$. On the contrary, if the increase of $\hat{\lambda}_{i,v}$ is superior this could perfectly compensate the double effect of the increase of $\hat{\gamma}_{i,v}$ in the aristocratic procedure.

### 2.4.2 The nature of legitimacy and inequality of wage

The purpose of this section is to show how aristocratic legitimacy may be a substitute to variable wage as an incentive mechanism; whereas meritocratic legitimacy on the contrary increases moral hazard. Thus, we will focus on the equilibrium behavior in second stage.

Now we assume in stage 2 that the principal can only offer a wage $w_j$ in case of high production and that in case of low production the wage will be null. This will be equivalent to a limited liability constraint in a sense that the principal will be limited to make the agent accountable for his failure. Thus, it will make moral hazard an issue. The payoff of the principal is then very simple $P(S = 1 \mid d_j = 1)(1 - w) + P(S = 0 \mid d_j =$

$1)(0-0) = P(S=1 \mid d_j=1)(1-w_j)$. If we denote $P(S=1 \mid d_j \in \{0,1\}) = \Pi_{j,d_j}$, the program of the principal is then:

$$\begin{aligned} & \max_{w_i} && \Pi_{j,1}(1-w_j) \\ w.r.t. \quad & && \Pi_{j,1}w_j - \psi_2 \geq \Pi_{j,0}w_j \qquad (2.3) \\ & && \Pi_{j,1}w_i - \psi_2 \geq 0 \qquad (2.4) \end{aligned}$$

This program is straightforward to resolve. Indeed, only saturating the incentive constraint, that is to say equation (4), is sufficient and leads to $w_j = \frac{\psi_2}{\Pi_{j,1}-\Pi_{j,0}}$. If we denote $\overline{w}_j$ the equilibrium wage, this leads directly to lemma 2.3.

**Lemma 2.3.** *The equilibrium wage in second stage is:*

$$\overline{w}_j = \frac{\psi_2}{a\hat{\gamma}_{i,v}[\Delta\pi - \hat{\lambda}_{i,v}(\Delta\pi - \Delta\underline{\pi})]}$$

*As a consequence,*

- $\frac{\partial \overline{w}_j}{\partial \hat{\gamma}_{i,v}} < 0$*: increasing the managerial competence, that is to say* $\hat{\gamma}_{i,v}$ *increases, allows to decrease the incentive wage*
- $\frac{\partial \overline{w}_j}{\partial \hat{\lambda}_{i,v}} > 0$*: increasing the business competence, that is to say* $\hat{\lambda}_{i,v}$ *increases, obliges to improve incentive wage.*

*Proof.* See appendix B □

Lemma 2.3 means that the incentive wage does not depend on the business ability $b$ of the principal but only on his managerial ability $a$ and on the business ability of the agent. So far, we compared only relative values by focusing on the variation of $\overline{w}_j$. Let us now focus on absolute value and denote $\overline{w}_j^{\lambda}$ the incentive wage in case of a *meritocratic procedure* and $\overline{w}_j^{\gamma}$ the incentive wage in case of an *aristocratic procedure*. This leads to proposition 2.2.

**Proposition 2.2.** *If* $\lambda_i = \gamma_i$ *then* $\overline{w}_j^{\lambda} > \overline{w}_j^{\gamma}$*: the aristocratic procedure always allows to decrease incentive wage relatively to the meritocratic procedure.*

*Proof.* See appendix C □

Proposition 2.2 means that the incentive wage will *always* be inferior in the *aristocratic procedure*. It is due to the complementarity between task 1 and task 3 whereas task 2 and

task 3 are substitutable to each other. The interpretation is that the managerial task of the principal exacerbates the marginal return of the agent's effort in task 3 such that having a principal with high managerial abilities makes him more optimistic about contributing to make the production of the team completed. On the contrary, if the principal as a high business ability it will not enhance the agent's productivity. Then the agent will rely on him and it will tend to incentivize him to free riding behavior.

Besides, as agent compares himself with the principal with respect to business task, increasing certainty about principal's competence on this task decreases agent self confidence simultaneously. So, the more the principal will be good at the business task, the more the agent will think he is himself incompetent. This *intimidation mechanism* is the core of this chapter and can be seen as a unexpected side effect of tournament. He will then be more pessimistic about his chances of completing task 3 and will demand a higher wage to exert high effort. The fact the gain will be less likely in the eyes of the employee will have to be compensated by the fact the gain will be higher. In some ways, the looser of the competition becomes a burden for the winner whereas in the *aristocratic procedure* this incentive issue is not relevant because the agent has his self-confidence about his business ability preserved in a sense that he belief in owning business ability remains unchanged (lemma 2.2).

This proposition undertones that a principal selected on a managerial task will be more "accepted" in a sense that he will less need to use strong incentives to motivate the agent. It is because the ability the principal owns does not send a bad signal to the agent on his own business ability. He cannot compare himself to the principal such that he does not feel disparaged by his promotion. In other words, after the competition, the self-confidence of the looser is preserved because the task he will complete once agent is different than the selection task. For him, stage 2 will become a fresh start. The consequence is that in a *meritocratic procedure*, the leader will be rejected by his peers because they will feel disregarded of not being promoted. It also suggest that an holistic organization organized with social class (in a sense that a social class would be defined by a shared competence among people that constitute it) will favor more acceptation of leader that a more egalitarian organization. Indeed some one "different", with a different ability or even a different social background or social belongings will be more accepted because it will neutralize rivalries issues.

It also suggests that the hierarchy *between* profession will be more accepted that a hierarchy *within* a profession. A solution would be to choose a criteria different than "experience" or an ability based on passed achievement but to choose a neutral skill specific to leaders tasks to select the leader. In an organization such as audit firms it would be relevant at the moment of co-opting to use commercial abilities or managerial abilities rather than technical skills in accounting for instance to justify promotion in order to maintain the looser motivated. This could be a way to institutionalize the transformation from a profession of employee to another profession: the profession of manager.

### 2.4.3 Culture of humility and culture of performance

The purpose of this section is to study the behavior of opponents during the tournament with respect to the procedure implemented by the firm. The firm wants to choose the procedure that incentivizes the most to exert high effort for both competitors. This issue is directly related to how the more incentivizing procedure will be a crucial stake to maximize global production in stage 2 ( cf. proposition 2.1). As a preliminary work, we need to establish the payoff with respect to a constant effort in first stage in case of success at the tournament (principal side) but also in case of failure (agent side). Finally we will compare the marginal return of effort of the first stage in the two procedures to study the incentive issue.

We denote $P_{P_i}$ the payoff of opponent $i$ in second stage if he becomes principal and $W_j = \Pi_{j,1}\frac{\psi_2}{\Pi_{j,1}-\Pi_{j,0}}$ the expected wage given by $i$ to $j$. It is straightforward to show that:

$$\begin{aligned}
P_{P_i} =& \Pi_{j,1} - W(\hat{\gamma}_{i,v}, \hat{\lambda}_{i,v}) \\
P_{P_i} =& a\hat{\gamma}_{i,v}\left[\hat{\lambda}_{i,v}(b + \underline{\pi}_1 - \pi_1) + \pi_1\right]\left[1 - \frac{\psi_2}{a\hat{\gamma}_{i,v}[\Delta\pi - \hat{\lambda}_{i,v}(\Delta\pi - \underline{\Delta\pi})]}\right]
\end{aligned}$$

Furthermore, we denote $P_{A_i}$ the payoff of $i$ if he becomes agent in second stage.

$$\begin{aligned}
P_{A_i} =& W(\hat{\gamma}_{j,v}, \hat{\lambda}_{j,v}) - \psi_2 \\
P_{A_i} =& a\hat{\gamma}_{j,v}\left[\hat{\lambda}_{j,v}(b + \underline{\pi}_1 - \pi_1) + \pi_1\right]\frac{\psi_2}{a\hat{\gamma}_{j,v}[\Delta\pi - \hat{\lambda}_{j,v}(\Delta\pi - \underline{\Delta\pi})]} - \psi_2
\end{aligned}$$

**Lemma 2.4.** *For opponent i's payoff we have the following properties:*

- $\frac{\partial P_{P_i}}{\partial \hat{\gamma}_{i,v}} > \frac{\partial P_{P_i}}{\partial \hat{\lambda}_{i,v}}$
- $\frac{\partial P_{A_i}}{\partial \hat{\gamma}_{i,d}} > \frac{\partial P_{A_i}}{\partial \hat{\lambda}_{i,d}}$

*Proof.* See appendix D □

So far we focused on derivatives issues with respect to both natures of legitimacy, let us now study and compare the payoffs in the two procedures. For this, we denote $P^{\gamma}_{P_i} = P^{\gamma}_{P_i}(e_i)$ and $P^{\lambda}_{P_i} = P^{\lambda}_{P_i}(e_i)$ respectively the payoff of $i$ if he is the principal in second stage in case of an *aristocratic procedure* and a *meritocratic procedure* with respect to the choice of effort $e_i \in \{0, 1\}$ during the tournament. Then we have $P^{\lambda}_{P_i}(e_i) = \Pi_{j,1}[\hat{\lambda}_{i,v}(e_i)] - W[\hat{\lambda}_{i,v}(e_i)]$ and $P^{\gamma}_{P_i}(e_i) = \Pi_{j,1}[\hat{\gamma}_{i,v}(e_i)] - W[\hat{\gamma}_{i,v}(e_i)]$. Similarly we denote $P^{\gamma}_{A_i} = P^{\gamma}_{A_i}(e_i)$ and $P^{\lambda}_{A_i} = P^{\lambda}_{A_i}(e_i)$ respectively the payoff of $i$ if he is the agent in second stage in case of an *aristocratic procedure* and a *meritocratic procedure* with respect to the choices of efforts of both opponents. Thus we have $P^{\gamma}_{A_i}(e_i) = W[\hat{\gamma}_{i,v}(e_i)] - \psi_2$ and $P^{\lambda}_{A_i}(e_i) = W[\hat{\lambda}_{i,v}(e_i)] - \psi_2$. Then lemma 2.4 leads to proposition 2.3.

**Proposition 2.3.** *Relatively to the aristocratic procedure, the meritocratic procedure provides insurance for the looser of the competition, that is to say for opponent i's payoff we have the following properties:*

- $P^{\gamma}_{P_i}(e_i) > P^{\lambda}_{P_i}(e_i)$
- $P^{\gamma}_{A_i}(e_i) < P^{\lambda}_{A_i}(e_i)$

*Proof.* See appendix E □

Proposition 2.3 means that the *meritocratic procedure* as a function of insurance for the looser because it contains the amplitude of the payoffs in case of victory or defeat and that for two reasons. Firstly it is a pure monetary insurance because loosing the competition reveals he is not competent and thus, it will require a higher wage to incentivize him (cf Proposition 2.2). Secondly it is also a cognitive insurance in a sense that it maintains an optimistic informational environment for the agent. Indeed, loosing the competition gives him information about the high business ability of his leader in task 2. As a consequence he will expect a more likely success in completing the task and receiving indeed his wage,

thanks to the ability of the principal. For this reason the *meritocratic procedure* allows him to have a free riding behavior because he will receive his wage whatever task 2 (exerted by the principal) or task 3 (exerted by the agent) is completed. And so even without exerting high effort because he will always be able rely on the executive's business ability. This is due to the substitutability of the two business tasks but it is also due to the assumption that task 2 is more "technical" than task 3 which was necessary to justify *a priori* that the principal should be selected on his business ability instead of his managerial ability.

On the contrary, the *aristocratic procedure* does not provide insurance to the agent. Indeed, the managerial ability exacerbates the marginal return of the agent's effort such that it will not be necessary to provide a high wage to the agent to incentivize him. And so, in the same proportion that it exacerbates the probability of producing a high level of production for the whole team. It finally has no impact on the rent of the agent. In other words, the cognitive insurance is exactly compensated by the decrease of the incentive wage. Besides, in case of victory, the principal will not have to deal with an incentive issue due to the discouragement of the agent so that his payoff will be higher.

As a consequence, paradoxically, with respect to a constant effort the *meritocratic procedure* rewards more the losers (that is to say the "undeserving" opponent) and penalizes the winner (that is to say the "deserving" opponent) relatively to the *aristocratic procedure*.

From now we are going to compare not only the payoff with respect to a constant effort like we have done until now, but the marginal return of effort during tournament with the *aristocratic procedure* $\Delta P^{\gamma}$ and with the *meritocratic procedure* $\Delta P^{\lambda}$. The purpose is to study the incentive issue of both procedures on efforts in the first stage. Indeed, it is assumed that the firm wants to choose the procedure of selection that will reveal as much as possible the ability of the winner and thus expect the competition to incentivize the highest effort. Indeed, it is quite intuitive that the firm designs a tournament to reveal as much competence as possible in order to maximize production in stage 2. We denote $\Delta P^{\gamma}$ the marginal return of effort in stage 1 in the *aristocratic procedure* and $\Delta P^{\lambda}$ the marginal return of the *meritocratic procedure*. The terms $P_W(1)$ and $P_L(1)$ are the probability of winning and loosing the tournament exerting high effort and the term $P_W(0)$ and $P_L(0)$ are

the probability of winning and loosing the tournament exerting low effort. Thus we have:

$$\Delta P^{\gamma} = P_W(1)P^{\gamma}_{P_i}(1) - P_W(0)P^{\gamma}_{P_i}(0) + P_L(1)P^{\gamma}_{A_i} - P_L(0)P^{\gamma}_{A_i}$$
$$\Delta P^{\lambda} = P_W(1)P^{\lambda}_{P_i}(1) - P_W(0)P^{\lambda}_{P_i}(0) + P_L(1)P^{\lambda}_{A_i}(1) - P_L(0)P^{\lambda}_{A_i}(0)$$

The issue is not trivial because comparing absolute payoff in the second stage is not enough to infer marginal payoff in the first stage. Indeed, the second stage payoffs are endogenous and depend actually on the effort of the first stage as well, and so through the bayesian learning on competence. It is easy to decompose the spread between marginal payoff into a "first-stage effect" which is the variation due exclusively to the probability of winning and loosing the tournament and into a "second-stage effect" due exclusively to the variation of second stage's payoff with respect to effort of the first stage. That leads to:

$$\Delta P^{\gamma} - \Delta P^{\lambda} = \overbrace{\left[P_W(1) - P_W(0)\right]\left[P^{\gamma}_{P_i}(0) - P^{\lambda}_{P_i}(0)\right] + \left[P_L(1) - P_L(0)\right]\left[P^{\gamma}_{A_i} - P^{\lambda}_{A_i}(0)\right]}^{\text{first stage effect}}$$
$$\underbrace{+ P_W(1)\left[P^{\gamma}_{P_i}(1) - P^{\gamma}_{P_i}(0) - [P^{\lambda}_{P_i}(1) - P^{\lambda}_{P_i}(0)]\right] - P_L(1)\left[P^{\lambda}_{A_i}(1) - P^{\lambda}_{A_i}(0)\right]}_{\text{second stage effect}}$$

Let us focus on the "first-stage effect" for now. We know that $P_W(1) - P_W(0) > 0$ and $P^{\gamma}_{P_i}(0) - P^{\lambda}_{P_i}(0) > 0$ (cf. proposition 2.3). Exerting high effort increases the likelihood of winning the competition and the spread of payoff between the aristocratic and the meritocratic procedures in case of victory is positive such that the global effect is positive:

$$\left[P_W(1) - P_W(0)\right]\left[P^{\gamma}_{P_i}(0) - P^{\lambda}_{P_i}(0)\right] > 0$$

Besides $P_L(1) - P_L(0) < 0$ and $P^{\gamma}_{A_i} - P^{\lambda}_{A_i}(0) < 0$ (cf proposition 2.3) which leads to:

$$\left[P_L(1) - P_L(0)\right]\left[P^{\gamma}_{A_i} - P^{\lambda}_{A_i}(0)\right] > 0$$

Increasing effort decreases the probability of loosing but the spread of payoff between the aristocratic and the meritocratic procedures in case of defeat is negative. Thus the opponent loses more but has less chances to lose such that the global effect remains positive.

Thus, $\Delta P^{\gamma} > \Delta P^{\lambda}$ will be verified if the last term, representing exclusively the "second stage effect", is positive. As $P_W(1) > P_L(1)$ this will be verified if:

$$\left[P^{\gamma}_{P_i}(1) - P^{\gamma}_{P_i}(0)\right] - \left[P^{\lambda}_{P_i}(1) - P^{\lambda}_{P_i}(0)\right] - \left[P^{\lambda}_{A_i}(1) - P^{\lambda}_{A_i}(0)\right] + \left[P^{\gamma}_{A_i}(1) - P^{\gamma}_{A_i}(0)\right] > 0$$

We add the term $\left[P^{\gamma}_{A_i}(1) - P^{\gamma}_{A_i}(0)\right]$ because it is null and it improves the understanding of the expression. Indeed, this means that the marginal payoff of the second stage in

the *aristocratic procedure* must be superior to the marginal payoff of the second stage in the *meritocratic procedure*. Thus the first stage will influence the result only through the bayesian inference and not through the probability of wining or losing. This is actually quite intuitive because for both procedures, the assessment technology remains the same such that the first stage will not be a key determinant to compare behaviors in the two procedures.

**Lemma 2.5.** *$\Delta P^{\gamma} > \Delta P^{\lambda}$ if in the meritocratic procedure, by exerting effort the marginal informational rent paid in case of victory is superior to the marginal informational rent received in case of defeat, that is: $W_j^{\lambda}(1) - W_j^{\lambda}(0) \geq W_i^{\lambda}(1) - W_i^{\lambda}(0)$.*

*Proof.* See appendix F □

Lemma 2.5 means that to compare the marginal payoff in the *aristocratic procedure* and the *meritocratic procedure* it will be enough to compare the increase of the rent paid in case of victory to the increase of the rent received in case of defeat with respect to the effort exerted during the tournament (efforts of the first stage interfering through the learning process on abilities). It is because the marginal production will be always higher in *aristocratic procedure* (cf. proposition 2.1), such that only the cost of delegation (related to moral hazard issue) in the global payoff becomes a stake in case he will be the principal. In other words, he knows that the production will be higher but he does not know if the incentive issue will be aggravated or not. It also means that it is sufficient to focus only on the *meritocratic procedure* mostly because the marginal payoff of agent in case of the *aristocratic procedure* is null.

**Lemma 2.6.** *In the meritocratic procedure, the marginal rent paid in case of victory will be higher than the marginal rent received in case of defeat that is: $W_j^{\lambda}(1) - W_j^{\lambda}(0) \geq W_i^{\lambda}(1) - W_i^{\lambda}(0)$ is verified if:*

- *$\hat{\lambda}_i(1,0) > \hat{\lambda}_j(1,0)$ and $\hat{\lambda}_i(0,0) = \hat{\lambda}_j(0,0)$*
- *and if $\hat{\lambda}_i(1,1) = \hat{\lambda}_j(1,1)$ and $\hat{\lambda}_i(0,1) < \hat{\lambda}_j(0,1)$*

*Proof.* See appendix G □

Lemma 2.6 means that in the meritocratic procedure, the spread between the rent paid in case of victory and the rent received in case of defeat depends on the assessment technology, or in other words, on the posterior beliefs. This is due to the fact that the function of production is the same in second stage. Only the weight of one competence relatively to the other will change. This implies that lemma 2.6 is verified if we have an "asymmetric" assessment technology, that is to say $\hat{\lambda}_i(1,0) > \hat{\lambda}_j(1,0)$ and $\hat{\lambda}_i(0,0) = \hat{\lambda}_j(0,0)$ but also $\hat{\lambda}_i(1,1) = \hat{\lambda}_j(1,1)$ and $\hat{\lambda}_i(0,1) < \hat{\lambda}_j(0,1)$. To understand the intuition of this result we can present expression $W_j^\lambda(1) - W_j^\lambda(0) \geq W_i^\lambda(1) - W_i^\lambda(0)$ in the following way:

$$\underbrace{\left[W_j^\lambda(1) - W_i^\lambda(1)\right]}_{\text{Loss of exerting high effort}} + \underbrace{\left[W_i^\lambda(0) - W_j^\lambda(0)\right]}_{\text{Gain of exerting low effort}} > 0 \tag{2.5}$$

Let us focus now on the point of view of agent $i$. The intuition is that, in case his opponent $j$ exert low effort, $\hat{\lambda}_i(1,0) > \hat{\lambda}_j(1,0)$ will imply that $W_j^\lambda(1) > W_i^\lambda(1)$. And then, $\hat{\lambda}_i(0,0) = \hat{\lambda}_j(0,0)$ will imply that $W_j^\lambda(0) = W_i^\lambda(0)$ such that expression (2.5) will be verified. Furthermore, in case this time opponent $j$ exerts low effort, $\hat{\lambda}_i(0,1) < \hat{\lambda}_j(0,1)$ will imply $W_i^\lambda(0) > W_j^\lambda(0)$. Then, $\hat{\lambda}_i(1,1) = \hat{\lambda}_j(1,1)$ will imply $W_i^\lambda(1) = W_j^\lambda(0)$ such that expression (2.5) will be also verified.

Let us interpret more extensively the first case when agent $j$ exerts low effort. Expression $\hat{\lambda}_i(1,0) > \hat{\lambda}_j(1,0)$ means that in the case agent $j$ exert low effort, and if agent $i$ exerts more effort than him, the competence agent $i$ will reveal if he wins will be superior to the competence his opponent will reveal if his opponent wins. Yet, we know that the marginal rent received by the agent in stage 2 is increasing with the competence of the principal as the agent will rely on principal's ability and learn about his own lack of ability (cf. lemma 2.4) such that the principal will have to increase the wage of the agent to avoid free riding behavior. As a consequence for agent $i$, increasing his effort will imply that the marginal rent he would paid in case of victory will be superior to the marginal rent he would received in case of failure. Such that by increasing his effort, he will decrease his payoff if he becomes principal and increase his payoff if he becomes agent. Thus, he has an incentive to exert low effort to reveal as less as possible his ability. If he chooses to exert low effort, then $\hat{\lambda}_i(0,0) = \hat{\lambda}_j(0,0)$ that will imply $W_i^\lambda(0) = W_j^\lambda(0)$ such that the rent he would paid in case of victory would be exactly identical to the rent he would received in case of defeat.

Now, let us explain the case when his opponent agent $j$ exert high effort. Indeed, in that

case, $\hat{\lambda}_i(0,1) < \hat{\lambda}_j(0,1)$ will imply $W_i^{\lambda}(0) > W_j^{\lambda}(0)$. Expression $\hat{\lambda}_i(0,1) < \hat{\lambda}_j(0,1)$ means that if agent $i$ exerts low effort, then his victory will be a weak signal about his ability in comparison with the signal his defeat will reveal about the ability of his opponent. It suggests that there is an opportunity cost of exerting high effort. Indeed, in case of defeat it becomes more interesting to be seen as absolutely incompetent to be able to completely rely on the winner's ability and receive a higher rent. For this reason, there is an incentive to exert low effort to reveal less ability. On the contrary, if he decides to exert high effort he would receive exactly the same rent in case of defeat than the rent paid in case of victory as $\hat{\lambda}_i(1,1) = \hat{\lambda}_j(1,1)$ than implies $W_i^{\lambda}(1) = W_j^{\lambda}(0)$.

**Proposition 2.4.** *Relatively to the aristocratic procedure, the meritocratic procedure favors a culture of humility that is to say $\Delta P^{\gamma} > \Delta P^{\lambda}$ is verified if $\lambda_i = \frac{1}{2}$, $\pi_1 < 1 - \underline{\pi}_1$ and $\pi_0 < 1 - \underline{\pi}_0$:*

*Proof.* See appendix H □

Proposition 2.4 means that, if the condition $\lambda_i = \frac{1}{2}$, $\pi_1 < 1 - \underline{\pi}_1$ and $\pi_0 < 1 - \underline{\pi}_0$ are verified, the *meritocratic procedure* will reduce the marginal return of effort relatively to the *aristocratic procedure* whatever the effort of the opponent. It means the *meritocratic procedure* would be less incentivizing and would favor less the emergence of high effort as a dominant strategy for both competitors. It is because those conditions will allow the conditions of lemma 2.6 to hold that is: $\hat{\lambda}_i(1,0) > \hat{\lambda}_j(1,0)$ and $\hat{\lambda}_i(0,0) = \hat{\lambda}_j(0,0)$ but also $\hat{\lambda}_i(1,1) = \hat{\lambda}_j(1,1)$ and $\hat{\lambda}_i(0,1) < \hat{\lambda}_j(0,1)$. By ripple effect, it will imply that lemma 2.5 will be verified as well and $\Delta P^{\gamma} > \Delta P^{\lambda}$ will hold.

The condition $\lambda_i = \frac{1}{2}$ is straightforward to understand: it means that the competition is *fair* in a sense that none of the opponents starts being *a priori* advantaged. As we assumed $\lambda_i = \gamma_i$, it means it must be verified for both competences. It becomes then quite intuitive that $\hat{\lambda}_{i,v}(1,1) = \hat{\lambda}_{j,v}(1,1)$ and $\hat{\lambda}_{i,v}(0,0) = \hat{\lambda}_{j,v}(0,0)$ will be verified. Indeed, it is quite intuitive that if $\lambda_i = \frac{1}{2}$ (that is to say $\lambda_i = \lambda_j$) and if both opponents choose the same strategy, they will learn exactly the same information on there ability in case of victory or defeat such that $\hat{\lambda}_{i,v} = \hat{\lambda}_{j,v}$ will hold.

The additional conditions $\pi_1 < 1 - \underline{\pi}_1$ and $\pi_0 < 1 - \underline{\pi}_0$ are the one which guarantee that the assessment technology is not symmetric that is to say $\hat{\lambda}_i(1,0) > \hat{\lambda}_j(1,0)$ and $\hat{\lambda}_i(0,1) < \hat{\lambda}_j(0,1)$. Expression $\pi_1 < 1 - \underline{\pi}_1$ means that with high effort the probability of achieving a high level of production with the high competence will be lower than the

probability of achieving a low level of production with the low competence. Similarly, expression $\pi_0 < 1 - \underline{\pi}_0$ means that with a low effort this time, the probability of producing a high level of production with high competence is inferior to the probability of producing a low level of production with low competence. We interpret it means the incompetence is more disadvantageous than the competence is advantageous. These conditions may be interpreted as the conditions that guarantee the *a priori* belief in loosing the competition is higher than the *a priori* belief in winning. And so because even thought incompetence or competence are equally likely (because $\lambda_i = \frac{1}{2}$), being incompetent is more disadvantageous. As a consequence it will make success more informative on competence than failure is informative on incompetence. Indeed, the intuition is that if $i$ wins, he will infer that a high probability of owning the competence must have compensated the fact that competence does not provide a high advantage on the production. Whereas in case of failure, the very disadvantageous effect of incompetence might be sufficient to explain defeat. Much more certainty on owning the competence is required to be optimistic about winning than certainty on owning incompetence is required to be sure about loosing because incompetence is more disadvantageous. In some ways, winning is more "surprising" and implies a high revision of belief relatively to defeat. Those assumptions guarantee that by increasing his effort, agent $i$ will reveal more ability if he wins that his opponent will reveal ability if he becomes principal. As a consequence the marginal informational rent paid in case of victory will be superior to the marginal informational rent received in case of defeat. This will imply that lemma 2.6 will be verified because the increase of $i$'s effort will make $i$ less hard to incentivize in case he fails than his opponent $j$. This in turn will imply lemma 2.5 to be verified as well namely $\Delta P^{\gamma} > \Delta P^{\lambda}$.

Let us explain more extensively what could be the interpretation of proposition 2.4. The first interpretation would be in term of leadership strategy and managerial culture. Proposition 2.4 suggests how a culture of humility can emerge in an organization if a *meritocratic procedure* is chosen whereas a culture of performance would emerge if an *aristocratic procedure* is chosen. Indeed, in a *meritocratic procedure* opponents will anticipate that the more they outperform their competitors, the more they will discourage him in the future and the more they will have to offer him a high wage to incentivize him. As a consequence it becomes interesting to decrease effort in order to hide one's strength in some ways and to keep low profile. We interpret this as an *identification mechanism*, in a

sense that the looser will still believe, in spite of defeat, that him and the winner have a close level of competence, and observing the success of his opponent, he will keep good faith in his future achievements as an employee. On the contrary, the *aristocratic procedure* will tend to favor a totally opposite leadership strategy based on a *differentiation mechanism* where the leader needs to be seen as an exceptional being capable of making extraordinary achievement that average people are not able to. In the *aristocratic procedure*, the more the winner outperformed his opponent, the more it will increase the productivity of the agent in the future without making him having a pessimistic belief about his ability in business task because of his failure at the tournament. This will imply that the more the principal has demonstrated a managerial ability, the more the incentive wage will be lower and the share of the output the principal will keep for himself will be higher.

Proposition 2.4 might shed a new light on academic failure in professionalizing courses. Indeed, we can interpret the *aristocratic procedure* as prestigious high education system based on generalist training (those training teaching knowledge not related to a specific operational task). The model suggests then that in such procedure of selection opponents are more incentivized to exert high effort and they are more incentivized to reveal ability. The reason is the perspective of being propelled at the top of the hierarchy without making monetary concession. Symmetrically, we can interpret the *meritocratic procedure* as professionalizing courses designed to train to specific demand focused on operational task. Proposition 2.4 suggests that the less attractive wage in case of success will not be very incentivizing such that opponents might choose not to exert effort and not to reveal competence. We might interpret this lack of motivation as a reason for academic failure in those kind of trainings.

We argue that proposition 2.4 can also explain a situation of blockage and stasis in a fratricidal struggle. Indeed we could interpret the noisy signal after tournament as a general preference of the organization on an idea or a project and not specifically on a competence. Competing would then consist in elaborating an idea or a project that would seduce the most the organization and that would be designed to be applied in case of victory. As a consequence, the model could capture a situation where two persons compete to become the leader of a team and have different political projects or operational visions for the team (which is a transposition of the business task) but they have the *a priori* belief that both projects have equally chances to be favored by the organization (which is a transposition of the uncertainty on business ability). Loosing the competition will send a

signal that his vision for the team will not be taken into account and valued by the firm and will tend to discourage the looser. Anticipating that, rivals might have interest in not investing to much effort in differentiating one from another about their operational visions for the team. This operational vision can represents a political program for instance during primary election of political parti (in this example the political parti would delegate the evaluation to electors). Two opponents might have different political programs within the same political family that represents different political currents. Proposition 2.4 suggests that it will be in their interests to forsake the idea of investing to much effort in elaborating a high quality political program (i.e a political program that would be widely valued by the electors) in fear of discouraging to much their opponents in case of victory. Indeed, the latter would then interpret is defeat as a signal that his political ideas will not be taken into account in the future. Thus, if second stage represents for instance parliamentary election, the winner of the primary election might then have to make concession on ministerial positions or on member of the parliament positions if he wants his former rival to support him during the national election campaign (in that example, the proportion of ministerial position representing the political current of the looser is a transposition of the incentive wage in the general case). The organization might anticipate that and choose another criteria based on managerial ability or human qualities or more generally on criteria related to the personalities of the opponents and not their programs. The political parti might even define in advance (before the primary election) the major elements of the political program of the parti. It also can be a tacit agreement between the opponents that anticipate the future issue of gathering the different political currents and choose to focus the primary campaign on a different criteria. The consequence could be notably the emergence of ideological vacuum in political campaign.

## 2.5 Conclusion

The aim of this chapter is to study the role of the nature of competence to bolster the legitimacy of an executive. We focus on the one hand on a managerial ability as a criteria of selection and on a second hand on a business ability as another criteria. The first one is easy to master but it is crucial for the production of the team (executive and employee), whereas the second one is very technical and requires a high ability but can

be compensated by the ability of the employee. The implicit issue in this work is that the demonstration of competence of the executive may be either humiliating or reassuring for the employee. If it is humiliating it will imply a rejection, whereas if it is reassuring it will imply acceptation.

Our first result consists in showing that the demonstration of strength will be humiliating if the achievement is on the same task than the one the employee must master himself. However, it will be reassuring if the achievement is on a complementary task such as managerial task. For this reason, our work shed a new light on a substitute to regular monetary incentives. Indeed, the strategy of the firm will be focused on changing the informational environment on the self-confidence of the employee and his confidence in the ability of his executive. In general an model of incentive assume exogenous beliefs and monetary incentive must then take this into account. In this work we made theses beliefs endogenous. Thus revealing the business competence of the executive will reveal the incompetence of the agent and diminish the marginal return of his effort which would necessitate a higher wage in term of incentive. It will be necessary to propose a higher wage to compensate the fact that in the eyes of the agent, his chances of making a high production are little. On the contrary the managerial ability will have a opposite effect: it will increase the marginal return of the employee's effort and it will enable low remuneration.

Our second result is about the incentivize impact of the choice of the evaluation task on effort during the first stage. We showed that under certain assumption an *aristocratic procedure* is more incentivizing than a *meritocratic procedure*. We interpret that such that in a *meritocratic procedure*, contrary to an *aristocratic procedure*, it is more in the interest of opponents to reduce their performances by decreasing their effort in order to hide their abilities to each other. Then they will preserve the self confidence of their future employees in case of victory and it will be less costly to incentivize him. It suggests how a culture of humility could emerge in an organization whereas an *aristocratic procedure* would favor the emergence of a culture of performance.

Our third result is about the strategy of the firm if it wants to maximize the production once the executive is selected. Actually, it will be also efficient to choose managerial ability even though this ability is much easier to master than the business ability and even though the business task of the manager is harder than the one of employee. Its complementary nature will make it crucial to enhance to efficiency of the whole team whereas

the business ability will only enhance this production of the executive. In other words, it is not efficient to reveal information about business ability of the manager because it reveals information about the incompetence of the employee. Besides, as an *aristocratic procedure* is more incentivizing it guarantees that at the equilibrium more ability will be revealed. This guarantees that at the equilibrium an *aristocratic procedure* will maximize production in second stage.

This model suggests several applications. The first result sheds new light on the issue of rejection of authority and more specifically the rejection by the peers. Indeed, it suggests that an employee will accept more a leader selected on a different ability than his own ability. Observing a peer being promoted instead of him would make him feel humiliated by the organization and will entail a lack of motivation to work. Now if we interpret business ability and managerial ability as characteristics of social belonging, it suggests that holistic societies organized by social class will imply more acceptation of authority than egalitarian society. It also suggests that the hierarchy *between* professions, (established through an *aristocratic procedure* such as high education) will be more accepted than the hierarchy *within* a profession (established through a *meritocratic procedure* such as demonstration of business ability in a career).

The second result might be interpreted such that education based on professionalizing courses designed to meet the demands of firms on business task will favor academic failure. Whereas high education based on more generalist trainings will allow to reveal more ability. Indeed, in professionalizing courses opponents anticipate that their rewards in case of victory could not be enough relatively to their rewards in case of failure such that it is not even worth working. What is quite counter intuitive in this prediction about academic failure is that this is not due to the actual competence of opponents (as both opponents are assumed *a priori* equally competent in business ability and managerial ability in both procedures) but it is due to egalitarian culture that emerges through the procedure of selection. On the contrary, in generalist training the reward in case of success is higher because inequality of wage will be much more accepted and as a consequence, opponents will be much more incentivized to reveal abilities.

We argue our second result could also explain a situation of blockage in fratricidal struggle and particularly in political parti when it comes to choose a leader and candidate for the next national election. Indeed, it is possible to interpret the signal at the end of

the tournament not as a competence like we did previously, but as information on the preference of the organization on an idea, a project or a way of governing. Thus, exerting effort would consist in either elaborating a political program based on political ideology (which would be a transposition of the business ability we have previously discussed) or to develop a reputation on one's way of governing (which would be a transposition of managerial ability). Our result suggests that each opponent anticipates that if the organization widely prefer his program relatively to the other, the looser of the competition will infer that his political program will never be valued by the parti. In the perceptive of national election he might demand high concession (on ministerial position for instance) to bring his support to the new leader during the forthcoming campaign. This will be an incentive for a future leader to forsake the idea of exerting too much effort in elaborating a political program during the tournament to limit the extent of his victory. The parti might anticipate that and deliberately choose to select a leader on a different criteria such that his way of governing or more generally his personality. This could explain notably ideological vacuum in primary election for instance.

One of the limit of our work is how the first stage is modeled. Indeed first we did not formalize the behavior of the organization as a maximization program and we only focused on the spread between the marginal payoff of both procedures for opponents. This allowed us to capture the incentive issue for the organization during the tournament but it concealed some complexity. Indeed, the organization might support some cost implementing a procedure that would be different between an *aristocratic procedure* and a *meritocratic procedure*. We could notably imagine that an *aristocratic procedure* would generate a higher cost for a firm. Indeed, it could be easier for a firm to assess on business ability because it is precisely the ability on which workers are specialized. It could be also less costly as it could be sufficient to observe achievements of an employee on a productive task whereas the assessment of managerial ability requires a probation period which generates then an opportunity cost. This could explain notably why a *meritocratic procedure* could remain implemented in organization whereas an *aristocratic procedure* seems finally more incentivizing and productive.

Another limit of our work is assumptions on the production function in stage 2. We could imagine a case where there are no uncertainty on the managerial ability required for the principal. It would capture a case where the managerial task is so easy to master

that it would be reasonable to assume that anybody would be able to master it. As a consequence, revealing ability of the principal on this task would be useless. This assumption would naturally modify the results of the model and we could imagine to find conditions that would make a *meritocratic procedure* more efficient for the global output and more incentivizing during the tournament. It could also be interesting to find the conditions that guarantee that in spite of the managerial task being mastered by anyone, it would be still more efficient to select leader on this criteria because of incentives issues in second stage due to rivalry's issues.

Finally, in further research we think it would be interesting to assume that principal and agent never compete against each other but enter the firm at a different time. This assumption would may be allow to neutralize the rivalry's issue like the choice of managerial ability as criteria of selection did, guaranteeing simultaneously that the organization could select on business competence. This would avoid the cost of establishing probation period to evaluate managerial ability. Besides, we could imagine that being aware his executive was selected on business ability would be highly motivating to work hard for an employee. A high employee turnover would then become a major stake for the firm to avoid rivalry to emerge.

## Appendix

### A/ Proof lemma 2.1

- We will have $x_{i,v}(1, e_j) > x_{i,v}(0, e_j)$ verified if $\frac{\partial x_{i,v}(e_i,e_j)}{\partial e_i} > 0$. We know that:

$$x_{i,v}(e_i, e_j) = \frac{x_i \pi_{e_i}(1 - \underline{\pi}_{e_j})}{x_i \pi_{e_i}(1 - \underline{\pi}_{e_j}) + (1 - x_i)\underline{\pi}_{e_i}(1 - \pi_{e_j})}$$

  We denote $D = x_i \pi_{e_i}(1 - \underline{\pi}_{e_j}) + (1 - x_i)\underline{\pi}_{e_i}(1 - \pi_{e_j})$. And we know that $\pi_{e_i} = e_i\theta_H + \epsilon$ and $\underline{\pi}_{e_i} = e_i\theta_L + \epsilon$. Thus we have:

$$\begin{aligned}\frac{\partial x_{i,v}(e_i, e_j)}{\partial e_i} = \Big[ & x_i(1 - \underline{\pi}_{e_j})\theta_H[x_i \pi_{e_i}(1 - \underline{\pi}_{e_j}) + (1 - x_i)\underline{\pi}_{e_i}(1 - \pi_{e_j})] \\ & - x_i \pi_{e_i}(1 - \underline{\pi}_{e_j})[x_i(1 - \underline{\pi}_{e_j})\theta_H + (1 - x_i)(1 - \pi_{e_j})\theta_L] \Big] \Big/ D^2\end{aligned}$$

Let us focus on the sign of the numerator N.

$$\begin{aligned}N > 0 =& x_i(1-\underline{\pi}_{e_j})\theta_H\Big[x_i\pi_{e_i}(1-\underline{\pi}_{e_j})+(1-x_i)\underline{\pi}_{e_i}(1-\pi_{e_j})\Big]\\ &- x_i\pi_{e_i}(1-\underline{\pi}_{e_j})\Big[x_i(1-\underline{\pi}_{e_j})\theta_H+(1-x_i)(1-\pi_{e_j})\theta_L\Big] > 0\\ N > 0 =& x_i(1-\underline{\pi}_{e_j})\theta_H x_i\pi_{e_i}(1-\underline{\pi}_{e_j})+x_i(1-\underline{\pi}_{e_j})\theta_H(1-x_i)\underline{\pi}_{e_i}(1-\pi_{e_j})\\ &- x_i\pi_{e_i}(1-\underline{\pi}_{e_j})x_i(1-\underline{\pi}_{e_j})\theta_H - x_i\pi_{e_i}(1-\underline{\pi}_{e_j})(1-x_i)(1-\pi_{e_j})\theta_L > 0\end{aligned}$$

It leads to:

$$\begin{aligned}N > 0 =& x_i(1-\underline{\pi}_{e_j})\theta_H(1-x_i)\underline{\pi}_{e_i}(1-\pi_{e_j}) - x_i\pi_{e_i}(1-\underline{\pi}_{e_j})(1-x_i)(1-\pi_{e_j})\theta_L > 0\\ N > 0 =& x_i(1-\underline{\pi}_{e_j})(1-x_i)(1-\pi_{e_j})\Big[\theta_H\underline{\pi}_{e_i}-\pi_{e_i}\theta_L\Big] > 0\end{aligned}$$

The sign of N only depends on the sign of $\theta_H\underline{\pi}_{e_i}-\pi_{e_i}\theta_L$

$$\begin{aligned}\theta_H\underline{\pi}_{e_i}-\pi_{e_i}\theta_L =& \theta_H(e_i\theta_L+\epsilon)-\theta_L(e_i\theta_H+\epsilon)\\ \theta_H\underline{\pi}_{e_i}-\pi_{e_i}\theta_L =& \theta_H\theta_L e_i+\theta_H\epsilon-\theta_L\theta_H e_i-\theta_L\epsilon\\ \theta_H\underline{\pi}_{e_i}-\pi_{e_i}\theta_L =& \theta_H\epsilon-\theta_L\epsilon\end{aligned}$$

$\theta_H\epsilon-\theta_L\epsilon > 0$ is always verified. Thus $\frac{\partial x_{i,v}(e_i,e_j)}{\partial e_i} > 0$ and $x_{i,v}(1,e_j) > x_{i,v}(0,e_j)$.

- We will have $x_{i,d}(1,e_j) < x_{i,d}(0,e_j)$ verified if $\frac{\partial x_{i,d}(e_i,e_j)}{\partial e_i} < 0$. We know that:

$$x_{i,d}(e_i,e_j) = \frac{x_i(1-\pi_{e_i})\underline{\pi}_{e_j}}{x_i(1-\pi_{e_i})\underline{\pi}_{e_j}+(1-x_i)(1-\underline{\pi}_{e_i})\pi_{e_j}}$$

We denote $E = x_i(1-\pi_{e_i})\underline{\pi}_{e_j}+(1-x_i)(1-\underline{\pi}_{e_i})\pi_{e_j}$. Thus we have:

$$\begin{aligned}\frac{\partial x_{i,d}(e_i,e_j)}{\partial e_i} =& \Big[-x_i\underline{\pi}_{e_j}\theta_H[x_i(1-\pi_{e_i})\underline{\pi}_{e_j}+(1-x_i)(1-\underline{\pi}_{e_i})\pi_{e_j}]\\ &- x_i(1-\pi_{e_i})\underline{\pi}_{e_j}[-x_i\underline{\pi}_{e_j}\theta_H-(1-x_i)\pi_{e_j}\theta_L]\Big]\Big/E^2\end{aligned}$$

Let us focus on the numerator that we denote F.

$$\begin{aligned}F =& -x_i\underline{\pi}_{e_j}\theta_H\Big[x_i(1-\pi_{e_i})\underline{\pi}_{e_j}+(1-x_i)(1-\underline{\pi}_{e_i})\pi_{e_j}\Big]\\ &- x_i(1-\pi_{e_i})\underline{\pi}_{e_j}\Big[-x_i\underline{\pi}_{e_j}\theta_H-(1-x_i)\pi_{e_j}\theta_L\Big]\\ F =& -x_i\underline{\pi}_{e_j}\theta_H x_i(1-\pi_{e_i})\underline{\pi}_{e_j}-x_i\underline{\pi}_{e_j}\theta_H(1-x_i)(1-\underline{\pi}_{e_i})\pi_{e_j}\\ &+x_i(1-\pi_{e_i})\underline{\pi}_{e_j}x_i\underline{\pi}_{e_j}\theta_H+x_i(1-\pi_{e_i})\underline{\pi}_{e_j}(1-x_i)\pi_{e_j}\theta_L\end{aligned}$$

Then it leads to:

$$F = - x_i \underline{\pi}_{e_j} \theta_H (1 - x_i)(1 - \underline{\pi}_{e_i}) \pi_{e_j} + x_i (1 - \pi_{e_i}) \underline{\pi}_{e_j} (1 - x_i) \pi_{e_j} \theta_L$$

$$F = x_i \underline{\pi}_{e_j} (1 - x_i) \pi_{e_j} \Big[ - \theta_H (1 - \underline{\pi}_{e_i}) + \theta_L (1 - \pi_{e_i}) \Big]$$

As $\theta_H > \theta_L$ and $1 - \underline{\pi}_{e_j} > 1 - \pi_{e_j}$ then $-\theta_H(1 - \underline{\pi}_{e_j}) + \theta_L(1 - \pi_{e_j}) < 0$ and $F < 0$. As a conclusion we have $\frac{\partial x_{i,d}(e_i, e_j)}{\partial e_i} < 0$ so $x_{i,d}(1, e_j) < x_{i,d}(0, e_j)$ is verified.

- Let us prove that $x_{i,d}(e_i, e_j) < x_i$. We have:

$$\frac{x_i (1 - \pi_{e_i}) \underline{\pi}_{e_j}}{x_i (1 - \pi_{e_i}) \underline{\pi}_{e_j} + (1 - x_i)(1 - \underline{\pi}_{e_i}) \pi_{e_j}} < x_i$$

After simplifying by $x_i$, this expression is equivalent to:

$$\begin{aligned} (1 - \pi_{e_i}) \underline{\pi}_{e_j} (1 - x_i) - (1 - x_i)(1 - \underline{\pi}_{e_i}) \pi_{e_j} &< 0 \\ (1 - \pi_{e_i}) \underline{\pi}_{e_j} - (1 - \underline{\pi}_{e_i}) \pi_{e_j} &< 0 \end{aligned}$$

Which is always verified because $(1 - \pi_{e_i}) < (1 - \underline{\pi}_{e_i})$ and $\underline{\pi}_{e_j} < \pi_{e_j}$.

- Let us prove that $x_{i,v}(e_i, e_j) > x_i$. We have:

$$\frac{x_i \pi_{e_i} (1 - \underline{\pi}_{e_j})}{x_i \pi_{e_i} (1 - \underline{\pi}_{e_j}) + (1 - x_i) \underline{\pi}_{e_i} (1 - \pi_{e_j})} > x_i$$

After simplifying by $x_i$, this expression is equivalent to:

$$\begin{aligned} \pi_{e_i} (1 - \underline{\pi}_{e_j})(1 - x_i) - (1 - x_i) \underline{\pi}_{e_i} (1 - \pi_{e_j}) &> 0 \\ \pi_{e_i} (1 - \underline{\pi}_{e_j}) - \underline{\pi}_{e_i} (1 - \pi_{e_j}) &> 0 \end{aligned}$$

Which is always verified because $(1 - \pi_{e_i}) < (1 - \underline{\pi}_{e_i})$ and $\underline{\pi}_{e_j} < \pi_{e_j}$.

### B/ Proof lemma 2.3

Let us prove that $w^* = \frac{\psi_2}{a\hat{\gamma}_{i,v}[\Delta\pi - \hat{\lambda}_{i,v}(\Delta\pi - \Delta\underline{\pi})]}$

We have:

$$\begin{aligned}
\Pi_1 - \Pi_0 =& a\hat{\gamma}_{i,v}\Big[b\hat{\lambda}_{i,v} + \pi_1(1-\hat{\lambda}_{i,v}) + \underline{\pi}_1\hat{\lambda}_{i,v}\Big] \\
& - a\hat{\gamma}_{i,v}\Big[b\hat{\lambda}_{i,v} + \pi_0(1-\hat{\lambda}_{i,v}) + \underline{\pi}_0\hat{\lambda}_{i,v}\Big] \\
\Pi_1 - \Pi_0 =& a\hat{\gamma}_{i,v}\Big[b\hat{\lambda}_{i,v} + \pi_1(1-\hat{\lambda}_{i,v}) - b\hat{\lambda}_{i,v} \\
& - \pi_0(1-\hat{\lambda}_{i,v}) + \hat{\lambda}_{i,v}(\underline{\pi}_1 - \underline{\pi}_0)\Big] \\
\Pi_1 - \Pi_0 =& a\hat{\gamma}_{i,v}\Big[(1-\hat{\lambda}_{i,v})\Delta\pi + \hat{\lambda}_{i,v}\underline{\Delta\pi}\Big] \\
\Pi_1 - \Pi_0 =& a\hat{\gamma}_{i,v}\Big[\Delta\pi - \hat{\lambda}_{i,v}(\Delta\pi - \Delta\underline{\pi})\Big]
\end{aligned}$$

As $w^* = \frac{\psi_2}{\Pi_1 - \Pi_0}$, thus: $w^* = \frac{\psi_2}{a\hat{\gamma}_{i,v}[\Delta\pi - \hat{\lambda}_{i,v}(\Delta\pi - \Delta\underline{\pi})]}$

### C/ Proof proposition 2.2

Let us demonstrate that $\overline{w}_i^{\lambda} > \overline{w}_i^{\gamma}$ if $\lambda_i = \gamma_i$. We denote:

- $\overline{w}_i^{\lambda}(x') = \overline{w}_i^{\lambda}(\hat{\gamma}_{i,v} = x_0, \hat{\lambda}_{i,v} = x') = \frac{\psi_2}{ax_0[\Delta\pi - x'(\Delta\pi - \Delta\underline{\pi})]}$
- $\overline{w}_i^{\gamma}(x) = \overline{w}_i^{\lambda}(\hat{\gamma}_{i,v} = x, \hat{\lambda}_{i,v} = x_0) = \frac{\psi_2}{ax[\Delta\pi - x_0(\Delta\pi - \Delta\underline{\pi})]}$

With $(x_0; x) \in (0,1)^2$ such that $x \geq x_0$ and $(x_0; x') \in (0,1)^2$ such that $x' \geq x_0$. If $x = x_0$ then $\overline{w}_i^{\lambda}(x_0) = \overline{w}_i^{\gamma}(x_0) = \frac{\psi_2}{ax_0[\Delta\pi - x_0(\Delta\pi - \Delta\underline{\pi})]}$. As $\lambda_i = \gamma_i$ we denote $x_0$ as the exante self confidence in managerial ability (in case of an aristocratic procedure) and in business ability (in case of a meritocratic procedure). We also denote $x'$ as the expost self confidence in business ability in the *meritocratic procedure* and $x$ the expost self confidence in managerial ability in the *aristocratic procedure*. $x \neq x'$ because in spite of the assessing technology being identical in both procedures, both procedures do not reveal the same level of ability (as equilibrium efforts in stage 1 might be different). Then we have:

- $x' > x_0 <=> \overline{w}_i^{\lambda}(x') > \overline{w}_i^{\lambda}(x_0)$ as $\frac{\partial \overline{w}_i^{\lambda}(x)}{\partial x} > 0$ (cf lemma 2.3)
- $x > x_0 <=> \overline{w}_i^{\gamma}(x) < \overline{w}_i^{\gamma}(x_0)$ as $\frac{\partial \overline{w}_i^{\gamma}(x)}{\partial x} < 0$ (cf lemma 2.3)

Yet $\overline{w}_i^{\lambda}(x_0) = \overline{w}_i^{\gamma}(x_0)$ so $\overline{w}_i^{\lambda}(x') > \overline{w}_i^{\gamma}(x)$ thus $\overline{w}_i^{\lambda} > \overline{w}_i^{\gamma}$.

## D/ Proof Lemma 2.4

1) Let us prove that $\frac{\partial P_{P_i}}{\partial \hat{\gamma}_{i,v}} > \frac{\partial P_{P_i}}{\partial \hat{\lambda}_{i,v}}$.

$$P_{P_i} = a\hat{\gamma}_{i,v}\left[\hat{\lambda}_{i,v}(b+\underline{\pi}_1-\pi_1)+\pi_1\right]\left[1-\frac{\psi_2}{a\hat{\gamma}_{i,v}[\Delta\pi-\hat{\lambda}_{i,v}(\Delta\pi-\underline{\Delta\pi})]}\right]$$

$$P_{P_i} = a\hat{\gamma}_{i,v}\left[\hat{\lambda}_{i,v}(b+\underline{\pi}_1-\pi_1)+\pi_1\right]-\frac{\psi_2 a\hat{\gamma}_{i,v}\left[\hat{\lambda}_{i,v}(b+\underline{\pi}_1-\pi_1)+\pi_1\right]}{a\hat{\gamma}_{i,v}[\Delta\pi-\hat{\lambda}_{i,v}(\Delta\pi-\underline{\Delta\pi})]}$$

$$P_{P_i} = a\hat{\gamma}_{i,v}\left[\hat{\lambda}_{i,v}(b+\underline{\pi}_1-\pi_1)+\pi_1\right]-\frac{\psi_2\left[\hat{\lambda}_{i,v}(b+\underline{\pi}_1-\pi_1)+\pi_1\right]}{[\Delta\pi-\hat{\lambda}_{i,v}(\Delta\pi-\underline{\Delta\pi})]}$$

Thus $\frac{\partial P_{P_i}}{\partial \hat{\gamma}_{i,v}} = a\left[\hat{\lambda}_{i,v}(b+\underline{\pi}_1-\pi_1)+\pi_1\right]$ and is positive.

$$\frac{\partial P_{P_i}}{\partial \hat{\lambda}_{i,v}} = a\hat{\gamma}_{i,v}(b+\underline{\pi}_1-\pi_1) - \left[-\psi_2\frac{[\hat{\lambda}_{i,v}(b+\underline{\pi}_1+\pi_1][-(\Delta\pi-\underline{\Delta\pi})]-[b+\underline{\pi}_1+\pi_1][\Delta\pi-\hat{\lambda}_{i,v}(\Delta\pi-\underline{\Delta\pi})]}{[\Delta\pi-\hat{\lambda}_{i,v}(\Delta\pi-\underline{\Delta\pi})]^2}\right]$$

$$\frac{\partial P_{P_i}}{\partial \hat{\lambda}_{i,v}} = a\hat{\gamma}_{i,v}(b+\underline{\pi}_1-\pi_1) - \left[\psi_2\frac{[\hat{\lambda}_{i,v}(b+\underline{\pi}_1+\pi_1](\Delta\pi-\underline{\Delta\pi})+[b+\underline{\pi}_1+\pi_1][\Delta\pi-\hat{\lambda}_{i,v}(\Delta\pi-\underline{\Delta\pi})]}{[\Delta\pi-\hat{\lambda}_{i,v}(\Delta\pi-\underline{\Delta\pi})]^2}\right]$$

As a consequence we have:

$$\frac{\partial P_{P_i}}{\partial \hat{\gamma}_{i,v}} - \frac{\partial P_{P_i}}{\partial \hat{\lambda}_{i,v}} > 0 <=> a\left[\hat{\lambda}_{i,v}(b+\underline{\pi}_1-\pi_1)+\pi_1\right] - a\hat{\gamma}_{i,v}(b+\underline{\pi}_1-\pi_1) + \left[\psi_2\frac{[\hat{\lambda}_{i,v}(b+\underline{\pi}_1+\pi_1](\Delta\pi-\underline{\Delta\pi})+[b+\underline{\pi}_1+\pi_1][\Delta\pi-\hat{\lambda}_{i,v}(\Delta\pi-\underline{\Delta\pi})]}{[\Delta\pi-\hat{\lambda}_{i,v}(\Delta\pi-\underline{\Delta\pi})]^2}\right] > 0$$

Which is verified if $a\left[\hat{\lambda}_{i,v}(b+\underline{\pi}_1-\pi_1)+\pi_1\right] - a\hat{\gamma}_{i,v}(b+\underline{\pi}_1-\pi_1) > 0$. Yet, this is always verified because it is equivalent to $\frac{\partial \Pi_1}{\partial \hat{\gamma}_{i,v}} - \frac{\partial \Pi_1}{\partial \hat{\lambda}_{i,v}} > 0$ which is always verified (cf proposition 2.1).

2) Let us prove that $\frac{\partial P_{A_i}}{\partial \hat{\gamma}_{j,v}} < \frac{\partial P_{A_i}}{\partial \hat{\lambda}_{j,v}}$ and $\frac{\partial P_{A_i}}{\partial \hat{\gamma}_{i,v}} > \frac{\partial P_{A_i}}{\partial \hat{\lambda}_{i,v}}$

We have:

$$P_{A_i} = a\hat{\gamma}_{j,v}\left[\hat{\lambda}_{j,v}(b+\underline{\pi}_1-\pi_1)+\pi_1\right]\frac{\psi_2}{a\hat{\gamma}_{j,v}[\Delta\pi-\hat{\lambda}_{j,v}(\Delta\pi-\underline{\Delta\pi})]}-\psi_2$$

$$P_{A_i} = \frac{\psi_2\left[\hat{\lambda}_{j,v}(b+\underline{\pi}_1-\pi_1)+\pi_1\right]}{[\Delta\pi-\hat{\lambda}_{j,v}(\Delta\pi-\underline{\Delta\pi})]}-\psi_2$$

It is straight forward that $\frac{\partial P_{A_i}}{\partial\hat{\gamma}_{j,v}}=0$

$$\frac{\partial P_{A_i}}{\partial\hat{\lambda}_{j,v}} = -\psi_2\frac{[\hat{\lambda}_{j,v}(b+\underline{\pi}_1+\pi_1)[-(\Delta\pi-\underline{\Delta\pi})]-[b+\underline{\pi}_1+\pi_1][\Delta\pi-\hat{\lambda}_{j,v}(\Delta\pi-\underline{\Delta\pi})]}{[\Delta\pi-\hat{\lambda}_{i,v}(\Delta\pi-\underline{\Delta\pi})]^2}$$

$$\frac{\partial P_{A_i}}{\partial\hat{\lambda}_{j,v}} = \psi_2\frac{[\hat{\lambda}_{i,v}(b+\underline{\pi}_1+\pi_1](\Delta\pi-\underline{\Delta\pi})+[b+\underline{\pi}_1+\pi_1][\Delta\pi-\hat{\lambda}_{i,v}(\Delta\pi-\underline{\Delta\pi})]}{[\Delta\pi-\hat{\lambda}_{i,v}(\Delta\pi-\underline{\Delta\pi})]^2}$$

Thus $\frac{\partial P_{A_i}}{\partial\hat{\lambda}_{j,v}}>0=\frac{\partial P_{A_i}}{\partial\hat{\gamma}_{j,v}}$. We also have:

$$P_{A_i} = \frac{\psi_2\left[(1-\hat{\lambda}_{i,d})(b+\underline{\pi}_1-\pi_1)+\pi_1\right]}{[\Delta\pi-(1-\hat{\lambda}_{i,d})(\Delta\pi-\underline{\Delta\pi})]}-\psi_2$$

Which leads to:

$$\frac{\partial P_{A_i}}{\partial\hat{\lambda}_{i,d}} = -\psi_2\frac{[(1-\hat{\lambda}_{i,d})(b+\underline{\pi}_1-\pi_1)+\pi_1](\Delta\pi-\underline{\Delta\pi})+[b+\underline{\pi}_1-\pi_1][\Delta\pi-(1-\hat{\lambda}_{i,d})(\Delta\pi-\underline{\Delta\pi})]}{[\Delta\pi-(1-\hat{\lambda}_{i,d})(\Delta\pi-\underline{\Delta\pi})]^2}$$

Which is always negative. Thus we have $\frac{\partial P_{A_i}}{\partial\hat{\lambda}_{i,d}}<0=\frac{\partial P_{A_i}}{\partial\hat{\gamma}_{i,d}}$

### E/ Proof of Proposition 2.3

Let us prove that $P^{\gamma}_{P_i}>P^{\lambda}_{P_i}$ and $P^{\gamma}_{A_i}<P^{\lambda}_{A_i}$. We denote:

- $P^{\gamma}_{P_i}$ so that:

$$P^{\gamma}_{P_i}(y)=P_{P_i}(\hat{\gamma}_{i,v}=y;\hat{\lambda}_{i,v}=y_0)=ay\left[y_0(b+\underline{\pi}_1-\pi_1)+\pi_1\right]-\frac{\psi_2\left[y_0(b+\underline{\pi}_1-\pi_1)+\pi_1\right]}{[\Delta\pi-y_0(\Delta\pi-\underline{\Delta\pi})]}$$

- $P^{\lambda}_{P_i}$ so that:

$$P^{\lambda}_{P_i}(y)=P_{P_i}(\hat{\gamma}_{i,v}=y_0;\hat{\lambda}_{i,v}=y)=ay_0\left[y(b+\underline{\pi}_1-\pi_1)+\pi_1\right]-\frac{\psi_2\left[y(b+\underline{\pi}_1-\pi_1)+\pi_1\right]}{[\Delta\pi-y(\Delta\pi-\underline{\Delta\pi})]}$$

Thus $P^{\gamma}_{P_i}(y_0)=P^{\lambda}_{P_i}(y_0)$. Now we have two cases:

- In the case where $\frac{\partial P_{P_i}}{\partial \hat{\lambda}_{i,v}} > 0$

$$\begin{aligned} y &> y_0 \\ \text{implies } P^{\gamma}_{P_i}(y) &> P^{\gamma}_{P_i}(y_0) \\ \text{and } P^{\lambda}_{P_i}(y) &> P^{\lambda}_{P_i}(y_0) \end{aligned}$$

As $P^{\gamma}_{P_i}(y_0) = P^{\lambda}_{P_i}(y_0)$ we can infer that $P^{\gamma}_{P_i}(y) > P^{\lambda}_{P_i}(y)$ because $\frac{\partial P_{P_i}}{\partial \hat{\gamma}_{i,v}} > \frac{\partial P_{P_i}}{\partial \hat{\lambda}_{i,v}}$, that is to say managerial ability "increases faster" the payoff.

- In the case where $\frac{\partial P_{P_i}}{\partial \hat{\lambda}_{i,v}} < 0$

$$\begin{aligned} y &> y_0 \\ \text{implies } P^{\gamma}_{P_i}(y) &> P^{\gamma}_{P_i}(y_0) \\ \text{and } P^{\lambda}_{P_i}(y) &< P^{\lambda}_{P_i}(y_0) \end{aligned}$$

As $P^{\gamma}_{P_i}(y_0) = P^{\lambda}_{P_i}(y_0)$ it is straightforward that $P^{\gamma}_{P_i}(y) > P^{\lambda}_{P_i}(y)$.

Besides, we denote:

- $P^{\gamma}_{A_i}$ so that:

$$P^{\gamma}_{A_i}(y) = P_{A_i}(\hat{\gamma}_{i,d} = y; \hat{\lambda}_{i,d} = y_0) = \frac{\psi_2\Big[(1-y_0)(b+\underline{\pi}_1-\pi_1)+\pi_1\Big]}{[\Delta\pi-(1-y_0)(\Delta\pi-\underline{\Delta\pi})]} - \psi_2$$

- $P^{\lambda}_{A_i}$ so that:

$$P^{\lambda}_{A_i}(y) = P_{A_i}(\hat{\gamma}_{i,d} = y_0; \hat{\lambda}_{i,d} = y) = \frac{\psi_2\Big[(1-y)(b+\underline{\pi}_1-\pi_1)+\pi_1\Big]}{[\Delta\pi-(1-y)(\Delta\pi-\underline{\Delta\pi})]} - \psi_2$$

Thus $P^{\gamma}_{A_i}(y_0) = P^{\lambda}_{A_i}(y_0)$.
As we know that $\frac{\partial P_{A_i}}{\partial \hat{\lambda}_{i,d}} < 0$ and $\frac{\partial P_{A_i}}{\partial \hat{\gamma}_{i,d}} = 0$

$$\begin{aligned} y &< y_0 \\ \text{implies } P^{\gamma}_{A_i}(y) &= P^{\gamma}_{A_i}(y_0) \\ \text{and } P^{\lambda}_{A_i}(y) &> P^{\lambda}_{A_i}(y_0) \end{aligned}$$

As $P^{\gamma}_{A_i}(y_0) = P^{\lambda}_{A_i}(y_0)$ it is straight forward that $P^{\gamma}_{A_i}(y) < P^{\lambda}_{A_i}(y)$.

### G/ Proof Lemma 2.5

Let us prove that $\Delta P^\gamma > \Delta P^\lambda$ if $W_j^\lambda(1) - W_j^\lambda(0) \geq W_i^\lambda(1) - W_i^\lambda(0)$ and $\theta_L \geq 0$.

1) Let us prove that $\Delta P^\gamma > \Delta P^\lambda$ if $\left[P_{P_i}^\gamma(1) - P_{P_i}^\gamma(0)\right] - \left[P_{P_i}^\lambda(1) - P_{P_i}^\lambda(0)\right] - \left[P_{A_i}^\lambda(1) - P_{A_i}^\lambda(0)\right] > 0$.
We have:

$$\Delta P^\gamma = P_W(1)P_{P_i}^\gamma(1) - P_W(0)P_{P_i}^\gamma(0) + P_L(1)P_{A_i}^\gamma(1) - P_L(0)P_{A_i}^\gamma(0)$$
$$\Delta P^\gamma = P_W(1)P_{P_i}^\gamma(1) - P_W(1)P_{P_i}^\gamma(0) + P_W(1)P_{P_i}^\gamma(0) - P_W(0)P_{P_i}^\gamma(0) + P_L(1)P_{A_i}^\gamma(1) - P_L(0)P_{A_i}^\gamma(0)$$
$$\Delta P^\gamma = P_W(1)\left[P_{P_i}^\gamma(1) - P_{P_i}^\gamma(0)\right] + P_{P_i}^\gamma(0)\left[P_W(1) - P_W(0)\right] + P_{A_i}^\gamma\left[P_L(1) - P_L(0)\right]$$

As $P_{A_i}^\gamma(1) = P_{A_i}^\gamma(0)$. We also have:

$$\begin{aligned}\Delta P^\lambda =& P_W(1)P_{P_i}^\lambda(1) - P_W(1)P_{P_i}^\lambda(0) + P_W(1)P_{P_i}^\lambda(0) - P_W(0)P_{P_i}^\lambda(0)\\ &+ P_L(1)P_{A_i}^\lambda(1) - P_L(1)P_{A_i}^\lambda(0) + P_L(1)P_{A_i}^\lambda(0) - P_L(0)P_{A_i}^\lambda(0)\\ \Delta P^\lambda =& P_W(1)\left[P_{P_i}^\lambda(1) - P_{P_i}^\lambda(0)\right] + P_{P_i}^\lambda(0)\left[P_W(1) - P_W(0)\right]\\ &+ P_L(1)\left[P_{A_i}^\lambda(1) - P_{A_i}^\lambda(0)\right] + P_{A_i}^\lambda(0)\left[P_L(1) - P_L(0)\right]\end{aligned}$$

That leads to:

$$\begin{aligned}\Delta P^\gamma - \Delta P^\lambda =& \left[P_W(1) - P_W(0)\right]\left[P_{P_i}^\gamma(0) - P_{P_i}^\lambda(0)\right] + \left[P_L(1) - P_L(0)\right]\left[P_{A_i}^\gamma - P_{A_i}^\lambda(0)\right]\\ &+ P_W(1)\left[P_{P_i}^\gamma(1) - P_{P_i}^\gamma(0) - [P_{P_i}^\lambda(1) - P_{P_i}^\lambda(0)]\right] - P_L(1)\left[P_{A_i}^\lambda(1) - P_{A_i}^\lambda(0)\right]\end{aligned}$$

i) Now let us find the conditions that guarantee that $P_W(1) - P_W(0) > 0$.

$$P_W(1) \geq P_W(0)$$
$$<=> \lambda_i\pi_1(1-\underline{\pi}_{e_j}) + (1-\lambda_i)\underline{\pi}_1(1-\pi_{e_j}) \geq \lambda_i\pi_0(1-\underline{\pi}_{e_j}) + (1-\lambda_i)\underline{\pi}_0(1-\pi_{e_j})$$

As $\pi_1 > \pi_0$ is always verified, the proposition holds if $\underline{\pi}_1 \geq \underline{\pi}_0$ that is $\theta_L + \epsilon \geq \epsilon$, which leads to $\theta_L \geq 0$.

ii) Now let us find condition that guarantee that $P_L(1) - P_L(0) \leq 0$

$$P_L(1) \leq P_L(0)$$
$$<=> (1-\lambda_i)(1-\underline{\pi}_1)\pi_{e_j} + \lambda_i(1-\pi_1)\underline{\pi}_{e_j} \leq (1-\lambda_i)(1-\underline{\pi}_0)\pi_{e_j} + \lambda_i(1-\pi_0)\underline{\pi}_{e_j}$$

This will be verified if $(1-\lambda_i)(\underline{\pi}_1 - \underline{\pi}_0)\pi_{e_j} + \lambda_i(\pi_1 - \pi_0)\underline{\pi}_{e_j} \geq 0$. Like previously, as we know that $\pi_1 > \pi_0$ holds, the proposition is guaranteed if if $\underline{\pi}_1 \geq \underline{\pi}_0$ that is $\theta_L \geq 0$.

As a consequence, we know that $P_W(1) - P_W(0) > 0$ and $P^{\gamma}_{P_i}(0) - P^{\lambda}_{P_i}(0) > 0$ (cf proposition 2.3) and besides $P_L(1) - P_L(0) < 0$ and $P^{\gamma}_{A_i} - P^{\lambda}_{A_i}(0) < 0$ (cf proposition 2.3) which leads to $\Big[P_L(1) - P_L(0)\Big]\Big[P^{\gamma}_{A_i} - P^{\lambda}_{A_i}(0)\Big] > 0$. Thus, $\Delta P^{\gamma} > \Delta P^{\lambda}$ if $P_W(1)\Big[P^{\gamma}_{P_i}(1) - P^{\gamma}_{P_i}(0) - [P^{\lambda}_{P_i}(1) - P^{\lambda}_{P_i}(0)]\Big] - P_L(1)\Big[P^{\lambda}_{A_i}(1) - P^{\lambda}_{A_i}(0)\Big] > 0$.

Now, let us find conditions that guarantee that $P_W(1) \geq P_L(1)$:

$$\begin{aligned} & P_W(1) \geq P_L(1) \\ <=> \lambda_i\pi_1(1-\underline{\pi}_{e_j}) + (1-\lambda_i)\underline{\pi}_1(1-\pi_{e_j}) &\geq \lambda_i(1-\pi_1)\underline{\pi}_{e_j} + (1-\lambda_i)(1-\underline{\pi}_1)\pi_{e_j} \\ <=> \lambda_i\pi_1 - \lambda_i\pi_1\underline{\pi}_{e_j} + (1-\lambda_i)\underline{\pi}_1 - (1-\lambda_i)\underline{\pi}_1\pi_{e_j} &\geq \lambda_i\pi_{e_j} - \lambda_i\pi_1\underline{\pi}_{e_j} + (1-\lambda_i)\underline{\pi}_{e_j} - (1-\lambda_i)\underline{\pi}_1\pi_{e_j} \\ <=> \lambda_i\pi_1 + (1-\lambda_i)\underline{\pi}_1 &\geq \lambda_i\pi_{e_j} + (1-\lambda_i)\underline{\pi}_{e_j} \end{aligned}$$

It will be verified if and only if $\lambda_i(\pi_1 - \pi_0) + (1-\lambda_i)(\underline{\pi}_1 - \underline{\pi}_0) \geq 0$. If $e_j = 1$ it will always be verified. If $e_j = 0$ it will be verified if $\underline{\pi}_1 - \underline{\pi}_0 \geq 0$ that is $\theta_L + \epsilon \geq \epsilon$, which leads to $\theta_L \geq 0$. Thus $P_W(1) \geq P_L(1)$ will be verified if $\theta_L \geq 0$.

As a consequence, as $P_W(1) > P_L(1)$ for $\theta_L \geq 0$, $\Delta P^{\gamma} - \Delta P^{\lambda}$ will be verified if $P^{\gamma}_{P_i}(1) - P^{\gamma}_{P_i}(0) - \Big[P^{\lambda}_{P_i}(1) - P^{\lambda}_{P_i}(0)\Big] - \Big[P^{\lambda}_{A_i}(1) - P^{\lambda}_{A_i}(0)\Big] > 0$.

2) let us prove now that $P^{\gamma}_{P_i}(1) - P^{\gamma}_{P_i}(0) - \Big[P^{\lambda}_{P_i}(1) - P^{\lambda}_{P_i}(0)\Big] - \Big[P^{\lambda}_{A_i}(1) - P^{\lambda}_{A_i}(0)\Big] > 0$ if $W^{\lambda}_j(1) - W^{\lambda}_j(0) \geq W^{\lambda}_i(1) - W^{\lambda}_i(0)$.
We have by spliting the principal "side" of the marginal payoff:

$$\begin{aligned} & P^{\gamma}_{P_i}(1) - P^{\gamma}_{P_i}(0) - \Big[P^{\lambda}_{P_i}(1) - P^{\lambda}_{P_i}(0)\Big] - \Big[P^{\lambda}_{A_i}(1) - P^{\lambda}_{A_i}(0)\Big] > 0 \\ <=> \Pi^{\gamma}_j(1) - \Pi^{\gamma}_j(0) - \Big[W^{\gamma}_j(1) - W^{\gamma}_j(0)\Big] &- \Big[\Pi^{\lambda}_j(1) - \Pi^{\lambda}_j(0)\Big] \\ + \Big[W^{\lambda}_j(1) - W^{\lambda}_j(0)\Big] &- \Big[W^{\lambda}_i(1) - W^{\lambda}_i(0)\Big] > 0 \end{aligned}$$

As $W^{\gamma}_j(1) - W^{\gamma}_j(0) = 0$ it will be verified if :

- $\Pi^{\gamma}_j(1) - \Pi^{\gamma}_j(0) \geq \Pi^{\lambda}_j(1) - \Pi^{\lambda}_j(0)$

- and $W_j^\lambda(1) - W_j^\lambda(0) \geq W_i^\lambda(1) - W_i^\lambda(0)$

Let us prove that $\Pi_j^\gamma(1) - \Pi_j^\gamma(0) \geq \Pi_j^\lambda(1) - \Pi_j^\lambda(0)$. It will be verified if $\frac{\partial \Pi_{j,1}^\gamma[\hat{\gamma}_{i,v}(e_i)]}{\partial e_i} > \frac{\partial \Pi_{j,1}^\lambda[\hat{\lambda}_{i,v}(e_i)]}{\partial e_i}$

Yet $\frac{\partial \Pi_{j,1}^\gamma[\hat{\gamma}_{i,v}(e_i)]}{\partial e_i} > \frac{\partial \Pi_{j,1}^\lambda[\hat{\lambda}_{i,v}(e_i)]}{\partial e_i}$ is equivalent to:

$$\frac{\hat{\gamma}_{i,v}}{\partial e_i} \frac{\partial \Pi_{j,1}^\gamma[\hat{\gamma}_{i,v}(e_i)]}{\partial \hat{\gamma}_{i,v}(e_i)} > \frac{\hat{\lambda}_{i,v}}{\partial e_i} \frac{\partial \Pi_{j,1}^\lambda[\hat{\lambda}_{i,v}(e_i)]}{\partial \hat{\lambda}_{i,v}(e_i)}$$

As the assessing technology is by assumption identical whatever the procedure we have $\frac{\hat{\gamma}_{i,v}}{\partial e_i} = \frac{\hat{\lambda}_{i,v}}{\partial e_i}$. Thus the expression is equivalent to:

$$\frac{\partial \Pi_{j,1}^\gamma[\hat{\gamma}_{i,v}(e_i)]}{\partial \hat{\gamma}_{i,v}(e_i)} > \frac{\partial \Pi_{j,1}^\lambda[\hat{\lambda}_{i,v}(e_i)]}{\partial \hat{\lambda}_{i,v}(e_i)}$$

$$\lambda_i(b + \underline{\pi}_1 - \pi_1) + \pi_1 > \gamma_i(b + \underline{\pi}_1 - \pi_1)$$

$$(\lambda_i - \gamma_i)(b + \underline{\pi}_1 - \pi_1) + \pi_1 > 0$$

As $\lambda_i = \gamma_i$ because the *a priori* belief in both competences are assumed identical before the tournament, the proposition is always verified.

Thus, the expression $P_{P_i}^\gamma(1) - P_{P_i}^\gamma(0) - \left[P_{P_i}^\lambda(1) - P_{P_i}^\lambda(0)\right] - \left[P_{A_i}^\lambda(1) - P_{A_i}^\lambda(0)\right] > 0$ will be verified only if $W_j^\lambda(1) - W_j^\lambda(0) \geq W_i^\lambda(1) - W_i^\lambda(0)$

3) As a conclusion, if $W_j^\lambda(1) - W_j^\lambda(0) \geq W_i^\lambda(1) - W_i^\lambda(0)$ and if $\theta_L \geq 0$ (conditions that guarantee $P_W(1) \geq P_L(1)$, and $P_W(1) \geq P_W(0)$, and $P_L(1) \leq P_L(0)$ ) it implies $\Delta P^\gamma > \Delta P^\lambda$.

### H/ Proof Lemma 2.6

As demonstrated in lemma 2.5, to prove that $\Delta P^\gamma > \Delta P^\lambda$, we need to prove that $W_j^\lambda(1) - W_j^\lambda(0) > W_i^\lambda(1) - W_i^\lambda(0)$. Let us prove it is verified if:

- $\hat{\lambda}_i(1,1) = \hat{\lambda}_j(1,1)$ and $\hat{\lambda}_i(0,1) < \hat{\lambda}_j(0,1)$
- and if $\hat{\lambda}_i(1,0) > \hat{\lambda}_j(1,0)$ and $\hat{\lambda}_i(0,0) = \hat{\lambda}_j(0,0)$

$W_j^\lambda(1) - W_j^\lambda(0) \geq W_i^\lambda(1) - W_i^\lambda(0)$ is equivalent to:

$$\left[W_j^\lambda(1) - W_i^\lambda(1)\right] + \left[W_i^\lambda(0) - W_j^\lambda(0)\right] > 0 \tag{2.6}$$

To find conditions that guarantee expression (2.7), we study two cases with respect to the strategy of the opponent agent $j$. We will find conditions such that:

i. in case $e_j = 1$, $W_j^\lambda(1) = W_i^\lambda(1)$ and $W_i^\lambda(0) > W_j^\lambda(0)$ that will imply that expression (2.7) will hold.

ii. in case $e_j = 0$, $W_j^\lambda(1) > W_i^\lambda(1)$ and $W_i^\lambda(0) = W_j^\lambda(0)$ that will imply that expression (2.7) will hold as well.

We define $W(x)$ a function such that:

$$W(x) = \left[x(b + \underline{\pi}_1 - \pi_1] + \pi_1\right] \frac{\psi_2}{\Delta\pi - x(\Delta\pi - \underline{\Delta\pi})}$$

As a consequence:

- For $x = \hat{\lambda}_i(1, e_j)$:

  we have $W[\hat{\lambda}_i(1, e_j)] = W_j^\lambda(1) = \left[\hat{\lambda}_i(1, e_j)(b + \underline{\pi}_1 - \pi_1) + \pi_1\right] \frac{\psi_2}{\Delta\pi - \hat{\lambda}_i(1, e_j)(\Delta\pi - \underline{\Delta\pi})}$

- For $x = \hat{\lambda}_i(0, e_j)$:

  we have $W[\hat{\lambda}_i(0, e_j)] = W_j^\lambda(0) = \left[\hat{\lambda}_i(0, e_j)(b + \underline{\pi}_1 - \pi_1) + \pi_1\right] \frac{\psi_2}{\Delta\pi - \hat{\lambda}_i(0, e_j)(\Delta\pi - \underline{\Delta\pi})}$

- For $x = \hat{\lambda}_j(1, e_j)$:

  we have $W[\hat{\lambda}_j(1, e_j)] = W_i^\lambda(1) = \left[\hat{\lambda}_j(1, e_j)(b + \underline{\pi}_1 - \pi_1) + \pi_1\right] \frac{\psi_2}{\Delta\pi - \hat{\lambda}_j(1, e_j)(\Delta\pi - \underline{\Delta\pi})}$

- For $x = \hat{\lambda}_j(0, e_j)$:

  we have $W[\hat{\lambda}_j(0, e_j)] = W_i^\lambda(0) = \left[\hat{\lambda}_j(0, e_j)(b + \underline{\pi}_1 - \pi_1) + \pi_1\right] \frac{\psi_2}{\Delta\pi - \hat{\lambda}_j(0, e_j)(\Delta\pi - \underline{\Delta\pi})}$

Let us demonstrate that $W(x)$ is an increasing function.

$$W(x) = \left[x(b + \underline{\pi}_1 - \pi_1] + \pi_1\right] \frac{\psi_2}{\Delta\pi - x(\Delta\pi - \underline{\Delta\pi})}$$

$$W'(x) = \psi_2 \frac{(b + \underline{\pi}_1 - \pi_1)[\Delta\pi - x(\Delta\pi - \underline{\Delta\pi})] - [-(\Delta\pi - \underline{\Delta\pi})][x(b + \underline{\pi}_1 - \pi_1) + \pi_1]}{\left[\Delta\pi - x(\Delta\pi - \underline{\Delta\pi})\right]^2}$$

$$W'(x) = \psi_2 \frac{(b + \underline{\pi}_1 - \pi_1)[\Delta\pi - x(\Delta\pi - \underline{\Delta\pi})] + [\Delta\pi - \underline{\Delta\pi}][x(b + \underline{\pi}_1 - \pi_1) + \pi_1]}{\left[\Delta\pi - x(\Delta\pi - \underline{\Delta\pi})\right]^2}$$

W' is always positive.

As a consequence, as $W(x)$ is an increasing function:

i. to demonstrate $W_j^\lambda(1) \geq W_i^\lambda(1)$, that is $W[\hat{\lambda}_i(1, e_j)] \geq W[\hat{\lambda}_j(1, e_j)]$, we need to demonstrate $\hat{\lambda}_i(1, e_j) \geq \hat{\lambda}_j(1, e_j)$. Furthermore, do demonstrate $W_j^\lambda(1) = W_i^\lambda(1)$ we need to prove $\hat{\lambda}_i(1, e_j) = \hat{\lambda}_j(1, e_j)$.

ii. to demonstrate $W_i^\lambda(0) \geq W_j^\lambda(0)$, that is $W[\hat{\lambda}_j(0,e_j)] \geq W[\hat{\lambda}_i(0,e_j)]$, we need to demonstrate $\hat{\lambda}_j(0,e_j) \geq \hat{\lambda}_i(0,e_j)$. Furthermore, to demonstrate $W_i^\lambda(0) = W_j^\lambda(0)$ we need to prove $\hat{\lambda}_j(0,e_j) = \hat{\lambda}_i(0,e_j)$

As a conclusion, if we study the cases with respect to the strategy of $j$, expression (2.7) will be verified:

i. in case $e_j = 1$, if $W_j^\lambda(1) = W_j^\lambda(1)$ and $W_j^\lambda(0) > W_j^\lambda(0)$ that is $\hat{\lambda}_i(1,1) = \hat{\lambda}_j(1,1)$ and $\hat{\lambda}_i(0,1) < \hat{\lambda}_j(0,1)$

ii. in case $e_j = 0$ if $W_j^\lambda(1) > W_j^\lambda(1)$ and $W_j^\lambda(0) = W_j^\lambda(0)$ that is $\hat{\lambda}_i(1,0) > \hat{\lambda}_j(1,0)$ and $\hat{\lambda}_i(0,0) = \hat{\lambda}_j(0,0)$

### I/ Proof Proposition 2.4

As demonstrated in lemma 2.6, to prove that $\Delta P^\gamma > \Delta P^\lambda$, we need to prove that:

$$\left[W_j^\lambda(1) - W_i^\lambda(1)\right] + \left[W_i^\lambda(0) - W_j^\lambda(0)\right] > 0 \tag{2.7}$$

For this we proved that:

- in case $e_j = 1$, $\hat{\lambda}_i(1,1) = \hat{\lambda}_j(1,1)$ and $\hat{\lambda}_i(0,1) < \hat{\lambda}_j(0,1)$ that will imply $W_j^\lambda(1) = W_j^\lambda(1)$ and $W_j^\lambda(0) > W_j^\lambda(0)$ such that will guarantee expression (2.7) will hold.
- and in case $e_j = 0$, $\hat{\lambda}_i(1,0) > \hat{\lambda}_j(1,0)$ and $\hat{\lambda}_i(0,0) = \hat{\lambda}_j(0,0)$ that will imply $W_j^\lambda(1) > W_j^\lambda(1)$ and $W_j^\lambda(0) = W_j^\lambda(0)$ that will also guarantee expression (2.7) will hold.

We will now prove it those conditions are guaranteed if $\lambda_i = \frac{1}{2}$, $\epsilon < \frac{1}{2}$ and $\theta_H + \theta_L < (1 - 2\epsilon)$ which is equivalent to $\lambda = \frac{1}{2}$, $\pi_1 < 1 - \underline{\pi}_1$ and $\pi_0 < 1 - \underline{\pi}_0$:

Let us find condition that guarantees $\hat{\lambda}_{i,v}(e_i,e_j) \geq \hat{\lambda}_{j,v}(e_i,e_j)$. By successive equivalence we have:

$$\begin{aligned}
\hat{\lambda}_{i,v}(e_i,e_j) &\geq \hat{\lambda}_{j,v}(e_i,e_j) \\
\frac{\lambda_i \pi_{e_i}(1-\underline{\pi}_{e_j})}{\lambda_i \pi_{e_i}(1-\underline{\pi}_{e_j}) + (1-\lambda_i)\underline{\pi}_{e_i}(1-\pi_{e_j})} &\geq \frac{(1-\lambda_i)\pi_{e_j}(1-\underline{\pi}_{e_i})}{(1-\lambda_i)\pi_{e_j}(1-\underline{\pi}_{e_i}) + \lambda_i \underline{\pi}_{e_j}(1-\pi_{e_i})}
\end{aligned}$$

Which is equivalent to:

$$\lambda_i \pi_{e_i}(1-\underline{\pi}_{e_j})\Big[(1-\lambda_i)\pi_{e_j}(1-\underline{\pi}_{e_i})+\lambda_i\underline{\pi}_{e_j}(1-\pi_{e_i})\Big] \geq$$
$$(1-\lambda_i)\pi_{e_j}(1-\underline{\pi}_{e_i})\Big[\lambda_i\pi_{e_i}(1-\underline{\pi}_{e_j})+(1-\lambda_i)\underline{\pi}_{e_i}(1-\pi_{e_j})\Big]$$
$$\lambda_i\pi_{e_i}(1-\underline{\pi}_{e_j})(1-\lambda_i)\pi_{e_j}(1-\underline{\pi}_{e_i})+\lambda_i\pi_{e_i}(1-\underline{\pi}_{e_j})\lambda_i\underline{\pi}_{e_j}(1-\pi_{e_i}) \geq$$
$$(1-\lambda_i)\pi_{e_j}(1-\underline{\pi}_{e_i})\lambda_i\pi_{e_i}(1-\underline{\pi}_{e_j})+(1-\lambda_i)\pi_{e_j}(1-\underline{\pi}_{e_i})(1-\lambda_i)\underline{\pi}_{e_i}(1-\pi_{e_j})$$

If we assume $\lambda_i = \frac{1}{2}$ the expression is equivalent to:

$$\pi_{e_i}(1-\underline{\pi}_{e_j})\underline{\pi}_{e_j}(1-\pi_{e_i})-\pi_{e_j}(1-\underline{\pi}_{e_i})\underline{\pi}_{e_i}(1-\pi_{e_j}) \geq 0$$

such that we know that :

$$\hat{\lambda}_{i,v}(e_i,e_j) \geq \hat{\lambda}_{j,v}(e_i,e_j) <=> \pi_{e_i}(1-\underline{\pi}_{e_j})\underline{\pi}_{e_j}(1-\pi_{e_i}) \geq \pi_{e_j}(1-\underline{\pi}_{e_i})\underline{\pi}_{e_i}(1-\pi_{e_j}) \quad (2.8)$$

And that:

$$\hat{\lambda}_{i,v}(e_i,e_j) \leq \hat{\lambda}_{j,v}(e_i,e_j) <=> \pi_{e_i}(1-\underline{\pi}_{e_j})\underline{\pi}_{e_j}(1-\pi_{e_i}) \leq \pi_{e_j}(1-\underline{\pi}_{e_i})\underline{\pi}_{e_i}(1-\pi_{e_j}) \quad (2.9)$$

As a consequence, we can now study several cases with respect to the strategy of agent $j$:

i. In case $e_j = 1$

- if $e_i = 1$ let us demonstrate that $\hat{\lambda}_i(1,1) = \hat{\lambda}_j(1,1)$ which implies $W_j^\lambda(1) = W_i^\lambda(1)$:

  Indeed, then equation (2.8) becomes $\pi_1(1-\underline{\pi}_1)\underline{\pi}_1(1-\pi_1) \geq \pi_1(1-\underline{\pi}_1)\underline{\pi}_1(1-\pi_1)$ such that we have $\hat{\lambda}_{i,v}(1,1) = \hat{\lambda}_{j,v}(1,1)$ and then $W_j^\lambda(1) = W_i^\lambda(1)$.

- if $e_i = 0$ let us demonstrate that $\hat{\lambda}_j(0,e_j) > \hat{\lambda}_i(0,e_j)$ which implies $W_i^\lambda(0) > W_j^\lambda(0)$:

  Indeed, then equation (2.9) becomes by successive equivalence:

$$\pi_0(1-\underline{\pi}_1)\underline{\pi}_1(1-\pi_0) \leq \pi_1(1-\underline{\pi}_0)\underline{\pi}_0(1-\pi_1)$$
$$(1-\underline{\pi}_1)\underline{\pi}_1 \leq \pi_1(1-\pi_1) \quad (2.10)$$

  This is equivalent to:

$$(\pi_1-\underline{\pi}_1)+\underline{\pi}_1^2-\pi_1^2 \geq 0$$
$$(\pi_1-\underline{\pi}_1)+(\underline{\pi}_1-\pi_1)(\underline{\pi}_1+\pi_1) \geq 0$$
$$(\pi_1-\underline{\pi}_1)\Big[1-(\underline{\pi}_1+\pi_1)\Big] \geq 0$$

As $(\pi_1 - \underline{\pi}_1) > 0$, the expression will be strictly verified if $1 - (\underline{\pi}_1 + \pi_1) > 0$ that is $\pi_1 < 1 - \underline{\pi}_1$. Thus it leads to $\theta_H + \theta_L < 1 - 2\epsilon$. As $\theta_L \geq 0$ (cf. lemma 2.5), it implies that $\theta_H + \theta_L > 0$. Thus $1 - 2\epsilon > 0$ must be verified that is $\epsilon < \frac{1}{2}$. The expression $1 - 2\epsilon > 0$ is also equivalent to $1 - \pi_0 - \underline{\pi}_0 > 0$ that is $\pi_0 < 1 - \underline{\pi}_0$. As a consequence, if $e_j = 1$ and $e_i = 0$, equation (2.9) will be verified and we have $\hat{\lambda}_j(0, e_j) > \hat{\lambda}_i(0, e_j)$ and then $W_i^\lambda(0) > W_j^\lambda(0)$

- As a consequence in case $e_j = 1$, if $\pi_1 < 1 - \underline{\pi}_1$ and $\pi_0 < 1 - \underline{\pi}_0$ then $W_j^\lambda(1) = W_i^\lambda(1)$ and $W_i^\lambda(0) > W_j^\lambda(0)$ such that $W_j^\lambda(1) - W_j^\lambda(0) > W_i^\lambda(1) - W_i^\lambda(0)$. It implies Proposition 2.4 is verified.

ii. In case $e_j = 0$:

- if $e_i = 1$, let us demonstrate that $W_j^\lambda(1) > W_i^\lambda(1)$, that is $\hat{\lambda}_i(1, e_j) \geq \hat{\lambda}_j(1, e_j)$: Indeed, then equation (2.8) becomes by successive equivalences:

$$\pi_1(1 - \underline{\pi}_0)\underline{\pi}_0(1 - \pi_1) \geq \pi_0(1 - \underline{\pi}_1)\underline{\pi}_1(1 - \pi_0)$$
$$\pi_1(1 - \pi_1) \geq (1 - \underline{\pi}_1)\underline{\pi}_1 \tag{2.11}$$

Expression 2.11 is identical to expression 2.10 in the previous item. As a consequence, it implies that if $e_i = 0$ and $e_j = 1$ then equation (2.8) will be verified and $W_j^\lambda(1) > W_i^\lambda(1)$ holds if $\pi_1 \leq 1 - \underline{\pi}_1$ and $\pi_0 \leq 1 - \underline{\pi}_0$.

- if $e_i = 0$ let us demonstrate that $W_i^\lambda(0) = W_j^\lambda(0)$ that is $\hat{\lambda}_j(0, e_j) = \hat{\lambda}_i(0, e_j)$: Indeed, then the expression (2.9) becomes $\pi_0(1 - \underline{\pi}_0)\underline{\pi}_0(1 - \pi_0) \leq \pi_0(1 - \underline{\pi}_0)\underline{\pi}_0(1 - \pi_0)$ such that we have $\hat{\lambda}_j(0, e_j) = \hat{\lambda}_i(0, e_j)$ and then $W_i^\lambda(0) = W_j^\lambda(0)$.
- As a consequence, in case $e_j = 0$, if expression $\pi_1 < 1 - \underline{\pi}_1$ and $\pi_0 < 1 - \underline{\pi}_0$ are verified then $W_j^\lambda(1) > W_i^\lambda(1)$ and $W_i^\lambda(0) = W_j^\lambda(0)$ such that $W_j^\lambda(1) - W_j^\lambda(0) > W_i^\lambda(1) - W_i^\lambda(0)$. It implies Proposition 2.4 is verified.

iii. As a consequence, in both cases whatever the strategy of the agent $j$ ($e_j = 1$ or $e_j = 0$), if $\pi_1 < 1 - \underline{\pi}_1$ and $\pi_0 < 1 - \underline{\pi}_0$ are verified, expression (2.7) will be verified and proposition 2.4 will hold.

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# Chapter 3

# The hidden cost of merit-based promotion procedure

## 3.1 Introduction

This chapter is using mostly the experimental methodology even though we will present also a tractable theoretical framework to explain what predictions we attempt to prove with our experiment. What we study is the willingness of an employee to accept wage inequality between him and his executive with respect to the procedure of selection of his executive. More specifically, the purpose is to study a merit-based promotion procedure that is a procedure where the best employee (i.e the one who makes the best performance) is chosen to become the executive. The stake for the organization would be to establish a procedure that makes effort of the subordinates less costly to incentivize than a regular monetary incentive as it would allow to decrease the incentive wage and favor obedience.

To tackle this issue, we design an experiment constituted of two stages. The first stage is a tournament with two opponents. Each opponent must invest an amount of money in an investment project such that the winner is the one who makes a higher income. The probability for an opponent to win depends on the quality of his project that can be profitable or unprofitable and is established exogenously. Investment projects were previously randomly allocated such that opponents ignore if they have a high quality or less quality project and we ask them before and after the tournament to declare their beliefs in owning the less profitable project. The second stage is an elicitation phase using

a Becker Degroot Marschak (BDM) procedure.[1] The looser will be asked to invest again and to declare the share of the future income he would demand to invest heavily rather than lightly (only two levels of investment are possible) knowing that the rest of the income will be given to the winner. To study the relative effect of procedure of selection we use two treatments: in treatment 1 (procedure 1) the looser will have to invest again in the same project than the one he was endowed before the tournament, whereas in treatment 2 (procedure 2) he will be endowed a new project after failure before stage 2. The game intends to capture a promotion process followed by a hierarchical relationship where the quality of the project represents an unknown competence and the investment project can be interpreted as a production.Thus the level of monetary investment can be understood as an effort. Indeed, in order to have instruction as neutral as possible and to have measurable effort we chose to use a monetary effort contrary to a real effort task.

Experimental behavior are compared to theoretical predictions which are based on a two stages sequential game. The first stage is a tournament while the second stage is a standard principal-agent framework where the principal is the winner of the previous tournament.[2] The ability of each opponent are unknown but the tournament will bring information about it like in a career concern framework. The role of the firm is to choose between a procedure where the ability required by the agent in stage 1 is revealed during the tournament (procedure 1) or a procedure that select principal on a totally different ability (procedure 2). However, this choice is not captured in the experiment as each procedure corresponds to a different treatment because the purpose of the experiment is precisely to compare the efficiency of both procedures.

We get the following main empirical results which are consistent with the theoretical predictions. First, when the loser of the tournament keeps the same investment project than the one he was endowed before the tournament (treatment 1), his belief in having the more profitable investment project before stage 2 will be less optimistic than when he was endowed a new project after his defeat (treatment 2). This is actually a purely bayesian effect. It is due to the fact that the new information about the quality of the project that could have been inferred after the tournament becomes no longer useful if a

[1] A Becker Degroot Marschak (BDM) procedure is a experimental procedure that aims to elicit reservation price or to elicit belief that was established by Becker et al. (1964)

[2] In this work the principal would be the executive and the agent would be the employee

new project is given. The second result is that the incentive wage (i.e the wage the looser demands to invest heavily rather than lightly) demanded in second stage is negatively correlated with the belief in having the profitable investment. It means that a higher wage is seen, in the view of opponents, as a way to compensate the fact they are less optimistic about having the high quality project. If they have a strong belief that their investments will fail, they need to have a strong reward to make it worthwhile. Finally, the last result is that the incentive wage is higher on average in case losers keep the same investment project (treatment 1) than in case they receive a new project after failure (treatment 2). We interpret these results this way: in treatment 1, the individuals who become employees after failure, will become more pessimistic on the expected return of their projects and will be discouraged to invest again. They will them need a higher wage to be incentivized to invest again. Whereas in treatment 2, information on investment project of the first stage are not relevant any more. Thus the changing of project will be a "fresh start".

We argue this simple game captures the issue of merit-based promotion procedure in a sense that the "best employee" becomes the executive of his peers. Indeed, we previously mentioned that the quality of the project in the experiment represents an unknown ability. As a consequence, the treatment 1 (investing in the same project during the competition and during the hierarchical relationship) represents a procedure where the ability required during the tournament is the same ability required by the employee after the tournament during the hierarchical relationship. Thus it captures a situation where the worse employee remains an employee. And so, keeping using the same employee's ability even if the failure is precisely a signal on his lack of employee's ability. Whereas, investing in a different project during the hierarchical relationship (treatment 2) captures a promotion process which is not a signal on the employee's ability that is, the specific ability required by the looser during the hierarchical relationship. Thus our result suggest that the "merit-based" promotion procedure could exacerbate rivalry where the one who is not promoted will lose confidence and will be hard to incentivize to cooperative behavior. On the contrary, selecting executives on another ability than their employee's abilities would tend to defuse this phenomenon by preserving the confidence of employees.

Generally speaking, this chapter is related to the literature of non-monetary incentives (or informational incentives) such as peer effect, self-esteem and evaluation of performance (Azmat and Iriberri 2010, Kuhnen and Tymula 2012, Gill and Prowse 2012, Villeval

2016). More specifically, Kuhnen and Tymula (2012) show in a experiment how people work harder if they are aware that they will receive information about their rank order. This is the "positive" incentive effect of peer effect. However, a "negative" incentive effect has been observed as well. Indeed, Gill and Prowse (2012) show that an opponent may be discouraged to make a high performance if he observes his opponent achieving a high performance before him. This result is based on the same intuition than ours: comparing to each other can exacerbate rivalry and finally be counterproductive. But Gill and Prowse (2012) do not focus their analysis on the consequence in terms of incentive and acceptation of wage inequality. Furthermore, besides their experimental work, they made a model to explain their empirical results based on the behavioral concept of reference points.[1]

This issue is also related to the research on procedure of justice originally studied by social psychology (Tyler and Blader 2003) and experimental economics (Bolton et al. 2005, Ku and Salmon 2013). These authors study how people are more willing to accept unequal distribution of revenues if the allocation rule was previously established by a procedure seen as "fair". Bolton et al. (2005) study notably an ultimatum game preceded by a procedure of allocation of incomes that can be totally random or biased. They study the rejection rate of the offer of the proposer with respect to if the proposer can choose himself a unequal distribution or if this distribution depends on a pre-established bias or a random criteria established exogenously as a parameter of the experiment. If the proposal is established randomly (a random throw of a dice) it is in general less rejected than if the proposal is chosen by the proposer. However, among random procedure, if there is a biased procedure (a throw of loaded dice) in favor of an allocation rule that is not fair, it will be more rejected that a unbiased procedure. Ku and Salmon (2013) deepen this issue and show how the willingness to accept unequal outcome may depend on institutional elements. They deliberately part participants of their experiment into two categories: one is endowed generously (or "favored") and the other one is less endowed (or "unfavored"). Unfavored participants will be asked to accept or reject to transfer a part of their endowments to the favored participants being told that this transfer is actually an investment that will eventually increase their own incomes but in a smaller proportion than the income of favored people. To select favored and unfavored participants they

[1] A reference point in behavioral economic literature is an expected performance such that if an agent deviates above he will feel a psychological positive utility whereas if he deviates under he will feel a psychological negative utility.

used four kinds of procedures: a random procedure, a merit-based procedure where the one with the highest performance at an exante test will be selected to be in the favored category, a procedure where non cooperative behaviors (free riding at a public good game) are rewarded and finally a procedure that discriminates with respect to a social group identity (people are asked whether they prefer painting of Klee or Kandinsky). The first result is that disadvantaged people are more tolerant to inequality when the advantaged people share the same group identity. Furthermore it is showed that the merit based procedure does not favor acceptation of transfer to the advantaged people relatively to the random procedure. Our contribution is to deepen this last idea by proposing a theoretical explanation and by testing it.

In terms of methodology and design our work is related to the literature on elicitation of beliefs (Buser et al. 2018, Schlag et al. 2015, Becker et al. 1964). Buser et al. (2018) study how people do not perfectly update their beliefs after receiving a signal on their abilities relatively to a bayesian benchmark. The signal is a rating after passing some intelligence tests (the signal is noisy as it is an imperfect evaluation) and the belief is the belief in their own abilities to succeed at these tests. To elicit belief they use a Becker Degroot Marschak (BDM) procedure (Becker et al. 1964) that incentivizes participants to report sincere belief on their competences. They show that indeed people update their beliefs but not as strongly as the bayesian benchmark would suggest, especially when they receive "bad" signal. Besides Buser et al. (2018) add a final task where they measure the competitiveness of participants with respect to their abilities to update their beliefs. The first difference in our work is that we do not design real task but investment with a monetary effort. The second difference is that we use BDM procedure not to elicit belief but to elicit the incentive wage required to invest after the competition.

Our work is also related to some theoretical papers. It is notably related to works that deals with social mobility (i.e the fact individuals enjoy a standard of living superior or different than their parents) and the preferences for redistributive tax policies (Piketty 1995, Benabou and Tirole 2006). Piketty (1995) argues that the sequence of success and failure determining social mobility implies a subjective learning in term of statistical inference on the role of effort and pre-established allocation of resources. Indeed, they assume that success (such as being efficient at work, academic success ...) can be related to effort of individuals but also some external and exogenous circumstances (such as being born in a wealthy family for instance). But individual do not know to what extent

external circumstances or effort will count such that they only have a belief inherited from their parents and based on bayesian learning. As a consequence, people that will prefer a less redistributive tax are people that are from high wealthy and successful families origin and people who prefer a more redistributive tax are from low revenue families origin. In our work, we use the same idea that the learning on competence will establish the allocation of incomes preferences. Our contribution is to focus on the hierarchical relationship and moral hazard issue. Thus, we study incentive wage and there is no redistributive consideration like in tax. Furthermore, the bayesian learning will depend on relative performance. Mostly our contribution is to elicit a procedure that can neutralize the "negative" consequence of failure on incentive wage. Indeed, a failure at the tournament will tend to make individuals think that do not own the high quality project (or the high competence) which will imply that they will demand a higher wage to choose a high level of investment (or effort) in order to maintain his investment worthwhile. The negative consequence is that it will imply an extra cost for the principal. Besides, it sheds light on the issue of acceptation of hierarchy and moral hazard as the accepted wage in our work is an incentive wage and not only a simple transfer.

The rest of the chapter is organized as follows. Section 1 deals with the theoretical framework and the theoretical predictions. Section 2 deals with empirical analysis comprised of the experimental design, the econometrical models and the empirical results. Section 3 concludes.

## 3.2 Theoretical predictions

In this section, we will briefly expose our theoretical framework in order to explain and justify the econometrical model we intend to test further. For the sake of clarity, we deliberately use a different notation for the theoretical and econometrical models because the econometrical model does not shape exactly the theoretical ones.

### 3.2.1 Framework

A standard result in contract theory is that the wage sufficiently high to incentivize high effort from the employee will be negatively correlated with the marginal return of the effort of the employee that is the supplement of probability of producing high production

generated by high effort relatively to low effort. We will study how this marginal return of the effort may change with respect to the procedure of selection of the executive. As a consequence the theoretical framework is a two stages model: a promotion contest (stage 1) followed by a regular hierarchical relationship (stage 2).

Let us describe the stage 1 which represents a promotion contest. The promotion procedure is captured by a contest between agent $i$ and $j$ who have an *a priori* belief about their relative abilities. They both produce an output that can take two values $q_i \in \{\underline{q}, \overline{q}\}$ and the winner is the one who outperforms his opponent. The production is assumed to be stochastic such that we denote $\Pi_1$ the probability of producing a high level of production. We will assume the opponents do not know for sure if they have a higher or a lower ability but they have a belief about it captured by a probability which is common knowledge. Thus for $i$ we define $\Pi_1 = \lambda_{i,1}\pi_1 + (1 - \lambda_{i,1})\underline{\pi}_1$ where $\lambda_{i,1}$ is the belief of having the high ability in stage 1, $\pi_1$ and $\underline{\pi}_1$are the probabilities of producing the high output respectively with a high and low ability with $\pi_1 > \underline{\pi}_1$.

The firm can choose two kinds of procedures of promotion. In the first procedure opponents are evaluated on the same ability that the one they will require if they become employee in stage 2. In the second procedure they are evaluated on another ability different that the one they will require in second stage.[1]

During the first stage, the effort/investment is not formalized because we assume agents don't choose the level of their investments and exert an exogenous effort such that only the information that reveals defeat or success will matter. The purpose of this assumption is to match with the future experimental design that is mostly focused on the behavior of opponent in stage 2 with respect of their defeats in stage 1. It allows us to avoid strategic behavior to occur during stage 1 in the experiment as no backward induction is feasible. Besides, during the experiment it allows us to have a complete control of the likelihood of the signal during the promotion process as it will not depends on participants behavior.

Let us now describe the second stage of the model which captures a hierarchical rela-

[1] In the experiment, procedure 2 is captured by treatment 2 as we consider that to be given a new project in the hierarchical relationship is a reasonable approximation of being evaluated on another ability than during the promotion contest.

tionship. The standard model assumes that an executive denoted principal $j$ offers a wage to his employee denoted agent $i$ who can exert only two levels of effort $e_i \in \{0, 1\}$ (either a high level of effort, or investment, or a low level of effort). Besides the output $S$ can only take two values as well, (i.e $S \in \{\underline{S}, \overline{S}\}$). As effort of the employee is not observable by the executive and himself does not perform any task, the objective of the executive is to incentivize the agent to exert high effort by proposing a wage $\bar{t}$ in case the production is high and another wage $\underline{t}$ in case the output is low. The production is assumed stochastic and similar to the stage 1 except that now two levels of effort can be implemented. Namely: $\Pi_1 = \lambda_{i,2}\pi_1 + (1 - \lambda_{i,2})\underline{\pi}_1$ where $\lambda_{i,2}$ is the belief in having the high ability in stage 2 and $\pi_1$ and $\underline{\pi}_1$ are the probabilities of producing the high output respectively with a high and low ability in case of high effort. Similarly, we can define for a low effort $\Pi_0 = \lambda_{j,1}\pi_0 + (1 - \lambda_{i,1})\underline{\pi}_0$ where $\pi_0$ and $\underline{\pi}_0$ are the probabilities of producing the high output respectively with a high and low ability. We assume without loss of generality that $\underline{t} = 0$ (i.e the principal can only reward in case of high production). We get the following program:

$$\begin{aligned} \max_{\bar{t}} \quad & \Pi_1(\lambda_{i,2})(\bar{S} - \bar{t}) + [1 - \Pi_1(\lambda_{i,2})]\underline{S} \\ s.c. \quad & \Pi_1(\lambda_{i,2})\bar{t} - \psi_1 \geq \Pi_0(\lambda_{i,2})\bar{t} - \psi_0 \qquad (3.1) \\ & \Pi_1(\lambda_{i,2})\bar{t} - \psi_1 \geq 0 \qquad (3.2) \end{aligned}$$

The parameters $\psi_1$ and $\psi_0$ are the cost of exerting high an low effort respectively (or the cost of choosing a high or low level of investment). Equation (3.2) is the participation constraint, it means that the condition must be guaranteed if the principal wants the agent to exert effort. Equation (3.1) is the incentive constraint and this condition guarantees that the effort chosen by the agent will be the high level of effort. The solution of the principal's program is completely standard by saturating the incentive constraint (equation 3.1). We get the standard result obtained in the literature (Laffont and Martimort 2009):

$$\bar{t}^* = \frac{\psi_1 - \psi_0}{\Delta\Pi(\lambda_{i,2})} \qquad (3.3)$$

With $\Delta\Pi(\lambda_{i,2}) = \Pi_1(\lambda_{i,2}) - \Pi_0(\lambda_{i,2})$ the marginal return of high effort with respect to $\lambda_{i,2}$.

### 3.2.2 Theoretical findings

Let's now establish the several theoretical results that we intend to test in this experiment.

**Prediction 1:** *In procedure 1, where opponents are evaluated on the same ability required in stage 2, the belief in having a high ability will be inferior in stage 2 than in stage 1, that is:* $\lambda_{i,2} < \lambda_{i,1}$. *Whereas in procedure 2, when the ability required in stage 2 is different than the one required in stage 1, the belief in having a high ability will be identical in stage 1 and stage 2, that is:* $\lambda_{i,2} = \lambda_{i,1}$.

Prediction 1 is a straightforward effect of bayesian learning. The intuition is that defeat at the contest will send a negative signal on ability. This negative signal will not matter in procedure 2 because information on ability will be not useful in stage 2, as another ability will be required for the agent to produce.

**Prediction 2:** *The equilibrium wage in stage 2 decreases with respect to the belief in having a high ability.*

The second prediction is about the variation of the equilibrium wage with respect to the belief in having a good competence. Indeed, by denoting $\Delta\pi$ as $\Delta\Pi$ in case $\lambda_j = 1$, that is the marginal return of high effort with high ability, and $\Delta\underline{\pi}$ as $\Delta\Pi$ in case $\lambda_j = 0$, that is the marginal return of high effort with low ability, we can finally write using equation (3.3):

$$\bar{t}^* = \frac{\psi_1 - \psi_0}{\lambda_{i,2}(\Delta\pi - \Delta\underline{\pi}) + \Delta\underline{\pi}} \tag{3.4}$$

It is straightforward with equation (3.4) that $\bar{t}^*$ increases when $\lambda_{i,2}$ decreases. One of the main purpose of this experiment is to test equation (3.4) by showing that the incentive wage will be negatively correlated with the belief in having a high ability.

**Prediction 3:** *In procedure 1, where opponents are evaluated on the same ability required in stage 2, the equilibrium wage will be higher that in procedure 2 where the ability required in stage 2 is different than the one required in stage 1.*

The third theoretical finding is about the consequence of the bayesian inference on the demanded wage and is a straightforward consequence of equation (3.4) and prediction 1. We find that the wage requested in procedure 2, where different abilities are required in stage 1 and stage 2, will be lower than in procedure 1, where the same ability is required in both stages. That will give us a highlight on the importance of procedure of promotion

to shape the willingness to accept wage inequality.

We will explain in the next section the empirical analysis to test this theoretical work.

## 3.3 Empirical analysis

### 3.3.1 Experimental design

The experiment has been run at the Laboratoire d'Economie Experimentale de Strasbourg and subjects were students from the university of Strasbourg.[1]

The experiment has been run in 6 sessions with 24 subjects per session and 3 sessions per treatment. The 24 subjects were separated in groups of 6. In the first stage, each individual in each group was matched one by one with the 5 other members of the group in 5 successive promotion tournaments following a stranger protocol. During a tournament they had to make an investment in an investment project that was randomly allocated and whose they did not know if it was high or low quality (the project could be profitable or on the contrary unprofitable). The winner was the one who made the best return. As mentioned previously, this investment in the first stage was not a choice for participant because they was forced to invest only one amount (it explains why in the theoretical framework, this choice of investment is not formalized). The purpose was to allow us to have a complete control of the likelihood of the signal that defeat sent on owning the high quality or low quality project. Otherwise, this signal would have depended on participants choices of investment. Besides it avoided to observe strategic behaviors during stage 1 and allowed us to focus our analysis on the behaviors in following stage with respect to failure at the promotion. Each tournament were then followed by a second and last stage where only the loser was asked to invest again. In that stage 2, we used a BDM procedure to elicit the incentive wage that he would demand to invest heavily rather than lightly (only two levels of investment were possible). In treatment 1, it was asked to the loser to invest a second time in the same project that the one he was endowed before the tournament whereas in treatment 2 he was endowed randomly a new project after his defeat and was asked to invest in that last project.

Stage 1 (the tournament) and stage 2 (the elicitation) constitute what we denote a "game". This game is designed to fit schematically with a hierarchical relationship when

[1] lees.u-strasbg.fr

the effort is non contractible and with the promotion process that precedes it. The level of monetary investment can be understood as an effort and the investment project as a production. Besides, the quality of the project can be interpreted as a high or low ability to succeed at producing the production. Thus, being endowed a new project before stage 2 in treatment 2 can be understood as producing a production that requires a different ability than in stage 1 whereas in treatment 1, keeping the same project can be interpreted as producing in stage 2 a production that requires the same ability than in stage 1. In order to avoid strategic interactions in stage 2 we did not ask the winner to propose an incentive wage himself like the theoretical framework would suggest. This means that our design does not shape perfectly the theoretical framework. But we argue the philosophy remains the same as the core of the theoretical reasoning is based on the incentive wage and the bayesian learning mechanism and those will operates in this design anyway. Besides, this allowed to avoid that agent interpret the wage proposal of his former opponent as filled with "good intention" or "bad intention". Indeed, this behavioral bias is very common in the ultimatum game (Bolton et al. 2005) and could have occur in the experiment.

We also note that, before the tournament and before the second stage, we asked subjects to declare their beliefs in owning a low quality investment project. As we repeated a game 4 times per subject we obtained 5 observations of prior belief and posterior beliefs per subject and 5 incentive wages declared. As a consequence we had 60 observations per session on the loser side.

*Stage 1: the promotion tournament and the declaration of beliefs*

Let us explain extensively the design of the promotion tournament and the declaration of beliefs. Before each tournament each subject were allocated an amount of money which is the same for every subject: 100 EC (Experimental Currency). The computer assigned randomly an investment project at each subject. Project A had a average return higher than project B but the two competitors did not know in advance which project they were allocated. Each project could make an income of either 140 EC or 0 EC (any other income is impossible): each subject had 90% of chances to get 140 EC if he had the project A and only 50% if he had the project B. Then we asked subjects the following question: "What are your chances, in your point of view, that you have been endowed with the project B"? Neither remuneration during this phase was given and the gain during the following phases was not impacted by the reply.

During the tournament, subjects faced each other one by one and was forced to invest 80 EC in their investment projects allocated previously. We measured at the end the income of the investment and ranked opponents with respect to this and informed them of the ranking. The winner was the one who make a higher income (namely the one who get 140 EC whereas the other get 0). In case of a tie (namely when both opponents get simultaneously 140 or 0) the winner was drawn by lot. But this signal was noisy. Indeed, the incomes from investment projects were still random variables depending on the quality of the project (A or B) such that it was still feasible to wins with project B for instance even though it was less likely. We did not inform subjects on their chances of winning. The first reason is because we wanted to keep instructions as simple as possible. The second reason is because subjects could infer those probabilities of winning and loosing from the return of projects A and B (information that they have received previously). As a consequence they could infer that theoretically, if they have the high quality project their chances of winning would be 70% and if they have the low quality project 30%.[1] The gain of each subject did not correspond to the income of the investment because the latter was only used to select the winner. The winner received 300 EC and the looser 100 EC. We made then a second elicitation of belief and asked subjects the following question: "Now, knowing whether you have won or lost the tournament, what is your opinion on the percentage of chances that the computer allocated you the project B?".

Then in treatment 1, before the next phase of the game, the looser kept the same project whereas in treatment 2, he was endowed with a new project also drawn by lot between a project C and D. Project C was similar to project A and Project D was similar to B. As a consequence in treatment 2 we also asked them to declare their beliefs in owning project D.

*Stage 2: the elicitation of incentive wage*

Let us explain now in more details the next stage of the game where we wanted to elicit the incentive wage with a BDM procedure. In treatment 1, the looser was still in possession of the investment project allocated previously and still ignoring if it was project A or B. And in treatment 2, he was in possession of the investment project C or D allocated after the tournament also ignoring which one he actually owned. First, he was allocated 100

[1] Indeed, with high quality project we have $0,9 * (1 - 0,5) + \frac{1}{2}(0,9 * 0,5) + \frac{1}{2}(1 - 0,9)(1 - 0,5) = 0,7$ and with low quality project we have $0,5 * (1 - 0,9) + \frac{1}{2}(0,5 * 0,9) + \frac{1}{2}(1 - 0,5)(1 - 0,9) = 0,3$.

EC for this phase and then he was asked to answer the following question: "What is the minimum wage that you would demand for investing 80 EC, rather than 40 EC in the project that you have been endowed? You need to know that this wage will be received only if your investment has an income of 140 EC". We also informed that the winner of the tournament would receive $\left[140 - \text{this wage}\right]$ and that the winner was not asked to make any decision or any declaration. We also specified that the wage declared should be between 80 and 140 EC. Finally, we informed subjects on the return of the 2 investment projects with respect to the level of investment. On the one hand, the project A has 90% of chances of making an income of 140 EC, rather than 0, if the investment is 80 EC and only 40 % of chances of making an income of 140 EC, rather than 0, if the investment is 40 EC. On the other hand, the project B has 50% of chances of making an income of 140 EC, rather than 0, if the investment is 80 EC and only 30 % of chances of making an income of 140 EC, rather than 0, if the investment is 40 EC.

We used a BDM procedure to elicit the incentive wage that the looser of the tournament would demand to invest 80 EC instead of 40 EC. As a consequence, subjects did not actually receive the wage they declared, but this procedure incentivized them to answer sincerely to the question anyway.

Indeed, before answering to the question asked, we informed them that 2 different situations could occur. In the situation 1, subjects would be forced to invest 40 EC and receive a wage w EC if the income of their projects was 140 EC (the wage would be null in case the income is null). The wage w was drawn by lot between 80 and 140 EC (included) and each possible value of w had the same probability to occur (it followed an uniform distribution). The situation 2 is similar but subjects would be forced to invest 80 EC instead of 40 EC. The occurrence of one situation rather than the other depended on the value of w drawn and of the wage declared. Indeed, if w was inferior or equal to the wage demanded, the situation 1 occurred and subjects were forced to invest 40. However, if w was superior to the wage declared, the situation 2 occurred and subjects were forced to invest 80. This procedure guaranteed that the declaration of the incentive wage was truthful.

For the one who lost the tournament, the total gain for this phase was 100 (his allocation)+w EC (if the income was 140 EC) or 0 (if not) - 80 or 40 EC (depending on if situation 1 or 2 occurs). For the one who won the tournament the total gain of this phase was 140 EC $-$ w EC if the income is 140 or 0 otherwise.

### 3.3.2 Econometric models

The econometrical analysis will consist in testing equation (3.4). Nevertheless, we will adapt the notation to the experimental design notably because experimental variables have double index due to the number of successive games and the number of participants. Thus, we will test the correlation between the belief in owning the high quality project after defeat and the wage participants are willing to accept to invest 80 EC instead of 40 EC in the elicitation phase. Relying on equation (3.4) in the theoretical model we have:

$$w^*_{i,j} = \frac{\psi}{\hat{\mu}_{j,j}(\Delta\pi - \Delta\underline{\pi}) + \Delta\underline{\pi}}$$

We denote $w^*_{i,j}$ the wage participant $i$ declares he is willing to accept to invest 80 EC instead of 40 EC once he lost the tournament against participant $j$. It is a transposition of the variable $\bar{t}^*$ in the theoretical framework. We also denote $\hat{\mu}_{i,j}$ the belief for participant $i$ of having the high quality project given he just lost the competition facing agent $j$. It corresponds to the variable $\lambda_{i,2}$ in the theoretical framework which is the belief in having a high competence in second stage. Furthermore, we note that in treatment 1 the high quality project is project A and the low quality project is project B whereas in treatment 2, project C is the high quality project and the less profitable project is project D.

Besides, $\psi$ is the marginal cost of investment that is to say $80 - 40 = 40$. It corresponds to $\psi_1 - \psi_0$, the marginal cost of effort, in the theoretical framework. The variable $\Delta\pi = 90\% - 40\% = 50\%$ is the increase of the likelihood of getting a high output (140 instead of 0), by investing 80 instead of 40 when having the high quality project (A in treatment 1 or C in treatment 2). And the variable $\Delta\underline{\pi} = 50\% - 30\% = 20\%$ is the increase of the likelihood of getting a high output (140 instead of 0), by investing 80 instead of 40 when having this time the less profitable project (project B or D in treatment 2). For the sake of clarity, we name $\Delta\pi$ the marginal return of the high quality project and $\Delta\underline{\pi}$ the marginal return of the low quality project.

Player $i$ will repeat the whole game 5 times (tournament and elicitation phase) but the number of defeats is actually random such that the number of observations will vary for each $i$. As a consequence we will have 24 observations for each session and 3 sessions by treatment but the number of periods observed for each $i$ will changed with respect to the number of his defeats.

We will first study an econometrical model straightforward derivative from the theo-

retical model. We finally obtain the following econometrical model to test denoted Model 1:

$$\text{Model 1: } ln(w^*_{i,j}) = \alpha ln[\hat{\mu}_{i,j}(\Delta\pi - \Delta\underline{\pi}) + \Delta\underline{\pi}] + \beta ln(\psi) + \epsilon_{i,j} \tag{3.5}$$

The purpose will be to tested hypothesis $\alpha < 0$. It is important to understand that theoretically $\alpha = -1$ but the purpose of the chapter is to test qualitatively equation (3.4) and not quantitatively. As a consequence, the more $\alpha$ will be closed to zero the more the effect of the belief in having the high quality project on the wage will be interpreted as small and the more $\alpha$ will be negative and low the more the effect will be interpreted as strong.

For the sake of exhaustivity we will also study another econometrical model that we denote Model 2:

$$\text{Model 2: } ln(w^*_{i,j}) = \alpha ln[\frac{\hat{\mu}_{i,j}}{\mu_{i,j}}(\Delta\pi - \Delta\underline{\pi}) + \Delta\underline{\pi}] + \beta ln(\psi) + \epsilon_{i,j} \tag{3.6}$$

In equation (3.6), $\mu_{i,j}$ is the belief in having the high quality project (project A) before the tournament. Thus $\frac{\hat{\mu}_{i,j}}{\mu_{i,j}}$ is a variable that captures the *deception* after failure. Equation (3.6) would imply that without any bayesian inference (that is $\frac{\hat{\mu}_{i,j}}{\mu_{i,j}} = 1$), the choice of the wage would become independent of the belief. Indeed if $\frac{\hat{\mu}_{i,j}}{\mu_{i,j}} = 1$ is verified then equation (3.6) becomes:

$$ln(w^*_{i,j}) = \alpha ln(\Delta\pi) + \beta ln(\psi) + \epsilon_{i,j}$$

As a consequence, without any bayesian inference, the choice of the wage would only depend on the marginal return of the profitable project $\Delta\pi$.[1] Hence, we can interpret Model 2 such that, if there is no *deception*, the participant will "simplify" his cognitive approach of the issue only considering the case he has the high quality project and not taking into account the other potential case. In other word he will not think in term of expected return. As a consequence, it allows us to interpret equation (3.6) as a two-step reasoning for participants when he declares his wage. In a first step, he considers only the best scenario and the marginal cost of investment $\psi$, and appraises the wage he will demand. In a second step, he takes into account his *deception* and appraises a supplement to the wage.

[1] Indeed, it would imply $[\frac{\hat{\mu}_{i,j}}{\mu_{i,j}}(\Delta\pi - \Delta\underline{\pi}) + \Delta\underline{\pi}] = [(\Delta\pi - \Delta\underline{\pi}) + \Delta\underline{\pi}] = \Delta\pi$.

### 3.3.3 Empirical results

#### 3.3.3.1 Bayesian belief and descriptive statistics

Table 1 shows the proportion of individuals who did not revise their beliefs or who revised upwards by round, session and treatment. If we consider treatment 1, 25 % falls into this category for session 1. It is evaluated at 30 % and 35 % respectively for session 2 and 3.

**Result 1:** *In line with prediction 1, in treatment 2, when participants are endowed a new project after failure at the tournament, the belief in owning a high quality project in the elicitation stage is higher than in treatment 1, when participants keep the same project.*

Table 3.1 – *Descriptive statistics*

| Round | Treatment 1 | | | Treatment 2 | | |
|---|---|---|---|---|---|---|
| | *S*1 | *S*2 | *S*3 | *S*1 | *S*2 | *S*3 |
| 1 | 25.00 [a] | 33.33 | 33.33 | 91.67 | 100.00 | 83.33 |
| 2 | 25.00 | 16.67 | 41.67 | 75.00 | 83.33 | 100.00 |
| 3 | 25.00 | 33.33 | 50.00 | 83.33 | 91.67 | 75.00 |
| 4 | 33.33 | 25.00 | 16.67 | 83.33 | 83.33 | 75.00 |
| 5 | 16.67 | 41.67 | 33.33 | 75.00 | 75.00 | 75.00 |
| Sessions | 25.00 | 30.00 | 35.00 | 81.67 | 86.67 | 81.67 |
| Treatment | 30.00 | | | 83.34 | | |

[a] 25% of subjects in session 1 (S1) didn't downgrade their beliefs in treatment 1 (T1)

The failure led most people to downgrade their beliefs, 70% in treatment 1. However, we found that for treatment 2, the number of individuals who revised their beliefs is very low.

The distribution of beliefs reveals an heterogeneity in the individuals' behavior (Fig.3.1). Indeed, for the expost belief, about 50% of individuals have a belief revolves around the average in the treatments 1 & 2. For lower values (around 20 %), we find also a small concentration of individuals indicating a part of the person who downgraded their beliefs. If we consider the two treatments separately, we find that the greatest number of people having revised their beliefs are obtained in treatment 1 (Fig.3.2).

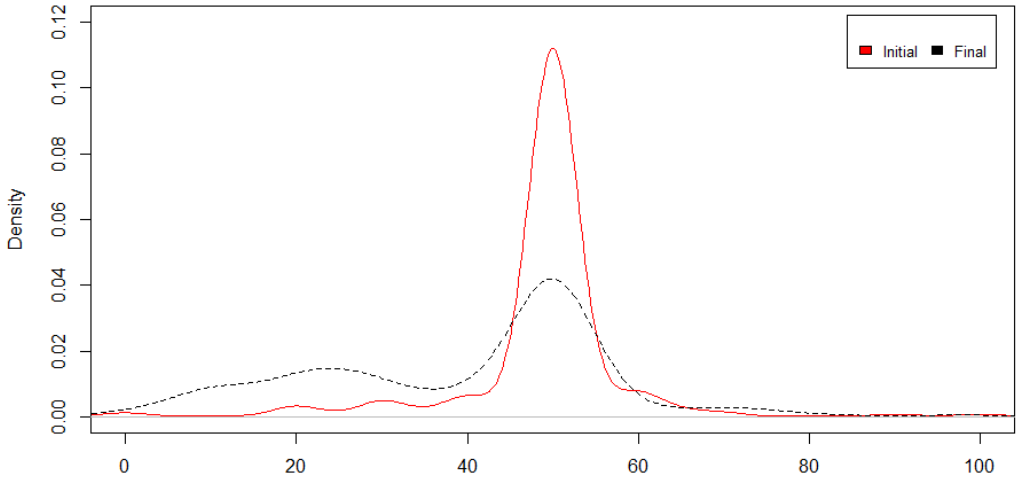



Figure 3.1 – *Initial and final belief for all of the sample*

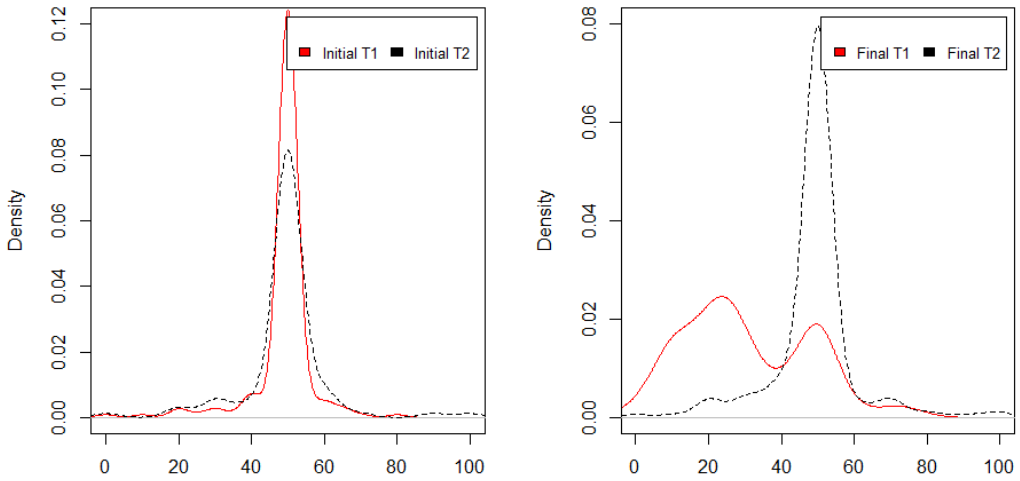



Figure 3.2 – *Initial and final belief for Treatments 1&2*

#### 3.3.3.2 Econometric analysis

Since each individual is observed 5 times during the experiment, we use the fixed effect panel data model. However, as only the losers are retained in each round, we end up with an unbalanced panel sample. An individual may be a loser in one round and win in another. Thus, the individual fixed effect is not relevant to analyze our data for which we do not have enough variation within cluster. So, we used a time fixed effect model and we introduce some control variables such as sex, age, or degree of risk aversion.

**Result 2:** *In line with prediction 2, the wage demanded in the elicitation stage is negatively correlated with the marginal return of effort.*

The estimate results of the econometrical Model 1 in table 2, correspond to equation (3.5). They show that the marginal return on investment impacts negatively and significantly the income requested by the individual. The elasticity value is between $-0.03312^{***}$ to $-0.026629^{**}$ depending on the different specifications.

Table 3.2 – *Estimation results for Model 1*

| Variables | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Marginal return | $-0.03312^{***}$ | $-0.02593^{**}$ | $-0.02657^{**}$ | $-0.02629^{**}$ |
| | (0.01069) | (0.01196) | (0.01191) | (0.01191) |
| Female | | | $-0.02579^{*}$ | $-0.02280$ |
| | | | (0.01484) | (0.01511) |
| Age | | | $-0.10429$ | $-0.10174$ |
| | | | (0.07934) | (0.07934) |
| Risk aversion | | | | 0.01980 |
| | | | | (0.01902) |
| Treatment | | ✓ | ✓ | ✓ |
| N | 360 | 360 | 360 | 360 |

The standard deviations are in parentheses.*** Significant at 1%, ** Significant at 5%, * Significant at 10%.

For the specification (1) we note that a decrease of 1% in the marginal return on investment leads to an increase of about 0.033% of the incentive wage. The belief update (BU) reflecting a low probability for an individual to see the return of his project increased, is negatively correlated with income. Indeed, the BU incites individuals to expect a low rate of return on their investments. So, faced with this situation, individuals will be more likely to ask for a higher income to limit their "losses" and make their investments worthwhile. Other control variables such as gender, age (specifications 2 & 3) and risk variable (specification 4) that describes whether the individual likes risk or not have been added to the model.[1] Estimates show that female dummy variable and age have a negative but not significant effect (specification 2 & 3). The risk variable has a positive but

[1]We ask individuals, if they consider to be a person who likes to take risks rather cautious. Indicate on a

not significant effect on the income. Since our data come from two different procedures (treatments), their effects is controlled using a dummy variable.[1]

Table 3.3 – *Estimation results for Model 2*

| Variables | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Relative marginal return | $-0.14579^{***}$ | $-0.14591^{***}$ | $-0.14597^{***}$ | $-0.15017^{***}$ |
| | (0.04170) | (0.04192) | (0.04234) | (0.04292) |
| Female | | | −0.01193 | −0.00854 |
| | | | (0.02239) | (0.02305) |
| Age | | | −0.03630 | −0.02965 |
| | | | (0.11720) | (0.11787) |
| Risk aversion | | | | 0.01942 |
| | | | | (0.03020) |
| Session | | ✓ | ✓ | ✓ |
| N | 179 | 179 | 179 | 179 |

The standard deviations are in parenthese.*** Significant at 1%, ** Significant at 5%, * Significant at 10%.

Table 3 gives the estimates results of the econometrical Model 2 that corresponds to equation (3.6). As a reminder, the main difference between Model 2 and Model 1 is that it explicitly considers the final belief relatively to the initial belief. As in Treatment 2 most individuals have not revised their beliefs, this model is only estimated for Treatment 1. The results are in line with those obtained with Model 1 but the relative marginal return impact in Model 2 is higher than the impact of marginal return in Model 1. Indeed, the relative marginal return on investment has a negative and significant effect on the negotiated income by individuals for all specifications. The elasticity value is between $-0.14579^{***}$ to $-0.15017^{***}$. As for Model 1, the variables ages, sex, risk and session do not affect individuals income.

scale of 1 to 10 where you think you are, 1 representing a person who is extremely careful and 10 representing a person who loves to take risks

[1]For all the considered specifications, the effect of the treatment is not statistically significant.

#### 3.3.3.3 Non-parametric test

Descriptive statistics reveal that individuals revise more in treatment 1 than in treatment 2 (Result 1). This difference in individual behavior could impact their expected incomes. Thus, the nonparametric Wilcoxon-Mann-Whitney test is used to test whether incomes are statistically different from one treatment to another. This test is commonly used by experimental economists for difference detection in central tendency between two samples (Feltovich 2003). We test the hypothesis Ho: income in treatment 1 and income in treatment 2 come from the same population. This test is based on equality of mean/median/mode of distributions.

**Result 3:** *In line with prediction 3, in treatment 2 when participants are endowed a new project after failure, the wage demanded is on average significantly inferior to the wage demanded in treatment 1, when participants keep the same project.*

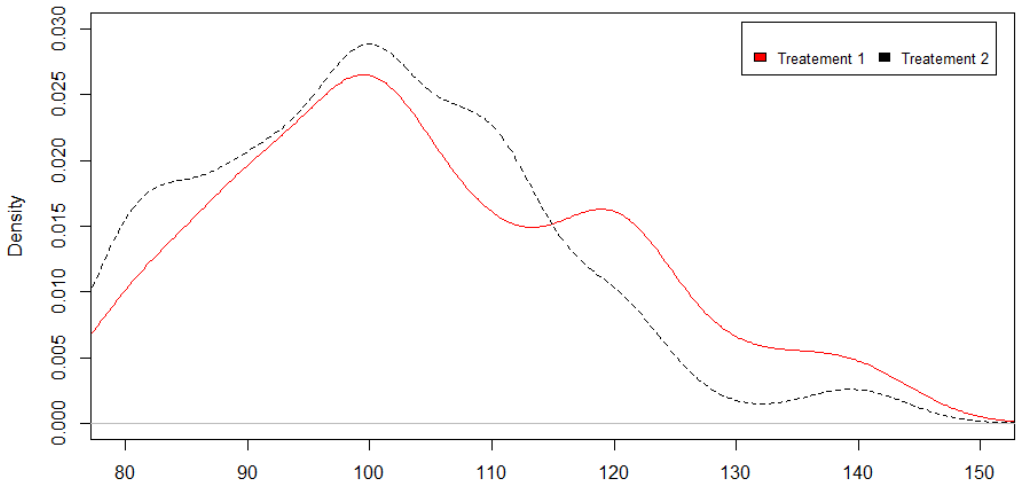



Figure 3.3 – *Distribution of wages in Treatments 1 & 2*

The results of test allow to reject the null hypothesis (P-value = 0.02466) at the 5% threshold. The average of income in treatment 1 is estimated at 104.77 EC (Sd = 15.75) and 100.59 EC (Sd = 13.73) for treatment 2. As observed in figure 3.3, for income level less than 115 EC, the frequency is higher in treatment 2 while it is higher in treatment 1 when income is higher than 115 EC. This high frequency for treatment 1 in extreme value of income (between 115 and 130) could be explained by the lower expectation of return on

investment as it is suggested by Result 2. We interpret that individuals that are pessimist about their chances of owning a high quality project will require a strong reward to make their investments worthwhile. It is then straightforward that this behavior occurred much more frequently in treatment 1 as the beliefs of owning the high quality project are smaller than in treatment 2 (Result 1). However, this is not the case in treatment 2 because the change of project was considered as a fresh start for individuals.

## 3.4 Conclusion

The aim of this experimental analysis was to investigate the issue of competition between peers and how it could be a major stake to explain how people accept inequality of wages . Most of the literature that deals with acceptation of inequality of revenue assumes some *inequity aversion* (Falk et al. 2008). Furthermore Ku and Salmon (2013) and Bolton et al. (2005) focus on the *procedural fairness* and highlight notably how people do not take merit (i.e a performance at a test) into account as a "fair" criteria of allocation of revenues but they rather prefer to take into the belonging to a social group. Our work wants to focus on how people are willing to accept a lower wage compared with their executive's incomes with respect to the procedure of selection of their executives. We particularly study how the choice of the nature of the task assessed to select executive might be crucial. Thus, we design an experiment that comprises a first phase that selects the higher performer among of two individuals to become the executive of the lower performer during the second phase of the experiment. The performance evaluated is the outcome they are able to make by investing in a investment project with a random return. None of them is aware in advance if they had received the most profitable project. After this competition only the employees has to invest again. We study two procedures. In the first procedure (treatment 1), the looser is asked to invest in the same project that the he one has been endowed before the competition, whereas in the second procedure (treatment 2) he receives a new investment project after his defeat, again without knowing if it is profitable or not. He is required to invest in that project in the second phase. We use a BDM procedure to elicit the wage he would request to invest heavily rather then lightly.

The main result observed in the experiment is that the wage demanded in the treat-

ment 1 is *on average* significantly higher than the wage demanded in treatment 2. We also observed that the wage demanded is negatively correlated with the belief in owning a profitable investment project and that this belief is inferior in treatment 1 than in treatment 2. These last two results obtained using econometrics methods allow us to interpret this difference in wages between the two treatments. Our interpretation is that the one who has failed as being promoted in treatment 1 will be more pessimist about his chances of owning the profitable project. He will then demand a higher wage to be incentivized to make a heavy investment in the next stage to make his investment worthwhile. Whereas in treatment 2, information received through the tournament about the return of the investment project they have endowed will be not relevant in the next phase anymore because the looser receives a new project after his defeat. This changing of investment project will be lived as a "fresh start". Those results fit with the theoretical findings. They study the limits of a procedure of selection where the best employees are promoted as executives. We argue these results question the efficiency of this kind of "merit based" promotion procedure to bolster the legitimacy of executive, in a sense that it would make inequality of wage more acceptable in the view of the employee.

Some interesting further research could be to add new treatments in the experiment. For example, what would be the consequences on bayesian inference if the opponents choose a different level of investment during the tournament? Indeed, for instance one participant could prefer invest a lot of his resources (effort or money) in the project and the other one few of his resources. This could shed new light on the role of effort during the competition as a way to bolster or undermine acceptation of inequality of income between a executive and his employee. Indeed, effort of the winner might exacerbate the discouragement of the looser during the second phase by exacerbating the spread between the two performances. Some others interesting further research would be to define more precisely what could be the ability that should be chosen to actually make employee accept more inequality. The idea would be to design real effort task. One specific ability for one specific task, like mathematical skills at an intelligence test for instance like Buser et al. (2018), could be required for the promotion and for the hierarchical relationship thereafter in a first treatment. Whereas in a second treatment we could change the required ability and the corresponding task, like verbal abilities for instance, and observe if the wage demanded is different between the two treatments.

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# General conclusion

This thesis studies how the procedures of selection of leaders chosen by an organization may bolster their legitimacy with regards to their employees. We also study how leaders may take into account these procedures to shape their strategies of leadership in order to bolster their legitimacy. The methodology is both theoretical, using contract theory, and experimental. The general framework in this thesis is to consider a two stage-game: the first stage is a tournament and the second is a hierarchical relationship such that the looser of the tournament becomes the subordinate of the winner.

The main idea is that legitimacy is treated by definition as the quality of a leader that does not need monetary incentive (or at least, who need few) to get the consent of his employee, namely to induce high effort from him. In our thesis, this spontaneous effort is incentivized by changing the informational environment of the employee about the efficiency of his effort. In other words, the degree of legitimacy of the leader, gives information to the employee that his own effort will be more or less rewarded in the future. The procedure chosen by the firm or the strategy chosen by the leader is then a lever to control a signal the employee has on the return of his effort. This will be the crucial stake to increase motivation and then effort. As a consequence this led us to define three concepts of legitimacy:

- A *procedural legitimacy*: the leader will be seen as legitimate if he was promoted through a competition with no favoritism. This kind of legitimacy will send a signal to the subordinate that it is unlikely he will be himself treated "unfairly" (i.e in a discriminatory way), such that his effort in the future will be "fairly" rewarded.

- A *meritocratic legitimacy*: the leader will be seen as legitimate if he demonstrates his ability to master the task or the knowledge of his own subordinate. The subordinate may evaluate his own ability to master operational task by comparing his own achievement with the performance of his executive. This could be a signal on the expected return of his effort and thus will change his motivation.

- An *aristocratic legitimacy*: the leader will be seen as legitimate if he is able to master specific managerial tasks that are only required from leaders and that the employee is unable to achieve. This is a more holistic approach where this managerial ability might indirectly enhance the productivity of the employee.

To deepen the analysis of those concepts we focus our thesis on four procedures of selection that the organization could choose. First, we study what we call an *internal procedure* and an *external procedure*. An *internal procedure* is a very intuitive process where future leaders are assessed by their peers. It means that the assessors during the selection process are the same persons than assessors during the hierarchical relationship itself. On the contrary, in an *external procedure*, the assessors during the selection process are external and neutral (in a sense that they do not evaluate the production during the hierarchical relationship). It corresponds to a more institutionalized process like using external contest in a public administration for instance or delegating the recruitment or promotions decision to a human resources department. Furthermore, we also study what we call a *meritocratic procedure* and an *aristocratic procedure*. A *meritocratic procedure* is a process where leaders are selected for their ability to master the task of their subordinates. It corresponds to promotion through experience in an organization. But it could also be theoretically an academic selection. Indeed, professionalizing trainings are typically a signal on competence of operational tasks required to the employee for instance. However, to our knowledge, we did not find any stylized fact that allows us to affirm that some high quality professionalized training would allow to be propelled at the top of the hierarchy right after finishing training. Thus that is why this interpretation of meritocratic procedure as a potential academic process is still a theoretical point of view. However, in the context of a selection established within an organization, we argue the *meritocratic procedure* is very common to promote people within a profession. Finally, the last procedure we study is an *aristocratic procedure*. It is a procedure where the organization selects leaders on their ability to master some managerial competences. This can be administrative skills or knowledges of the economics stake of the firm or general knowledges on the functioning of the organization and the professions that constitute it. It can be human skills or communication skills as well that may be required for a good management. This procedure is represented by high education with generalist training like some prestigious engineer training or business school. It can also represent a probation period designed by the firm where employees are expected to demonstrate a different ability than their routine tasks. It can

also be a more institutionalized process like internal contest for civil servants for example.

Our first chapter deals with the comparison between internal and external procedure. The objective of the chapter is to study theoretically how those processes may bolster or on the contrary undermine the *procedural legitimacy* that we have defined previously. We also study the role of effort to bolster legitimacy. We design a two-stage model where the winner of a tournament (stage 1) becomes the executive of his former opponent (stage 2). We show that effort may paradoxically bolster or undermine this type of legitimacy with respect to technological assumptions. Besides we show that, in bayesian terms, winning the competition reinforces the belief in being advantaged whereas loosing reinforces the belief in being disadvantaged. As a consequence, the winner will receive information about how his employee will be disadvantaged in the future and thus be less productive. This will tend to make winning the competition by being advantaged much less profitable. In order to incentivize more effort during the competition, the firm has to design an *external procedure* where opponents are not evaluated by their peers but by neutral and external people. Thus the competition will not bring information on a potential inequality of treatment in the future.

Our second chapter deals with the comparison between a meritocratic and an aristocratic procedures. The aim of this chapter is to study in a theoretical perspective how the choice of the competence on which an executive is evaluated to be promoted may be a crucial stake. We show that an *aristocratic procedure* where an executive is selected on a managerial ability will allow to increase his own wage, compared to a *meritocratic procedure* where he needs to demonstrate ability on the same task than his employee. The intuition is that it would neutralize the issue of rivalry with the employee by preserving the self confidence of the employee in spite he has failed at being promoted, making him easier to incentivize. The consequence is that selecting leaders on their ability to outperform their employees will tend to favor the emergence of a leadership culture of humility during the promotion process in a sense that opponents will strategically reduce their performances to preserve the self-confidence of their employees and then make him less costly to incentivize. On the contrary, selecting leaders on managerial ability will favor the emergence of a leadership culture of demonstration of strength. We argue this also could explain the emergence of ideological vacuum in internal electoral campaign in a parti. Indeed, it could be in the interest of two opponents that compete with each other to

become the leader of parti, to forsake the idea of elaborating a very precise and completed political program because in case of victory this program would be very cleaving, and it will send a signal to the looser that his own ideas will not be taken into account in the future. He would then not be cooperative and very costly to incentivize.

Our third chapter is an experimental work that aims to test some of the prediction highlighted in our second chapter. The aim of this chapter is to show how the willingness of an employee to accept inequality of wages between him and his executive will depend on the ability on which the executive is evaluated when he is promoted. This willingness to accept inequality is captured by the minimum wage enough to incentivize to work for his executive and is elicited through a Becker Degroot Marschak procedure. We show that selecting an executive on his ability to outperform his employee at his own task will be counterproductive to make employee accept inequality of wages. Abilities are represented by the random returns of investment projects they are endowed during the experiment. Those projects are randomly allocated such that participants do not know a priori if they have a profitable project or non profitable project. We argue this experiment confirms some of the predictions of the second chapter and that the efficiency of a *meritocratic procedure* may be challenged by this result.

Our work in this thesis is a highway for further research. Indeed, the procedures we have chosen to study and the general assumption we have made, notably on function of production, are not representative of the diversity of situations that may occur in a organization related to legitimacy issues. We argue we have established some concepts (based on the motivational aspect of legitimacy) and a theoretical framework (based on a tournament followed by a hierarchical relationship) that can be easily used as a basis for some theoretical extensions and that can constitute the basis of some experimental design as well.

A possible extension to our model in chapter 1 would be to change the objective of the organization by assuming simultaneously uncertainty on a potential preferential treatment and uncertainty on competence. We could then assume that an internal procedure, where candidates are evaluated by their colleagues, would assess better the competence than an external procedure. Indeed, external people could have very few information neither on candidates nor on the profession. Whereas colleagues, by their knowledge of the skills, and the knowledge of candidates in an long period, might have much more infor-

mation. As a consequence there could be a trade-off for the firm interesting to study. The firm could prefer to defuse suspicion on preferential treatment by choosing external procedure rather than choosing internal procedure and then reveal more ability. This issue is not trivial because we do not know *a priori* what would be more important in the eyes of the employee for his motivation between having a competent executive or believing that he will not be discriminated in the future and that his effort will be "fairly" rewarded. Besides, during the tournament upstream the hierarchical relationship, the external procedure might be so motivating to exert high effort that putting more effort could finally be a demonstration of ability as much valuable as internal procedure.

Our second chapter could also be used as a framework for further research. One of the limits of this chapter is that we did not formalize entirely the trade-off and the maximization program the organization in the first stage. We only focused on studying the comparison between the marginal return of effort of both opponents in a meritocratic and an aristocratic procedure. This allowed us to capture the incentive stake of those procedures during the tournament in the point of view of the organization but this could conceal some complexity. Indeed, the cost of implementing an aristocratic or a meritocratic procedure for the organization might not be necessary the same. The meritocratic procedure could be for instance less costly precisely because it could consist in evaluating subordinates on their ability to achieve a productive task. Whereas, the aristocratic procedure would then mobilize subordinate on a non productive task, which would then entail an opportunity cost. This could explain notably why a meritocratic procedures could be still used while our results suggest they should not be chosen by the organizations.

Another limit of our second chapter is the assumptions on the function of production in second stage. We could imagine a framework that would favor the emergence of a meritocratic procedure rather than an aristocratic procedure. Indeed, in the second chapter, we assume that there is uncertainty on managerial abilities but this could not be the case. We could assume that those managerial tasks would be so easy to master such that "anyone" could achieve them. As a consequence, it might then more optimal to select on business abilities. On the contrary, perhaps the incentive and rivalry stake in the second stage may be so major that it would be still interesting to select leader on another competence than their ability to outperform their subordinates at their own tasks. But there are other restrictive assumptions we make in the second stage. We assume that the executive and the subordinate are part of the same team with then a common output. We also assume that

the two business tasks of the executive and the subordinate are substitutable to each other, in order to capture that the mistake or the failure of one team partner can be compensated by the work of the other. Those assumptions explain notably why demonstrating business ability for the executive will incentivize his subordinate to rely on the ability of his executive rather than exerting effort himself. But we could also make different assumptions on the function of production. We could assume that there is no common output and that the business ability of the executive is not substitutable with the one of his subordinate but complementary. This would be close to the relationship where the business ability of the leader enhance the marginal return of the other a little bit like the managerial ability in our second chapter. Those assumptions may constitute a framework that would favor the emergence of a meritocratic procedure as the optimal procedure for the organization.

Another extension of our second chapter would be to assume that principal and agent never compete against each other but enter the firm at a different time. This hypothesis could make pointless the rivalry issue, that is central in this chapter. Indeed in this chapter, one of the purposes of selecting on managerial ability is precisely to neutralize rivalry's issues. As a consequence, selecting leaders and subordinates at different times, thus avoiding any possible comparison between them, could guarantee that it could be optimal for the organization to select on business competence. Besides, being aware that his leader was selected on his experience and his ability to master the task of his subordinates could send a highly motivating signal on the subordinate that people with the same professional profile can succeed and be rewarded.

Our experimental chapter, the third chapter, suggests also some further research. Indeed, we could add new treatments in the experiment. For example, we could be interested in what would be the consequences on the incentive wage demanded if participants do not invest the same amount during the tournament phase. Indeed, this could perfectly change bayesian learning after defeat. And so because it would create an ambiguity about what reason could be at the origin of winning the tournament between the effort or the competence. This could shed a new light on the consequence of the effort during the promotion process upstream the hierarchical relationship, to change the acceptation of inequality of wage between an executive and his subordinates. Some other interesting further research would be to design an experiment with real effort tasks. We could choose one specific task, requiring for example some specific skills like mathematical skills, to select the executive during the tournament phase. And then in one treatment we could ask

the looser of the tournament to continue exerting a task that requires mathematical skills, and in another treatment, ask him to perform another task that requires a completely different ability like knowledge in literature or grammar for instance. This kind of treatment could bring the advantage of being more realistic.

More generally speaking, our work in this thesis could offer interesting perspective on issues of monitoring and audit within organization but also on the functioning of audit firms in itself. Indeed, reporting and monitoring are also incentive mechanisms. We could use the same theoretical structure and create extensions to our models in order to explain how an appropriate procedure of selection, by bolstering his legitimacy, could allow a manager to loosen constraints of reporting and monitoring. About the functioning of audit firm, we could explain how an auditor "legitimate" could obtain the consent of his customers and the accounting information facilitating his work. In the spirit of our second chapter, it could also explain why it could be optimal that an auditor does not have the same educational background and professional profile than an account. More specifically, it could explain why auditors should never be former accounts. This approach might also be relevant for experimental research as we could design some monitoring simulations preceded by a selection stage that allow to split participants between those who will be monitored and those who will control. Different treatments could be used to test the efficiency of different procedures of selection.