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Essays in Corporate Finance and Competition Policy

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RÉSUMÉ

Cette thèse comporte quatre essais en finance d'entreprise et politique de concurrence. Le chapitre 1 s'intéresse à l'interaction entre la discipline exercée par les acquisitions et le niveau de tangibilité des actifs des entreprises. Les résultats empiriques convergent pour montrer qu'un affaiblissement de la discipline exercée par les acquisitions (mesuré par la présence de défenses ou de lois anti-OPA) a un effet négatif seulement sur la performance des entreprises intangibles. Cela suggère que la dette exerce un effet disciplinaire sur les managers des entreprises tangibles. L'étude empirique menée dans le chapitre 2 montre que le degré d'indépendance des cadres dirigeants vis-à-vis du Directeur Général a un impact positif sur la performance des entreprises et la qualité des décisions prises par le management.

Les deux derniers chapitres s'intéressent à la politique de lutte contre les ententes et aux programmes de clémence. Dans le chapitre 3, je présente un modèle théorique dans lequel l'autorité de la concurrence détient de l'information privée concernant la qualité des preuves initiales contre une entente. Je montre que l'introduction d'un programme de clémence permet alors à l'autorité de la concurrence de condamner une entente même quand les preuves initiales contre les entreprises sont faibles. Le dernier chapitre étudie l'impact des programmes de clémence sur l'effort exercé par l'autorité de la concurrence lors des enquêtes.

Mots-clés : Finance d'Entreprise ; Gouvernance d'Entreprise ; Défenses anti-OPA ; Cadres Dirigeants ; Politique de Concurrence ; Ententes ; Programmes de Clémence.

ABSTRACT

This thesis consists of four essays in corporate finance and competition policy. Chapter 1 focuses on the interaction between takeover discipline and asset tangibility. I show that higher takeover vulnerability (measured through takeover defenses and antitakeover laws) is associated with higher performance only in intangible firms. My favorite explanation is that tangible firms are already disciplined by debt. Chapter 2 empirically relates the internal organization of a firm with decision making quality and corporate performance. In a very robust way, firms with a smaller fraction of independent executives exhibit a lower level of profitability and lower shareholder returns following large acquisitions.

The two last chapters focus on cartel policy and leniency programs. In chapter 3, I present a model in which the Antitrust Authority is privately informed about the strength of a cartel case. I show that the Antitrust Authority can then obtain confessions even when it has no chance of finding hard evidence. Chapter 4 studies the impact of leniency programs on prosecution effort.

Keywords: Corporate Finance; Corporate Governance; Takeover Defenses; Executives; Competition Policy; Collusion; Leniency Programs.

Contents

Introduction

Partie I : Finance & Gouvernance d'Entreprise

En 1932, Adolf Berle et Gardiner Means insistaient déjà dans leur livre *"The Modern Corporation and Private Property"* sur les enjeux posés par la séparation entre actionnaires et dirigeants des grandes sociétés cotées. La gouvernance d'entreprise vise à résoudre les conflits d'agence nés de cette séparation entre la propriété et le contrôle. À partir d'angles d'analyse différents, les deux premiers chapitres de cette thèse soulignent l'importance de la gouvernance d'entreprise sur la performance des sociétés cotées. Le chapitre 1 met en perspective deux mécanismes de gouvernance, à savoir la pression exercée par les acquisitions (hostiles) et la discipline exercée par la dette. Le chapitre 2 s'intéresse à l'organisation interne des entreprises, et propose une nouvelle mesure de gouvernance fondée sur le degré d'indépendance des cadres dirigeants vis-à-vis du PDG.

Discipline des Acquisitions et Tangibilité des Actifs

Une littérature récente, initiée par l'article de Gompers, Ishii et Metrick (2003), montre que les entreprises exposées aux acquisitions (exposition mesurée par l'absence de défenses anti-OPA dans les statuts de l'entreprise) ont en moyenne des rendements boursiers et une valeur des actifs plus élevés. Certains travaux vont plus loin et identifient les entreprises ou les industries pour lesquelles le degré d'exposition aux acquisitions a une importance de premier ordre. Les articles de Giroud et Mueller (2010, 2011) montrent que les entreprises opérant dans les industries non-concurrentielles bénéficient davantage d'une exposition forte aux acquisitions que les entreprises opérant dans les industries concurrentielles ; Cremers and Nair (2005) montrent qu'une exposition forte aux acquisitions est associée avec une performance élevée seulement quand la qualité de la gouvernance interne, mesurée par la concentration de l'actionnariat ou la présence d'investisseurs institutionnels, est elevée.

Dans le chapitre 1 de ma thèse, je montre que les entreprises "intangibles" bénéficient davantage d'une exposition forte aux acquisitions que les entreprises "tangibles". Mon explication favorite est que la dette exerce déjà un effet disciplinaire sur les managers des entreprises "tangibles". À contrario, la dette n'est pas un mécanisme disciplinaire approprié pour les entreprises intangibles. Un niveau de dette élevé est problématique pour ces entreprises généralement caractérisées par des coûts de faillite élevés et des flux financiers volatils. La corrélation forte entre niveau de dette et tangibilité des actifs documentée par les études empiriques (Harris et Raviv (1991), Rajan et Zingales (1995), Titman et Wessels (1998), Rauh et Sufi (2012)) étaye cette hypothèse.

J'aborde ensuite la question de l'endogénéité des défenses anti-OPA. En particulier, il est possible que la corrélation positive entre exposition aux acquisitions et performance soit due au fait que les managers des entreprises en difficulté ont une incitation à mettre en place des défenses anti-OPA. Cette hypothèse peut expliquer mes résultats si, à la suite de mauvaises performances, les managers des entreprises intangibles sont plus susceptibles de mettre en place des protections anti-OPA que les managers des entreprises tangibles. Il se peut par exemple que le niveau de dette des entreprises tangibles soit suffisant pour dissuader les acquisitions (Stulz (1988), Harris et Raviv (1988)).

Pour traiter cette question, j'utilise l'adoption des lois anti-OPA comme un choc exogène sur le marché de prise de contrôle des enteprises (Bertrand et Mullainathan (2003), Chen, Nagar et Rajan (2004), Long et Wald (2007), Qiu et Yu (2009), Yun (2009), Giroud et Mueller (2010)). Je montre que l'introduction d'une loi anti-OPA conduit à une forte baisse de la performance des entreprises intangibles, alors que cela n'a pratiquement aucun effet sur la performance des entreprises tangibles. De manière similaire, l'annonce dans la presse des lois anti-OPA a un impact négatif seulement sur les rendements boursiers des entreprises intangibles.

Pour finir, j'apporte des éléments empiriques corroborant l'idée que la menace de la faillite permet de compenser un affaiblissement de la gouvernance externe. Je montre qu'une exposition forte aux acquisitions a un effet positif sur la performance des entreprises faiblement endettées, alors que cet effet n'est pas significatif sur la performance des entreprises endettées. La littérature empirique s'intéressant aux effets disciplinaires des acquisitions mentionne occasionnellement l'effet disciplinaire de la dette. Cremers et Nair (2005) montrent que la complémentarité entre le degré d'exposition aux acquisitions et l'activisme des actionnaires est observée seulement pour les entreprises faiblement endettées, et font remarquer que ce résultat est cohérent avec le rôle disciplinaire de la dette. L'article de Safieddine et Titman (1999) examine 573 tentatives de prise de contrôle entre 1982 et 1991 et montre que la performance future de l'entreprise cible est positivement corrélée avec l'accroissement de son niveau de dette autour de la tentative de prise de contrôle. Selon les auteurs, cela suggère que la dette force les managers de l'entreprise cible à prendre les décisions qui auraient été prises par l'acquéreur.

Dans l'ensemble, les résultats empiriques du chapitre 1 de ma thèse indiquent que le mécanisme disciplinaire approprié entre dette et exposition aux acquisitions dépend des caractéristiques des actifs de l'entreprise. Cela a des implications importantes en terme de gouvernance d'entreprise, suggérant par exemple que les propriétaires d'une entreprise intangible devraient éviter de mettre en place des défenses anti-OPA lors d'une introduction en bourse (Daines et Klausner (2001), Field et Karpoff (2002)).

Indépendance des Dirigeants et Performance des Entreprises

Dans le chapitre 2,[1] nous nous intéressons aux effets de l'indépendance des cadres dirigeants sur la qualité des décisions et la performance des entreprises. Les académiques et les praticiens ont admis depuis longtemps l'idée qu'en l'absence d'une surveillance rapprochée, les P.D.G des grandes entreprises cotées pouvaient prendre des décisions allant à l'encontre de l'intérêt de leurs actionnaires. Pour mettre en place des contre-pouvoirs au P.D.G., le consensus préconise de se reposer sur un conseil d'administration fort et indépendant du management. La littérature académique confirme le fait que l'indépendance des conseils d'administration permet une amélioration de la gouvernance des entreprises.[2] Cependant, elle n'apporte pas d'éléments empiriques indiquant que l'indépendance des conseils d'administration affecte la profitabilité ou la valeur des actifs d'une entreprise.[3]

[1] Le chapitre 2 de ma thèse est tiré d'un article écrit en collaboration avec Augustin Landier, David Sraer et David Thesmar : "Bottom-Up Corporate Governance", à paraître dans la Review of Finance.

[2] Les conseils d'administration "indépendants" semblent mieux prendre en compte la performance de l'entreprise lorsqu'ils décident de la rémunération ou du licenciement du P.D.G (Weisbach, 1988; Dahya et al., 2002). Le marché salue la nomination d'administrateurs indépendants avec des rendements anormaux positifs (Rosenstein and Wyatt, 1990)

[3] En réalité, la corrélation est négative. Une raison probable est que les entreprises en difficulté ont tendance à

Ce chapitre de ma thèse propose une mesure de gouvernance nouvelle et facile à mettre en oeuvre, basée sur le degré d'indépendance des cadres dirigeants vis-à-vis du P.D.G. Il montre que, contrairement à l'indépendance des conseils d'administration, l'indépendance des dirigeants vis-à-vis du P.D.G. prédit de manière forte la performance des entreprises.

Nous retenons de la littérature existante l'idée que la notion d'indépendance est importante, et orientons notre analyse sur les cadres dirigeants. Après tout, les P.D.G interagissent quotidiennement avec les autres cadres dirigeants, alors qu'ils ne rencontrent le conseil d'administration que quelques fois par an. Afin de mesurer le degré d'indépendance des cadres dirigeants vis-à-vis du P.D.G., nous calculons la fraction de cadres dirigeants qui ont rejoint l'entreprise *avant* que le P.D.G. soit nommé à son poste. Comme le P.D.G. est généralement impliqué dans le recrutement des autres cadres dirigeants, il est probable que ceux engagés après que le P.D.G. a été nommé à son poste partagent ses préférences et/ou qu'ils aient des incitations à lui "renvoyer l'ascenseur". Parallèlement, il est probable que les dirigeants ayant connu le leadership d'un autre P.D.G. contestent plus librement les décisions du management actuel.

Notre étude fournit tout d'abord des preuves qu'une bonne gouvernance interne (i.e. une fraction élevée de cadres dirigeants indépendants) prédit une plus forte profitabilité future, que ce soit en terme de performance opérationnelle ou de valeur des actifs. En revanche, de mauvaises performances ne conduisent *pas* à une diminution de la gouvernance interne, ce qui suggère un effet causal de la gouvernance interne sur la performance. Les résultats restent similaires lorsque nous contrôlons pour des mesures traditionnelles de gouvernance "externe". Nous montrons également que nos résultats ne sont pas simplement la conséquence du départ de cadres dirigeants anticipant de mauvaises performances à venir.

Nous étudions ensuite l'impact de la gouvernance interne sur la qualité des prises de décisions. Pour cela, nous examinons les acquisitions des entreprises, qui sont des projets d'investissement aux effets mesurables. Nous montrons qu'une plus faible fraction de cadres dirigeants indépendants est associée, suite à une acquisition importante, à des rendements boursiers plus faibles pour les actionnaires. À contrario, les indices standards de gouvernance externe ne sont pas corrélés aux pertes réalisées par les actionnaires suite à une acquisition. Il semblerait donc que le conseil d'administration, la pression des acquisitions ou le contenu des statuts de l'entreprise soient moins

engager plus d'administrateurs indépendants (Kaplan et Minton, 1994).

efficaces pour éviter de mauvaises acquisitions que la pression exercée par une équipe dirigeante indépendante.

Ces résultats empiriques font écho à un modèle théorique (Landier et al., 2009) montrant que les divergences de préférences le long de la chaîne de commande peuvent, dans certaines circonstances, avoir un effet positif sur la qualité des prises de décision. Dans ce modèle, un "Décideur" (par exemple le P.D.G.) doit choisir entre deux projets, mais a une préférence intrinsèque (un biais) pour l'un des deux. Le Décideur reçoit également une information objective (un signal) indiquant le projet qui a la probabilité la plus forte de réussir. La réalisation du projet requiert un effort des "Implémenteurs" (par exemple, les autres cadres dirigeants). Les Implémenteurs peuvent soit préférer le même projet que le P.D.G (chaîne de commande monolithique) ou l'autre (divergence des préférences). Landier et al. (2009) montre que les Implémenteurs dont les préférences sont différentes de celles du Décideur peuvent être utiles car ils forcent le Décideur à internaliser leur motivation. Le Décideur, s'il veut que le projet soit un succés, doit alors moins prendre en compte ses propres préférences. Les implémenteurs prennent à leur tour cela en considération et s'attendent à ce que le choix soit plus objectif : ils exercent alors davantage d'effort. Dans l'ensemble, de meilleures décisions sont prises. En parallèle, l'article montre que les divergences de préférences entre le Décideur et les Implémenteurs sont particulièrement utiles quand l'entreprise est confrontée à un environnement très incertain. Nous fournissons dans notre étude quelques éléments empiriques qui étayent cette prédiction.

À un niveau plus général, une contribution importante de ce chapitre est de proposer une variable "organisationnelle", définie au niveau de l'entreprise, possédant un pouvoir prédictif robuste sur les performances futures. Il se peut que notre indice de gouvernance interne mesure simplement l'étendu du pouvoir du P.D.G sur l'entreprise : les "P.D.G. puissants" sont peut-être plus susceptibles de réaliser des acquisitions inefficaces et de replacer les cadres dirigeants par leurs amis, sans qu'il y ait un lien clair entre ces deux comportements. La nouveauté est que notre mesure est la première à avoir une corrélation forte avec la performance des entreprises. A cet égard, notre indice est plus performant que les mesures traditionnelles du "pouvoir du P.D.G", comme la proportion d'administrateurs membre du management ou encore le fait que le P.D.G. préside ou non le conseil d'administration. Il s'avère que notre indice de gouvernance interne n'est pas corrélé avec les mesures traditionnelles de gouvernance externe.

Deux implications normatives pour les praticiens méritent d'être retenues de cette étude. Tout d'abord, notre analyse statistique indique que l'intensité d'une telle "gouvernance interne" peut être, au moins partiellement, observée et pourrait donc être intégrée dans les différents indices de qualité de gouvernance d'une entreprise. Cette remarque est indépendante de l'interprétation de nos résultats : qu'ils signalent la présence d'un P.D.G. non-autoritaire ou bien la saine discipline pour le P.D.G. d'avoir à convaincre les autres membres de l'équipe dirigeante, la fraction de cadres dirigeants indépendants telle que nous la mesurons prédit de manière robuste la performance future. La seconde implication s'appuie sur notre interprétation favorite, celle d'une "gouvernance par le bas" : en plus de surveiller le management et de le conseiller, un rôle clé du conseil d'administration devrait consister à mettre en place un équilibre des pouvoirs au sein de l'entreprise. Dit autrement, le rôle du conseil d'administration en tant que direction des ressources humaines ne se limite pas au problème de la succession du P.D.G., mais devrait également s'étendre au reste de l'équipe dirigeante. Ce rôle est particulièrement important au sein des industries, comme la finance, où le management des risques est essentiel. Par exemple, Ellul et Yerramilli (2010) montre que les banques ayant une fraction plus elevée de risk-managers indépendants ont mieux résisté à la crise financière de 2007-2008.

Partie II : Politique de Concurrence et Programmes de Clémence

La politique de lutte contre les ententes est confrontée au problème majeur de l'accès aux preuves. Pour répondre à ce défi, la plupart des pays développés se sont dotés de "programmes de clémence" qui offrent, sous certaines conditions, un traitement favorable aux entreprises repentantes en échange de preuves matérielles indiquant l'existence d'une entente. Spagnolo (2004) et Motta et Polo (2003) ont initié une littérature théorique visant à mesurer l'efficacité de ses programmes et à émettre des recommendations concernant la manière optimale de les concevoir. Le chapitre 3 contribue à cette littérature en proposant un modèle dans lequel l'autorité de la concurrence détient de l'information privée concernant la qualité des preuves initiales contre une entente. Le chapitre 4 étudie l'impact des programmes de clémence sur l'effort exercé par l'autorité de la concurrence lors des enquêtes.

Lutte contre les Ententes et Programmes de Clémence : le Rôle du Bluff dans l'Ouverture des Enquêtes

Le *Department of Justice* (DoJ) aux Etats-Unis et la Commission Européenne ont fait du démantelement des ententes une priorité, comme en témoigne la forte augmentation des amendes infligées aux entreprises condamnées.[4] Dans l'Union Européenne, l'amende record de 1 383€ millions contre des producteurs de verre automobile en est une autre illustration : il s'agit des amendes les plus élevées que la Commission ait jamais infligées dans une affaire d'entente, tant à une seule entreprise (896€ millions pour Saint Gobain) qu'à l'ensemble des membres d'une entente.

Une étape essentielle du développement de la politique Antitrust aux Etats-Unis fut la révision en 1993 de son programme de clémence. Dans sa version initiale,[5] la clémence était accordée aux entreprises repentantes de manière discrétionnaire. La nouvelle version du programme garantit de manière automatique l'amnistie totale à la première entreprise qui dénonce l'existence d'une entente ; par ailleurs, une clémence partielle peut-être accordée même lorsqu'une enquête est en cours. Pour finir, le DoJ a également mis en place en complément un programme de clémence pour les personnes physiques en 1994 qui protège les informateurs de sanctions pécuniaires et de poursuites pénales.[6] Depuis sa révision en 1993, le programme de clémence pour les entreprises a été l'outil d'investigation le plus efficace du DoJ ; il a notamment permis de démanteler des ententes internationales dans le secteur des vitamines et des électrodes de graphite.[7] Le niveau élevé des amendes, associé au fait de restreindre l'éligibilité au premier informateur, est généralement cité comme la clé du succès du programme de clémence américain. Cette logique de "batôn et carotte" est à l'origine des révisions récentes (2002 et 2006) du programme de clémence européen qui s'est avéré être également très efficace pour lutter contre les ententes.[8] Récemment, environ deux-tiers

[4] Aux Etats-Unis, les amendes avoisinaient 315$ millions par an entre 1995 et 1999 contre 628$ millions entre 2005 et 2009. Dans l'Union Européenne, l'augmentation est encore plus importante, de 54€ millions par an entre 1995 et 1999 contre 1 951€ millions entre 2005 et 2009.

[5] Le DoJ a introduit son premier programme de clémence en 1978.

[6] Dans l'Union Européenne, les violations de l'Article 81 et 82 ne peuvent pas faire l'objet de poursuites pénales. En particulier, les personnes physiques ne peuvent pas condamnées à des peines de prison.

[7] L'entente illicite dans le secteur des vitamines a été démantelée en 1999 grâce à la coopération de Rhône-Poulenc SA. Les deux principaux membres de l'entente, à savoir Hoffmann-La Roche et BASF, ont payé respectivement des amendes de 500$ millions et 225$ millions, alors que l'amende infligée à Rhône Poulenc a été annulée. Dans le cas des électrodes de graphite (1999), l'entreprise ayant coopéré jouait un role secondaire dans l'entente mais ses informations ont permis au DoJ de réunir des preuves suffisantes pour condamner les autres membres de l'entente. Au total, les entreprises de l'entente ont payé 400$ millions et trois personnes ont écopé de peines de prison (entre 9 et 17 mois).

[8] Pour plus de détails sur les différences et les similitudes des programmes de clémence américain et européen, voir la révue de Spagnolo (2007).

des condamnations prononcées par la Commission Européenne ont pour origine une demande de clémence.

La littérature théorique, initiée par les articles de Motta et Polo (2003) et Spagnolo (2004), a confirmé le fait qu'un programme de clémence bien conçu contribue à déstabiliser les ententes. Spagnolo (2004) et Rey (2003) soulignent par exemple que la clémence accroît les gains des entreprises qui dévient d'une entente car elle leur permet, en échange d'information, de ne pas payer d'amendes. Spagnolo (2004) montre qu'il est possible de dissuader ex ante la formation d'une entente en accordant à la première entreprise qui dénonce l'entente une récompense égale à la somme des amendes infligées aux autres membres. En parallèle, Aubert, Rey et Kovacic (2006) souligne que récompenser les personnes physiques contribue également à déstabiliser les ententes car les employés doivent alors être soudoyés pour garder le silence.

Plusieurs articles identifient cependant des effets indésirables qui diluent la dissuasion. La clémence réduit les sanctions imposées et accroît ainsi l'attrait des stratégies du type "collusion et confession" (Motta et Polo (2003), Spagnolo (2004)). De plus, les programmes de clémence renforcent potentiellement la collusion en donnant aux membres d'une entente un outil pour punir ceux qui dévient (Buccirossi et Spagnolo (2006) dans le contexte de transactions bilatérales illégales). Il est utile de remarquer que restreindre l'éligibilité au premier informateur réduit le risque de ces deux scénarios indésirables.

Les études empiriques, confrontées au caractère secret des ententes, utilisent des méthodes indirectes pour évaluer l'impact des programmes de clémence sur le comportement des entreprises. Harringon et Chang (2009) proposent un modèle de formation et de dissolution des ententes qui permet de tester l'efficacité d'un nouvel outil de clémence. En particulier, l'effet dissuasif de la clémence peut être évalué à travers les changements à court terme observés sur la durée de vie des ententes détectées. Le modèle de Miller (2009) permet, quant à lui, d'inférer la fréquence de création des ententes à partir du nombre d'ententes détectées. Il applique sa méthode aux procès verbaux émis par le DoJ entre 1985 et 2005 et montre que l'évolution du nombre d'ententes détectées autour de la révision en 1993 du programme de clémence américain indique une amélioration de l'effet dissuasif du programme. A contrario, l'article de Brenner (2009) montre que l'introduction d'une politique de clémence dans l'Union Européenne en 1996 (sans restriction de l'éligibilité au premier informateur et sans amnistie totale) n'a pas eu d'effet clair sur la dissuasion des ententes.

Cela suggère que la conception des programmes de clémence est un élément clé de leur réussite.

À défaut de dissuader leur formation, les autorités de concurrence doivent tenter de détecter les ententes et de les démanteler. La condamnation des producteurs de verre automobile souligne le rôle de la clémence lorsqu'une enquête est en cours. Selon la Commission Européenne :

"La Commission a ouvert cette enquête de sa propre initiative sur la base d'informations fiables transmises par un informateur anonyme. Ces informations ont incité la Commission à réaliser des inspections inopinées en 2005 sur plusieurs sites de producteurs de verre automobile en Europe. À l'issue de ces inspections, l'entreprise japonaise Asahi Glass Co. et sa filiale européenne AGC Flat Glass Europe (anciennement Glaverbel) ont présenté une demande au titre de la communication sur la clémence de 2002... Asahi/Glaverbel ayant coopéré pleinement avec la Commission et lui ayant fourni des informations complémentaires qui ont permis de révéler l'existence de l'infraction, son amende a été réduite de 50 %."

On peut en déduire que les inspections n'ont pas été une réussite totale puisque la *Communication de la Commission sur l'immunité d'amendes* (2006) spécifie que :

"Afin de pouvoir prétendre à une telle réduction, une entreprise doit fournir à la Commission des éléments de preuve de l'infraction présumée qui apportent une valeur ajoutée significative par rapport aux éléments de preuve déjà en possession de la Commission."

La période qui suit l'ouverture d'une enquête est généralement un jeu de dupes. L'autorité de la concurrence peut ouvrir une enquête en prétendant que la condamnation est probable, dans l'espoir que les entreprises dénoncent elles-mêmes l'entente. Le modèle présenté dans le chapitre 3 de ma thèse explore cette idée.

Formellement, je considère un jeu répété standard dans lequel les entreprises décident de se faire concurrence ou de former une entente. L'autorité de la concurrence doit réunir des preuves tangibles pour condamner l'entente. Quand les entreprises forment une entente, l'autorité de la concurrence reçoit un signal binaire (bon ou mauvais) qui détermine la probabilité de condamner les membres de l'entente dans le cas où une enquête serait ouverte, un mauvais signal étant associé à une faible probabilité. Comme les membres d'une entente n'observent pas le signal, il est possible qu'ils avouent leurs activités illégales même quand l'autorité de la concurrence ouvre une enquête après avoir reçu un mauvais signal. Dans ce cas, l'entente est démantelée bien qu'il était initialement peu probable que l'autorité de la concurrence puisse obtenir la condamnation des entreprises par ses propres moyens.

Le modèle développé dans ce chapitre s'inspire de Motta et Polo (2003). Dans leur modèle, la clémence permet à l'autorité de la concurrence de faire des économies sur le coût des enquêtes, et les ressources ainsi libérées renforcent les possibilités de détection. Une contribution importante de mon modèle est d'introduire de l'information privée du côté de l'autorité de la concurrence. Je montre alors que cet avantage informationnel, associé à de la clémence, accroît la probabilité de condamner les ententes. Cela renforce l'effet dissuasif du programme quand les règles d'éligibilité sont choisies de manière optimale.

Le modèle que je présente a d'importantes implications. En particulier, contrairement aux recommandations des politiques de clémence aux Etats-Unis et dans l'Union Européenne, les résultats du modèle suggèrent que la clémence devrait être accordée même lorsque le risque initial de condamnation est élevé.

Programmes de Clémence et Effort d'Investigation

Le chapitre 4 de ma thèse étudie l'impact des programmes de clémence sur l'effort exercé par l'autorité de la concurrence lors des enquêtes. Pour cela, je compare les politiques antitrust dans un modèle où la probabilité de condamner les entreprises est endogène. Dans l'article de Motta et Polo (2003), la clémence facilite l'obtention des pièces à conviction, ce qui permet aux autorités de concurrence de faire des économies sur le coût des enquêtes. Je montre dans ce chapitre qu'introduire un programme de clémence peut également pousser l'autorité de la concurrence à exercer davantage d'effort lors des enquêtes. De plus, je montre que l'effort exercé et l'efficacité intrinsèque de l'autorité sont des substituts stratégiques quand la clémence est offerte. Ce n'est pas le cas en l'absence de clémence.

Chapter 1

Takeover Discipline and Asset Tangibility

1.1. Introduction

A recent literature, starting with Gompers, Ishii and Metrick (2003), shows that firms with less takeover defenses have on average higher firm value and equity returns. However, we know less about the type of firms or industries in which takeover vulnerability matters relatively more. In this line of research, Giroud and Mueller (2010, 2011) show that firms in non-competitive industries benefit more from high takeover vulnerability than do firms in competitive industries. Cremers and Nair (2005) find that higher takeover vulnerability is associated with higher performance only when the quality of internal governance, proxied by public pension fund and blockholder ownership, is high.

In this paper, we show that higher takeover vulnerability is associated with higher performance only in intangible firms. Our favorite explanation is that debt already disciplines managers of tangible firms. In contrast, debt is not an appropriate disciplinary mechanism for intangible firms. Intangible firms have low liquidation values and low asset redeployability, and therefore, they might prefer to avoid debt and delegate monitoring to the market for corporate control. The idea that bankruptcy costs are large and thus that debt is not suitable for intangible firms has been often emphasized in the literature,[1] and is consistent with the strong positive association between leverage

[1] Aghion et al. (2004) mention that:
"These [bankruptcy costs] are likely to be relatively low for firms with a high proportion of tangible capital among their assets, particularly property, and equipment associated with generally applicable technologies. They are likely to be higher for innovative firms with a higher proportion of intangible assets, such as knowledge and reputation, and with more specialized equipment."

and asset tangibility documented by empirical studies (Harris and Raviv (1991), Rajan and Zingales (1995), Titman and Wessels (1998), Rauh and Sufi (2012)).[2]

A concern with firm-level takeover defenses is that they are likely to be endogenous. In particular, the positive association between takeover vulnerability and performance might be driven by the fact that managers of firms with low performance have incentives to adopt takeover defenses. However, this entrenchment hypothesis may explain our results only if following bad performance, managers of intangible firms are more likely to adopt takeover defenses than managers of tangible firms. Along these lines, it might be the case that high leverage is enough to deter takeovers (Stulz (1988), Harris and Raviv (1988)) in tangible firms.

In order to address endogeneity, we use the adoption of business combination laws as an exogenous shock to the market for corporate control (Bertrand and Mullainathan (2003), Cheng, Nagar and Rajan (2004), Long and Wald (2007), Qiu and Yu (2009), Yun (2009), Giroud and Mueller (2010)). We find that the introduction of a business combination law leads to a large decrease in operating performance for intangible firms, whereas it has virtually no effect on the performance of tangible firms. In the same vein, we find that press announcements of business combination laws have a significant negative effect on stock prices only for intangible firms.

Finally, we provide further evidence about the fact that the threat of bankruptcy substitutes for good external corporate governance. We find that higher takeover vulnerability has a positive impact on the performance of low-leverage firms, whereas it has no significant impact on the performance of high-leverage firms. The empirical literature on external corporate governance occasionally mentions the disciplinary role of debt. Cremers and Nair (2005) show that the complementarity between the market for corporate control and shareholder activism exists only in low-leverage firms, pointing out that this is consistent with the disciplinary role of debt. However, they do not investigate the direct effect of takeover vulnerability on the performance of low- and high-leverage firms. Examining a sample of 573 unsuccessful takeover attempts between 1982 and 1991, Safieddine and Titman (1999) find that the performance of former targets following failed

and Rajan and Zingales (1998) note that:
"too much debt is bad for companies that rely on intangible or specialized assets such as customer confidence, ideas, or people."

[2] This is not direct evidence however that intangible firms tend to avoid debt. Because intangible cash flows are on average more volatile than tangible ones, a low debt level might be enough to discipline managers of intangible firms.

takeovers is positively related to the change in the target's leverage ratio. Their explanation is that leverage commits managers to make the improvements that would be made by potential raiders.

Overall, our evidence indicates that the appropriate disciplinary mechanism between debt and takeovers depends on the characteristics of the firm assets. This has important implications for governance design. Our results suggest for instance that owners of intangible firms should avoid installing takeover defenses at the IPO (Daines and Klausner (2001), Field and Karpoff (2002)).

Our findings also echo the literature studying the influence of creditors on corporate governance. According to Nini, Smith and Sufi (2012), the role of creditors in corporate governance "could provide a partial explanation for why establishing a strong, causal relationship between equity-centered governance and performance is so weak". Consistent with their claim, we find that the positive relationship between takeover discipline and performance is strong only when the influence of creditors in corporate governance is low.

The rest of the paper proceeds as follows. Section 1.2 describes the hypotheses on the effects of takeover vulnerability in tangible and intangible firms. Section 1.3 presents the data on takeover defenses and examines the relationship between takeover vulnerability, asset tangibility and performance. Section 1.4 presents the data and the empirical methodology on business combination laws and looks at their effects on operating performance and stock returns. In section 1.5, we run additional regressions to test whether the threat of bankruptcy is a substitute for good external corporate governance. Section 1.6 concludes.

1.2. Development of the Hypotheses

A large theoretical literature (e.g. Grossman and Hart (1982), Jensen (1986), Dewatripont and Tirole (1994), Hart and Moore (1995)) emphasizes the role of debt in mitigating agency problems between managers and investors. First, debt limits managerial discretion by forcing the firm to disgorge cash flows (Jensen (1986)). Debt discipline also rests on debtholders' ability to exercise control when the firm defaults on its debt contract. Managers dislike default because they incur significant losses in that case. They generally experience large salary and bonus reductions (Gilson and Vetsuypens (1993)) when the firm is in financial distress; moreover, managerial turnover is about three times larger in financially distressed firms than in non-financially distressed firms

(Gilson (1989)).[3] Ex ante, this gives managers incentives to exert effort in order to avoid default.

However, when cash flows are stochastic, debt discipline is costly because it triggers (inefficient) liquidation in some states of the world. Liquidation – or more generally, financial distress – is relatively more costly for intangible firms. Gompers (1995) notes that the liquidation value of assets is increasing in their tangibility because tangible assets – e.g. machines and plants – are on average easier to sell than intangible assets – e.g. patents and copyrights. Since costs of financial distress are relatively large for intangible firms, these firms might prefer to avoid debt and delegate monitoring to the market for corporate control.[4] Beyond the costs of financial distress, debt is also not suitable to finance intangible projects because their cash flows are volatile and difficult to forecast.

The corporate finance literature also extensively mentions the role of takeovers in disciplining managers (e.g. Manne (1965), Jensen (1988), Scharfstein (1988), Shleifer and Vishny (1997)). Takeovers are more likely to occur following bad performance (Morck et al. (1989), Martin and McConnell (1991)), in which case managers are more likely to be replaced (Mikkelson and Partch (1997), Kini et al. (2004)). The prospect of being fired following a takeover pushes ex ante managers to exert effort. This view receives additional strong empirical support in Edmans et al. (2012), which identifies the disciplinary effect of takeovers by instrumenting stock prices with mutual fund redemptions: their findings indicate that low market valuations substantially raise the probability of takeovers.

Our discussion yields the following predictions:

Hypothesis 1 (Performance). The positive relation between takeover vulnerability and performance is stronger in intangible firms than in tangible firms.

Our argument in favor of this hypothesis is that debt already disciplines managers of tangible firms. We test for this hypothesis using data on takeover defenses and business combination laws. Our measures of performance are return on assets and Tobin's Q. We also examine stock prices around press announcements of business combination laws.

[3] In the same vein, Ozelge and Saunders (2012) and Nini, Smith and Sufi (2012) show that a covenant violation significantly increases the probability of forced CEO turnover.

[4] In the same vein, Williamson (1988) argues that liquidation is particularly costly when assets are not easily redeployable – and thus that equity, rather than debt, should be used to finance such assets.

Hypothesis 2 (Takeover defenses). Tangible firms have more takeover defenses than intangible firms.

If takeover vulnerability matters relatively more for the performance of intangible firms, shareholders of intangible firms are likely to be more active in fighting against the adoption of takeover defenses than shareholders of tangible firms. On average, intangible firms should thus have less takeover defenses than tangible firms.

Hypothesis 3 (Threat of bankruptcy). The positive relation between takeover vulnerability and performance is stronger in low-leverage firms than in high-leverage firms.

To get further confidence on the disciplinary role of debt, we analyze the interplay between takeover vulnerability, leverage and performance. If the threat of bankruptcy has a disciplinary effect, we should observe a lower impact of takeover discipline on the performance of high-leverage firms, which have on average a higher default probability than low-leverage firms.

We do not claim that debt is the only force driving the relations between takeover discipline, asset tangibility and performance. An alternative force is information asymmetry. The relative scarcity of public information on intangible firms makes good corporate governance a relatively more important issue for investors of these firms. As mentioned by Almeida and Campello (2007), asset tangibility reduces information asymmetry because tangible assets' payoffs are easier to observe.

1.3. Takeover Defenses

1.3.1 Data

Sample

Our initial sample consists of all firms in the Investor Responsibility Research Center (IRRC) database that have a match in Compustat. The IRRC database is available at WRDS and provides information about corporate governance provisions for the years 1990, 1993, 1995, 1998, 2000, 2002, 2004 and 2006. Following common practice, we use the information from the latest available publication to fill in the missing years. In each year, the firms present in the IRRC database account for more than 90 % of the total US stock market capitalization. Following Gompers, Ishii, and Metrick (2003), we exclude from our sample all firms with dual-class shares. We also exclude financial firms (SIC 6000 − 6999). Our sample period is from 1990 to 2007.

Our main measure of takeover vulnerability is the Entrenchment index (denoted hereafter, E) proposed by Bebchuk, Cohen and Ferrell (2009) which comprises 6 provisions restricting shareholder rights – namely classified board, limitations to amend bylaws, limitations to amend the charter, supermajority for merger approval, poison pill and golden parachute. In robustness checks, we use the Gompers, Ishii and Metrick (2003)'s Governance index (denoted hereafter, G), the Cremers and Nair (2005)'s Alternative Takeover Index (denoted hereafter, ATI) and a dummy indicating classified board as alternative measures of takeover vulnerability.[5]

Definition of variables

Asset tangibility. Our main measure of asset tangibility is the ratio of property, plant and equipment (Compustat item PPENT) over total assets. We rank firms according to their mean asset tangibility over the sample period. We then define "intangible firms" ("tangible firms") as firms with mean asset tangibility below (above) the median of the ranking. Following the same procedure, we also rank firms in four tangibility levels. In robustness checks, we compute goodwill-adjusted asset tangibility, defined as the ratio of property, plant and equipment over total assets minus goodwill (item GDWL), and cash-adjusted asset tangibility, defined as the ratio of property, plant and equipment over total assets minus cash holdings (item CHE).

Other accounting variables. We use two measures of performance, namely return on assets (ROA) and Tobin's Q. ROA is defined as operating income before depreciation and amortization (item OIBDP) over total assets.[6] Tobins' Q is the market value of assets divided by the book value of assets, where the market value of assets is the book value of assets plus the market value of common stock (item CSHO × item PRCC_F) minus the sum of the book value of common stock

[5] The G index comprises 24 provisions. The ATI index comprises three provisions: preferred blank check, classified boards and restrictions on calling special meetings and action through written consent. Bebchuk and Cohen (2005) shows that classified boards are associated with a significant reduction in firm value.

[6] Reporting rules about the recognition of R&D costs differ across industries. For instance, SFAS 86 issued by the FASB in 1985 allows R&D costs for software to be capitalized and amortized. Results are unchanged if we use operating income after depreciation and amortization over total assets as an alternative measure of operating performance.

(item CEQ) and balance sheet deferred taxes (item TXDB). Tobin's Q and ROA are industry-adjusted by subtracting the industry median in a given 48 Fama-French industry and year. Industry medians are computed using all available Compustat firms. We construct the 48 Fama-French industry dummies by matching the firm's 4-digit Standard Industrial Classification (SIC) codes of Compustat to the 48 Fama-French industries using the conversion table in the Appendix of Fama and French (1997). We follow the same procedure to construct the 10 Fama-French industries by using the table obtained from Kenneth French's website.

We use firm size, firm age, leverage, cash holdings and capital expenditures as control variables. Firm size is the logarithm of total assets. Firm age is the logarithm of one plus the number of years since the firm has been in Compustat. (Book) leverage is total debt (item DLC plus item DLTT) over total assets. Cash holdings and capital expenditures (item CAPX) are scaled by total assets. To reduce the effect of outliers, we winsorize (industry-adjusted) ROA, (industry-adjusted) Tobin's Q, book leverage, cash holdings and capital expenditures over total assets at the 1% and 99% of their empirical distribution.

Summary statistics

Table 1.1 presents summary statistics. Panel A shows firm characteristics. Column [1] reports data for the full sample. Columns [2] and [3] report data for both intangible and tangible firms. The spread in asset tangibility is large: intangible firms have a mean asset tangibility of 16% whereas tangible firms have a mean of 53%. The mean (median) book leverage of intangible firms is 20% (18%), compared to 30% (30%) for tangible firms. This is consistent with previous studies indicating that leverage increases with asset tangibility (Harris and Raviv (1991), Rajan and Zingales (1995)). Interestingly, the average intangible firm has net leverage - defined as the difference between leverage and cash holdings – close to 0. This suggests that the average intangible firm – unlike the average tangible firm – faces basically no risk of bankruptcy. Finally, the mean and the median of the industry-adjusted measures of performance are positive, pointing out that the sample firms, which consist of relatively large firms, are more profitable than the other firms in Compustat. Panel B shows a broad industry distribution of the sample based on the 10 Fama-French industries classification. Intangible and tangible firms strongly differ in terms of industry distribution. 87%

of “Hi-Tech” firms and 74% of “Healthcare” firms are intangible firms; conversely, 94% of “Energy” firms, 99% of “Utilities” and 75% of “Telecommunications“ firms are tangible firms. For the other industries (Nondurables, Durables, Manufacturing, Shops, Other), the proportion of intangible firms range between 43% and 60%.

Table 1.1: Takeover Defenses - Summary Statistics

Panel A of this table presents summary statistics (mean, median and standard deviation) on firm characteristics. Asset tangibility is property, plant and equipment (Compustat item PPENT) over total assets (item AT). Intangible firms (Tangible firms) comprise all firms with an asset tangibility mean over the sample period below (above) the median. Size is the logarithm of total assets. Age is the logarithm of one plus the number of years since the firm has been in Compustat. Return on assets (ROA) is operating income before depreciation and amortization (item OIBDP) divided by total assets in the current year. Tobin's Q is the market value of assets divided by the book value of assets, where the market value of assets is the book value of assets plus the market value of common stock (item CSHO × item PRCC_F) minus the sum of the book value of common stock (item CEQ) and balance sheet deferred taxes (item TXDB). Tobin's Q and ROA are industry-adjusted by subtracting the industry median in a given 48 Fama-French industry and year. Book leverage is long-term debt (item DLTT) plus short-term debt (item DLC) over total assets. Cash is cash holdings (item CHE) divided by total assets. Capital expenditure (item CAPX) is divided by total assets. The E index is the Bebchuk, Cohen and Ferrell (2009)'s Entrenchment index. Tobin's Q, ROA, leverage, cash holdings and capital expenditure are winsorized at the 1^{st} and 99^{th} percentiles. Panel B shows a broad industry distribution of the sample based on the 10 Fama-French industries classification. The share of intangible/tangible firms as a percentage of the total number of firms per industry is reported in parenthesis. The sample period is from 1990 to 2007.

Panel A: Firm Characteristics	*All Firms* Mean (Median) [SD] [1]	*Intangible Firms* Mean (Median) [SD] [2]	*Tangible Firms* Mean (Median) [SD] [3]
Asset Tangibility (%)	34.30 (28.45) [23.65]	15.69 (15.27) [8.662]	52.85 (51.32) [18.78]
Size	7.226 (7.093) [1.514]	6.876 (6.679) [1.497]	7.576 (7.481) [1.448]
Age	3.139 (3.296) [0.670]	2.990 (2.996) [0.661]	3.228 (3.526) [0.639]
(Industry-adjusted) ROA (%)	4.236 (2.681) [10.67]	5.319 (4.028) [12.37]	3.157 (1.684) [8.531]
(Industry-adjusted) Tobin's Q	0.285 (0.014) [1.021]	0.357 (0.023) [1.211]	0.216 (0.009) [0.792]
Cash (%)	12.13 (5.303) [15.79]	18.16 (10.82) [18.85]	6.104 (2.771) [8.422]
(Book) Leverage (%)	25.22 (24.70) [18.48]	20.31 (17.59) [18.73]	30.10 (30.25) [16.86]
Capital Expenditure (%)	6.068 (4.769) [4.947]	3.833 (3.171) [2.280]	8.297 (6.817) [5.574]
E Index	2.193 (2) [1.281]	2.128 (2) [1.262]	2.259 (2) [1.297]
Panel B: Industry Distribution	*All Firms* Obs.	*Intangible Firms* Obs. (%)	*Tangible Firms* Obs. (%)
Consumer Nondurables	1,324	751 (56.72)	573 (43.28)
Consumer Durables	674	404 (59.94)	270 (40.06)
Manufacturing	4,506	1,956 (43.41)	2,550 (56.59)
Energy	1,013	59 (5.82)	954 (94.18)
HiTech	3,954	3,453 (87.33)	501 (12.67)
Telecommunications	439	109 (24.83)	330 (75.17)
Shops	2,851	1,306 (45.81)	1,545 (54.19)
Healthcare	1,711	1,273 (74.40)	438 (25.60)
Utilities	2,043	21 (0.01)	2,022 (99.99)
Other	2,755	1,293 (46.93)	1,462 (53.07)
Total	21,270	10,625	10,645

1.3.2 Results

Performance

We examine in this section whether takeover vulnerability has a different effect on the performance of tangible and intangible firms. Figure 1.1 provides a first look at the relationship between the E index and performance for intangible and tangible firms.

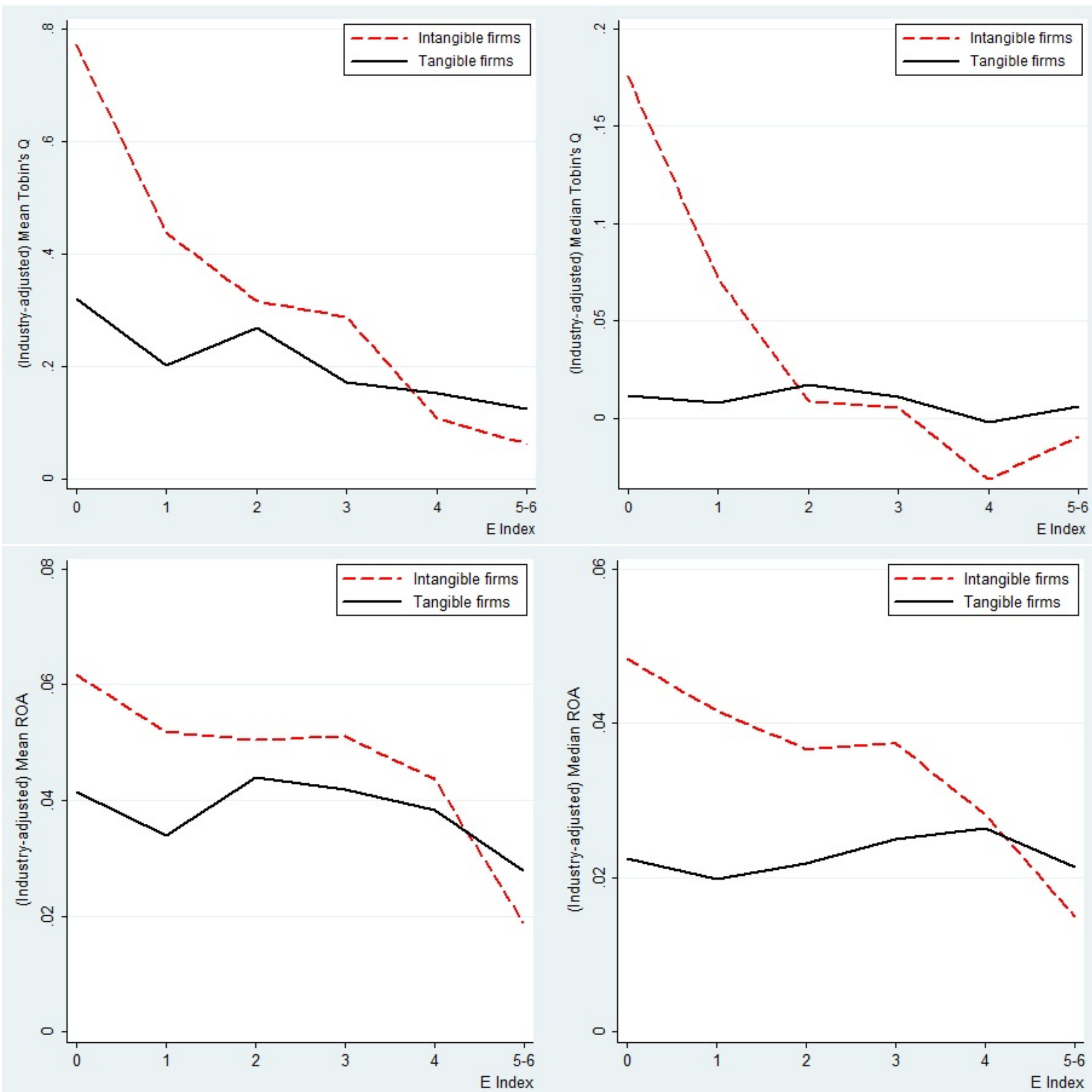


Figure 1.1: Takeover vulnerability and performance

Performance is measured through Tobin's Q (Figure 1.1, top) and through ROA (Figure 1.1, bottom). For each point of the E index, we present the mean and the median of the industry-adjusted measures of performance for both intangible and tangible firms. Figure 1.1 shows a clear negative association between poor takeover vulnerability (high value of the E index) and performance, but only so for intangible firms. This pattern holds for both the average and the median firm.

We move to a multivariate analysis and estimate the following equation:

$$Y_{it} = \alpha_j + \alpha_t + \beta_0 I_{\text{intangible},i} + \beta_1 E_{it} + \beta_2 (E_{it} \times I_{\text{intangible},i}) + \gamma (Controls)_{it} + \epsilon_{it} \tag{1.1}$$

Y_{it} measures industry-adjusted Tobin's Q of firm i in fiscal year t. Regressions with industry-adjusted ROA as the dependent variable are presented in the Appendix A ; the results are comparable, although statistically weaker. α_t and α_j – j indexes the 48 Fama-French industries – are respectively year- and industry-fixed effects. Using industry-fixed effects rather than firm-fixed effects is motivated by the fact that firms rarely change their governance provisions. E_{it} is the E index associated to firm i in year t. $I_{\text{intangible},i}$ equals one if firm i is an intangible firm and 0 otherwise. We include the control variables used by Gompers, Ishii and Metrick (2003), namely firm size, firm age, whether the firm is incorporated in Delaware and whether the firm belongs to the S&P 500. We include as additional controls book leverage, cash holdings over total assets, and capital expenditure over total assets.[7] We cluster standard errors at the firm level to account for serial correlation of the error term within the same firm. The coefficients of interest are β_1 and β_2. β_1 measures the effect of a one-point increase in the E index on the performance of tangible firms. β_2 captures whether the E index has an additional effect on the performance of intangible firms. The total effect of a one-point increase in the E index on the performance of intangible firms is β_1+β_2.

[7] We obtain similar results if we do not include these additional controls.

Table 1.2: Takeover Defenses and Tobin's Q

This table presents estimated coefficients from panel regressions of (industry-adjusted) Tobin's Q on the E index and control variables. Control variables are a Delaware dummy, an S&P 500 dummy, firm size, firm age, cash holdings, book leverage and capital expenditure. The intangible dummy equals one if the firm is an intangible firm, that is if the firm has a mean asset tangibility over the sample period below the median. In panel B, the sample is restricted to Democracies ($E = 0$) and Dictatorships ($E \geq 4$). Regressions include year and industry fixed effects. Standard errors, presented in parenthesis, are clustered at the firm level. The sample period is from 1990 to 2007. The coefficients are multiplied by 100 for expositional convenience. *, ** and *** denotes significance at the 10%, 5% and 1%, respectively.

Dependent Variable:	TOBIN'S Q					
	Panel A: All Sample			Panel B: Democracies versus Dictatorships		
	[1]	[2]	[3]		[4]	[5]
E	-5.589***	-1.960	-	Dict $\{0,1\}$	-29.71***	-7.702
	(1.231)	(1.344)			(6.295)	(7.006)
E * Intangible $\{0,1\}$	-	-7.431***	-	Dict $\{0,1\}$ *	-	-46.93***
		(2.501)		Intangible $\{0,1\}$		(12.34)
E * Tangibility Quartile= 1	-	-	-11.48***		-	-
			(3.192)			
E * Tangibility Quartile= 2	-	-	-6.919**		-	-
			(2.771)			
E * Tangibility Quartile= 3	-	-	-2.773		-	-
			(2.270)			
E * Tangibility Quartile= 4	-	-	-0.541		-	-
			(1.331)			
Intangible $\{0,1\}$	-	29.83***	-	Intangible $\{0,1\}$	-	50.14***
		(8.265)				(14.18)
Tangibility Quartile= 2	-	-	-21.39*		-	-
			(12.16)			
Tangibility Quartile= 3	-	-	-35.61***		-	-
			(11.68)			
Tangibility Quartile= 4	-	-	-67.50***		-	-
			(10.90)			
Size	-4.484***	-4.104**	-3.539**	Size	-2.636	-1.535
	(1.667)	(1.678)	(1.669)		(3.066)	(3.000)
Age	-14.01***	-13.69***	-13.36***	Age	-17.98***	-16.87***
	(3.039)	(3.009)	(3.024)		(4.933)	(4.812)
Delaware	-0.150	-0.380	-0.107	Delaware	-9.540	-9.024
	(3.581)	(3.601)	(3.577)		(6.628)	(6.529)
S&P 500	48.22***	48.13***	47.76***	S&P 500	31.91***	30.64***
	(4.624)	(4.625)	(4.600)		(7.258)	(7.063)
Cash	175.5***	170.3***	165.5***	Cash	167.7***	155.9***
	(15.57)	(15.41)	(15.13)		(32.99)	(32.22)
Leverage	-51.87***	-48.68***	-46.45***	Leverage	-73.81***	-67.52***
	(10.76)	(10.67)	(10.68)		(22.17)	(21.44)
Capital Expenditure	352.2***	392.2***	438.4***	Capital Expenditure	323.0***	390.2***
	(34.61)	(34.41)	(34.11)		(69.85)	(71.30)
Industry Fixed Effects	Yes	Yes	Yes	Industry Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Year Fixed Effects	Yes	Yes
R^2	0.18	0.18	0.19	R^2	0.21	0.22
Observations	19,499	19,499	19,499	Observations	5,282	5,280

The first three columns of Table 1.2 present the results. Consistent with the literature, column [1] shows that an increase in the E index is associated on average with a significant drop (at the 1% level) in Tobin's Q. In column [2], we include the interaction term between the E index and the intangible dummy. We find that a higher E index has no significant effect on the Tobin's Q of tangible firms, whereas it is associated with a significant drop in the Tobin's Q of intangible firms. As for the economic significance of the findings for intangible firms, a one-standard deviation increase in the E index (1.3) is associated with a reduction in industry-adjusted Tobin's Q of 12.2 percentage points ((2.0+7.4)*1.3).

In column [3], we sort firms into four tangibility quartiles. We then interact the E index with a set of 4 dummies, indicating each quartile. We find that the coefficient on the E index is monotonic over the quartiles. Moreover, the coefficient is small and insignificant in the two bottom quartiles (high asset tangibility) and large and significant in the two top quartiles (low asset tangibility). For firms in the top quartile, a one-standard deviation increase in the E index is associated with a reduction in industry-adjusted Tobin's Q of 14.9 percentage points (11.5*1.3).

Democracies versus Dictatorships. As a robustness check, we follow Core, Guay and Rusticus (2006) and examine differences in performance between Democracy firms and Dictatorship firms. We define Democracies as firms with a E index equal to 0, and Dictatorships as firms with a E index equal or above 4. We restrict the sample to Democracies and Dictatorships and estimate the following equation:

$$Y_{it} = \alpha_j + \alpha_t + \beta_0 I_{\text{intangible},i} + \beta_1 Dict_{it} + \beta_2 (Dict_{it} \times I_{\text{intangible},i}) + \gamma (Controls)_{it} + \epsilon_{it} \qquad (1.2)$$

Y_{it} measures industry-adjusted Tobin's Q of firm i in fiscal year t. α_j and α_t are industry and year-fixed effects. $Dict$ is a dummy variable that takes the value of 1 if the firm is a Dictatorship and 0 if the firm is a Democracy. The control variables are the same as in Equation (1.1).

Column [4] of Table 1.2 shows that Democracy firms have on average a higher Tobin's Q than Dictatorship firms. In Column [5], the coefficient on the dictatorship dummy is small (-7.7) and insignificant whereas the coefficient on the interaction term is large (-47.0) and significant at the 1% level. We obtain an estimated difference in Tobin's Q between intangible democracy firms and intangible dictatorship firms of 54.7 percentage points ($7.7 + 47.0$). This estimate is consistent with the difference computed from column [2], which is between 37.6 ($(7.4 + 2.0) * 4$) and 56.4 ($(7.4 + 2.0) * 6$).

Table 1.3: Takeover Defenses and Tobin's Q
Robustness

This table presents estimated coefficients from variants of regression [2] in Table 1.2. Only the coefficients on the E index and on the interaction term are reported. In row [1], we sort firms into two equal-sized groups based on asset tangibility computed in their year of entry in the sample. In row [2], we sort firms into two equal-sized groups based on the asset tangibility of their respective 48 Fama-French industry. Industry asset tangibility is computed by taking the mean asset tangibility of all firms in Compustat for each 48 Fama-French industry. The E index is replaced by the G index in row [3], by the ATI index in row [4] and by a Classified Board dummy in row [5]. We sort firms into two groups based on goodwill-adjusted tangibility (resp. cash-adjusted tangibility) in row [6] (resp. row [7]). Goodwill-adjusted tangibility is property, plant and equipment over total assets minus goodwill (item PPENT / (item AT - item GDWL)). Cash-adjusted tangibility is property, plant and equipment over total assets minus cash holdings (item PPENT / (item AT - item CHE)). In row [8], we exclude Hi-Tech firms (SIC codes 3570–3579, 3622, 3660–3692, 3694–3699, 3810–3839, 7370–7379, 7391, 8730–8734). In row [9], we exclude Utilities (SIC codes 4900–4949). In rows [10] and [11], we split the sample into two groups based on the sample HHI median. HHI is the Herfindahl-Hirschman index, which is computed as the sum of squared market shares of all firms in a given 48 Fama-French industry. Market shares are computed from Compustat based on firms' sales (item SALE). Standard errors, presented in parenthesis, are clustered at the firm level. The sample period is from 1990 to 2007. The coefficients are multiplied by 100 for expositional convenience. *, ** and *** denotes significance at the 10%, 5% and 1%, respectively.

Dependent Variable:		TOBIN'S Q	
	E	E * Intangible	Obs.
[1] Asset Tangibility (Initial value)	-3.022^{**}	-4.977^{**}	19,438
	(1.460)	(2.507)	
[2] Industry Asset Tangibility	-3.333^{**}	-4.752^{*}	19,499
	(1.493)	(2.507)	
[3] G index	0.136	-3.183^{***}	19,499
	(0.613)	(1.137)	
[4] ATI index	2.589	-11.94^{***}	19,499
	(1.880)	(3.510)	
[5] Classified Board Dummy	4.471	-25.74^{***}	19,499
	(3.875)	(6.715)	
[6] Goodwill-adjusted Tangibility	-3.777^{**}	-5.354^{*}	17,154
	(1.539)	(2.781)	
[7] Cash-adjusted Tangibility	-3.292^{**}	-4.800^{*}	19,480
	(1.441)	(2.50)	
[8] Excluding Hi-Tech	−1.922	-6.086^{**}	16,013
	(1.300)	(2.813)	
[9] Excluding Utilities	−2.597	-6.879^{***}	17,498
	(1.609)	(2.654)	
[10] Competitive Industries	−1.839	-7.287^{**}	9,875
	(1.542)	(3.488)	
[11] Non-competitive Industries	−2.553	-6.947^{**}	9,624
	(2.101)	(3.177)	

Robustness. We estimate here variants of Equation (1.1). Table 1.3 presents the results.

Alternative sorting. In row [1], we sort firms into two equal-sized groups based on asset tangibility computed in their year of entry in the sample. In row [2], we sort firms into two equal-sized groups based on the asset tangibility of their respective 48 Fama-French industry. Industry asset tangibility is computed by taking the mean asset tangibility of all firms in Compustat for each 48 Fama-French industry. In both cases, we obtain similar, although weaker results. The coefficient on the E index becomes statistically significant, but the impact is low in economic terms: a one-standard deviation increase in the E index is in both cases associated with a decrease in Tobin's Q of around 4 percentage points. Moreover, the coefficient on the interaction term remains large and significant.

Alternative measures of takeover vulnerability. In rows [3] to [5], we use alternative measures of takeover vulnerability, namely the G index, the ATI index and the classified board dummy. The results are very similar to those in Table 1.2. While the coefficients on either the G index, the ATI index or the classified board dummy are small and insignificant, the coefficients on the interaction term are large and significant at the 1% level. As for the economic magnitude of the effect, a one-standard deviation increase in the G index (respectively the ATI index, and the classified board dummy) is associated with a decrease in Tobin's Q of 8.1 percentage points (respectively 8.6, and 10.5), which is close to the estimate associated with a one-standard deviation increase in the E index.

Alternative measures of tangibility. In rows [6] to [7], we use alternative measures of asset tangibility. A concern associated to the use of the baseline asset tangibility measure is that we are implicitly sorting firms with respect to their acquisition activity: acquisitions generate goodwill which mechanically decreases the ratio of property, plant and equipment over total assets. To address this point, we adjust asset tangibility for goodwill.[8] Goodwill-adjusted asset tangibility is defined as the ratio of property, plant and equipment over total assets minus goodwill. Goodwill represents 14% (8.1%) of the intangible assets – defined as total assets minus property, plant and equipment – of the average (median) sample firm. We also run Equation (1.1) with a cash-adjusted measure of asset tangibility, which is the ratio of property, plant and equipment over

[8] Goodwill is the difference between the target's purchase price and the fair value of its assets.

total assets minus cash holdings. In both cases, we obtain similar, although weaker, results. The coefficient on the E index becomes statistically significant, but the impact is low in economic terms: a one-standard deviation increase in the E index is associated with a decrease in Tobin's Q of 4.9 percentage points (4.3) when asset tangibility is adjusted for goodwill (cash). Moreover, the coefficient on the interaction term remains large and significant.

Industries. We also investigate whether our results are not driven by any specific industry. "Hi-Tech" firms represent a large fraction of intangible firms. In row [8], we exclude the "Hi-Tech" sector and obtain similar results. Conversely, utilities represent a non-negligible fraction of tangible firms. Excluding utilities also yields similar results (row [9]). More generally, we find in untabulated regressions that removing any of the 10 Fama-French industries yields similar findings.

Competition. Mueller and Giroud (2011) argue that high takeover vulnerability matters only in non-competitive indutries where the lack of competitive pressure fails to discipline managers. Our results might be driven by Giroud and Mueller (2011) findings if, for instance, intangible firms are more likely to belong to non-competitive industries. To address this issue, we split the sample into competitive and non-competitive industries in rows [10] and [11]. We follow Mueller and Giroud (2011) and we compute, for each fiscal year and 48 Fama-French industry, the Herfindahl-Hirschman index (HHI), defined as the sum of squared market shares:

$$HHI_{jt} \equiv \sum s_{ijt}^2 \tag{1.3}$$

s_{ijt} is the market share of firm i in industry j in fiscal year t. We compute market shares from Compustat using firms' sales (item SALE). [9] We then sort firms into competitive and non-competitive industries using the sample HHI median. We find that high takeover vulnerability is associated with a significant decrease in the performance of intangible firms both in competitive and non-competitive industries. As an additional robustness check (results not presented), we add the HHI as control in Equation (1.1). Doing so has no material effects on the results.

Overall, the evidence obtained so far indicates that takeover vulnerability has an economically and statistically significant impact only on the performance of intangible firms. This result is robust

[9] We obtain similar results if we compute the HHI at the three-digit SIC code level, or if we use the "C4", which is the sum of market shares of the four largest firm in a 48 Fama-French industry.

to alternative measures of takeover vulnerability, alternative measures of asset tangibility, and the degree of competition pressure. Moreover, it is not driven by any specific industry.

Asset tangibility and shareholder rights

We investigate here whether intangible firms have on average a higher exposure to takeovers than tangible firms. As we find that takeover vulnerability matters relatively more for the performance of intangible firms, shareholders of intangible firms are likely to be more active in fighting against the adoption of takeover defenses than shareholders of tangible firms. Moreover, in tangible firms, debtholders might ask for the adoption of takeover defenses in order to protect the value of their claims against potential raiders.[10] We sort firms into tangibility quartiles and estimate the following equation:

$$E_{it} = \alpha_j + \alpha_t + \beta_0 I_{\text{TQ}=1,i} + \beta_1 I_{\text{TQ}=2,i} + \beta_2 I_{\text{TQ}=3,i} + \gamma(Controls)_{it} + \epsilon_{it} \tag{1.4}$$

E_{it} is a measure of takeover vulnerability (E index, G index, ATI index or the classified board dummy) of firm i in fiscal year t. α_j and α_t are industry and year-fixed effects. $I_{\text{TQ}=1}$ ($I_{\text{TQ}=2}$, $I_{\text{TQ}=3}$) is a dummy variable that takes the value of 1 if the firm belongs to the first (second, third) tangibility quartile. The control variables are firm age, firm size, whether the firm is incorporated in Delaware and whether the firm belongs to the S&P 500.

Table 1.4 presents the result. Whether takeover vulnerability is measured using the E index, the G index, the ATI index or the classified board dummy, intangible firms have on average less takeover defenses than tangible firms. This finding is consistent with the view that tangible firms, which are more likely to be financed by debt than intangible firms, reduce their exposure to takeovers in order to mitigate debtholders-shareholders conflicts.

[10] Firms with less takeover defenses face higher bond and loan spreads (Klock, Mansi and Maxwell (2005), Cremers, Nair and Wei (2007), Chava, Livdan and Purnanandam (2009)). Similarly, Francis et al. (2010) find that state antitakeover laws tend to decrease bond yields and increase bond values.

Table 1.4: Asset Tangibility and Takeover Defenses

This table presents estimated coefficients from panel regressions of takeover vulnerability measures on asset tangibility and control variables. Control variables are a Delaware dummy, an S&P 500 dummy, firm size and firm age. Regressions include year and industry fixed effects. Standard errors, presented in parentheses, are clustered at the firm level. The sample period is from 1990 to 2007. *, ** and *** denotes significance at the 10%, 5% and 1%, respectively.

Dependent Variable:	E INDEX	G INDEX	ATI INDEX	CLASSIFIED BOARD
	[1]	[2]	[3]	[4]
Tangibility Quartile= 3	-0.197*	-0.023	-0.087	-0.074*
	(0.101)	(0.223)	(0.074)	(0.040)
Tangibility Quartile= 2	-0.312***	-0.194	-0.179**	-0.125***
	(0.108)	(0.233)	(0.0801)	(0.0431)
Tangibility Quartile= 1	-0.423***	-0.619***	-0.203**	-0.149***
	(0.116)	(0.240)	(0.086)	(0.046)
Size	-0.071***	0.026	0.048***	-0.007
	(0.024)	(0.051)	(0.018)	(0.010)
Age	0.244***	1.127***	-0.014	-0.012
	(0.047)	(0.095)	(0.033)	(0.018)
Delaware	0.194***	-0.171	0.351***	0.025
	(0.059)	(0.124)	(0.042)	(0.023)
S&P 500	0.156**	0.437***	0.063	-0.001
	(0.070)	(0.146)	(0.051)	(0.028)
Industry Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
R^2	0.08	0.16	0.10	0.05
Observations	21,270	21,270	21,270	21,270

1.4. Instrumental Approach: Business Combination Laws

As mentioned in the introduction, takeover defenses are likely to be endogenous. In order to address this concern, we use the adoption of state antitakeover laws as an exogenous shock to the market for corporate control. US States enacted three generations of antitakeover laws. The first generation laws were deemed unconstitutional by the Supreme Court in 1982. As a response, some states passed second generation laws that were declared constitutional by the Supreme Court in 1987, which pushed more states to vote what was called third generation antitakeover laws.[11] Following Bertrand and Mullainathan (2003) and Giroud and Mueller (2010), we restrict our attention to business combination (BC) laws which are the most stringent among the second and third generation

[11] For more details about antitakeover laws, see Bertrand and Mullainathan (2003).

antitakeover laws.[12] BC laws were passed in 30 states between 1985 and 1991.[13] They impose a moratorium on certain kinds of transactions (in particular asset sales and mergers) between a large shareholder and a firm for a period usually ranging between three and five years after the shareholder's stake reaches a pre-specified threshold.

1.4.1 Data

Sample. Our initial sample consists of all firms in Compustat located and incorporated in the United States. We exclude all observations for which total assets or sales are either missing or non-positive. We also exclude financial firms. The sample period is from 1976 to 1995, which is the same period as in Bertrand and Mullainathan (2003) and Giroud and Mueller (2010).

Compustat only reports the state of incorporation for the latest available year. Bertrand and Mullainathan (2003) checked in a randomly selected sample of 200 firms if any of these firms had change their state of incorporation. They found only three changes, all of the them to Delaware and before the passage of the 1988 Delaware antitakeover law.[14]

We follow Giroud and Mueller (2010) and use ROA, defined as operating income before depreciation and amortization over total assets, as the main measure of operating performance. To mitigate the effect of outliers, we follow Giroud and Mueller (2010) and trim ROA at the 1^{st} and 99^{th} percentiles. The definition of control variables is the same as in section 1.3.

Summary statistics. Table 1.5 presents summary statistics. Panel A shows firm characteristics. Column [1] reports data for the full sample. The average firm is younger and smaller than in the takeover defenses sample, which is due to the fact that data on takeover defenses are available only for large firms. Columns [2] and [3] report data for intangible and tangible firms. The spread in asset tangibility is almost identical to the one in the takeover defenses sample: intangible

[12] Karpoff and Malatesta (1989) find that among antitakeover laws, press announcements of BC laws had the most negative effect on stock prices.

[13] The 30 states are Arizona (1987), Connecticut (1989), Delaware (1988), Georgia (1988), Idaho (1988), Illinois (1989), Indiana (1986), Kansas (1989), Kentucky (1987), Maryland (1989), Massachusetts (1989), Maine (1988), Michigan (1989), Minnesota (1987), Missouri (1986), New Jersey (1986), Nevada (1991), New York (1985), Ohio (1990), Oklahoma (1991), Pennsylvania (1989), Rhode Island (1990), South Carolina (1988), South Dakota (1990), Tennessee (1988), Virginia (1988), Washington (1987), Wisconsin (1987) and Wyoming (1989). Years are from Bertrand and Mullainathan (2003).

[14] Similarly, Cheng, Nagar and Rajan (2005) find that none of the 587 *Forbes* 500 firms in their sample changed their state of incorporation during the sample period from 1984 to 1991; and Yun (2009) shows that about 1% of the 212 manufacturing firms in his sample changed their state of incorporation during a sample period from 1987 to 2000.

firms have a mean asset tangibility of 20%, whereas tangible firms have a mean of 55%. As for the takeover defenses sample, intangible firms are smaller, younger, have lower leverage and hoard more cash than tangible firms.

Panel B shows a broad industry distribution of our sample based on the 10 Fama-French industries classification. The industry distributions of tangible and intangible firms mirror those from the takeover defenses sample (Table 1.1, Panel B). A large majority of "Hi-Tech" and "Healthcare" firms are intangible firms, and a large majority of "Energy", "Telecommunications" and "Utilities" firms are tangible firms.

Table 1.5: Business Combination Laws – Summary Statistics

Panel A of this table presents summary statistics (mean, median and standard deviation) on firm characteristics. The definition of variables is the same as in Table 1.1, except that ROA is not industry-adjusted. Panel B shows a broad industry distribution of the sample based on the 10 Fama-French industries classification. The share of intangible/tangible firms as a percent of the total number of firms per industry is reported in parenthesis. The sample period is from 1976 to 1995.

Panel A: Firm Characteristics	*All Firms* Mean (Median) [SD] [1]	*Intangible Firms* Mean (Median) [SD] [2]	*Tangible Firms* Mean (Median) [SD] [3]
Asset Tangibility (%)	35.89 (29.55) [23.74]	16.75 (15.84) [7.457]	55.01 (52.98) [18.42]
Size	4.093 (3.963) [2.307]	3.450 (3.365) [2.000]	4,736 (4.747) [2.412]
Age	2.228 (2.303) [0.952]	2.082 (2.079) [0.930]	2.375 (2.485) [0.952]
ROA (%)	7.915 (11.95) [19.83]	4.656 (10.11) [22.97]	11.18 (13.22) [15.41]
Cash (%)	12.45 (5.365) [16.96]	16.78 (8.168) [20.10]	8.123 (3.683) [11.56]
(Book) Leverage (%)	29.08 (26.34) [23.94]	24.95 (19.63) [24.37]	33.20 (31.30) [22.78]
Panel B: Industry Distribution	*All Firms* Obs.	*Intangible Firms* Obs. (%)	*Tangible Firms* Obs. (%)
Consumer Nondurables	7,220	3,779 (52.34)	3,441 (47.66)
Consumer Durables	3,096	1,962 (63.37)	1,134 (36.63)
Manufacturing	18,180	8,975 (49.37)	9,205 (50.63)
Energy	5,485	204 (3.73)	5,281 (96.27)
HiTech	16,762	13,207 (78.79)	3,553 (21.21)
Telecommunications	3,785	1,151 (30.41)	2,634 (69.59)
Shops	13,291	7,512 (56.52)	5,779 (43.48)
Healthcare	7,656	5,263 (68.74)	2,393 (31.36)
Utilities	6,700	20 (0.003)	6,680 (99.997)
Other	15,870	6,942 (43.74)	8,906 (56.26)
Total	98,045	49,015	49,006

Empirical methodology. We examine whether BC laws have a different effect on tangible and intangible firms. For this, we follow Giroud and Mueller (2010)'s approach – which in turn is inspired by Bertrand and Mullainathan (2003) – and estimate:

$$Y_{it} = \alpha_i + \alpha_t + \beta_0 BC_{kt} + \beta_1 (BC_{kt} \times I_{\text{intangible},i}) + \gamma (Controls)_{ijklt} + \epsilon_{it} \quad (1.5)$$

Y_{it} measures ROA of firm i in fiscal year t. α_i and α_t are firm- and year-fixed effects. Firm-fixed effects control for any unobserved fixed differences between treated firms – i.e., firms protected by a BC law – and nontreated firms. BC_{kt} is a dummy that equals one if a BC law has been adopted in state k at time t. We include "state-year" and "industry-year" controls in order to account for state shocks and industry shocks contemporaneous to the passage of a BC law. The "state-year" control (respectively "industry-year" control) is the mean value of the dependent variable in state of location l (respectively in the 3-digit industry j) and year t, excluding firm i itself from the mean. The other control variables are, as in Giroud and Mueller (2010), firm size, the square of firm size and firm age. We also include leverage and cash holdings as control variables because tangible and intangible firms significantly differ along these two dimensions.

As mentioned by Giroud and Mueller (2010), the identification strategy benefits from a general lack of congruence between a firm's industry, state of location, and state of incorporation. The distribution of the firms' state of incorporation and state of location (not presented) is very similar to the one in Giroud and Mueller (2010). Only 38.9% of the firms in our sample are incorporated in their state of location.

Because of serial correlation in the error term, differences-in-differences approaches can seriously understate the standard errors (Bertrand, Duflo and Mullainathan (2004)). We cluster standard errors at the state of incorporation level. This accounts for arbitrarily correlation across firms incorporated in the same state, as well as serial correlation within the same firm (Petersen (2009)). The statistical significance of the coefficients are similar if we report standard errors clustered at the state of location level.

1.4.2 Results

Performance.

Column [1] of Table 1.6 shows the average effect of BC laws on ROA. The coefficient on the BC dummy is -0.7, which implies that ROA drops by 0.7% on average after the introduction of a BC law. It is very similar to the estimate in Giroud and Mueller (2010), which equals -0.6.[15]

[15] Unlike our sample, Giroud and Mueller (2010) sample includes financial firms and exclude utilities.

Table 1.6: Business Combination Laws and Operating Performance

This table presents regression results of the impact of the BC laws on ROA. BC is a dummy that equals one if the firm is incorporated in a state that has passed a BC law. The intangible dummy equals one if the firm is an intangible firm, that is if the firm has a mean asset tangibility over the sample period below the median. Control variables are firm size, the square of firm size, firm age, leverage, cash holdings, the mean of the ROA in the firm's 3-digit industry excluding the firm itself, and the mean of the ROA in the firm's state of location excluding the firm itself. Regressions include year and firm fixed effects. Standard errors, presented in parenthesis, are clustered at the state of incorporation level. The sample period is from 1976 to 1995. The coefficients are multiplied by 100 for expositional convenience. *, ** and *** denotes significance at the 10%, 5% and 1%, respectively.

Dependent Variable:		ROA	
	[1]	[2]	[3]
BC	-0.744*	-0.090	-
	(0.398)	(0.439)	
BC * Intangible $\{0,1\}$	-	-1.312***	-
		(0.352)	
BC * Tangibility(Low)	-	-	-1.736***
			(0.500)
BC * Tangibility(Intermediate)	-	-	-0.870*
			(0.436)
BC * Tangibility(High)	-	-	0.380
			(0.496)
Industry-year	20.38***	20.01***	19.82***
	(3.362)	(3.373)	(3.286)
State-year	24.76***	24.18***	23.70***
	(3.559)	(3.550)	(3.595)
Size	7.787***	7.809***	7.832***
	(0.522)	(0.508)	(0.510)
Size^2	-0.587***	-0.592***	-0.595***
	(0.028)	(0.027)	(0.028)
Age	-3.158***	-3.085***	-3.054***
	(0.418)	(0.418)	(0.406)
Cash	-4.094***	-4.109***	-4.133***
	(0.635)	(0.632)	(0.629)
Leverage	-13.13***	-13.13***	-13.11***
	(0.397)	(0.384)	(0.381)
Firm Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
R^2	0.64	0.64	0.64
Observations	97,539	97,515	97,515

In column [2], the coefficient on the BC dummy equals -0.09 and is not significant whereas the coefficient on the interaction term between the BC dummy and the intangible dummy equals -1.31 and is significant at the 1% level. This implies that the introduction of a BC law has virtually no impact on the performance of tangible firms, whereas it is associated with a drop in ROA of 1.4% for intangible firms.[16] The results are similar if we use tangibility terciles (column [3]).

[16] The coefficients on the control variables are all significant at the 1% level. However, our estimates are very similar if we run the regression without any controls: the coefficient on the BC law equals -0.13 and is not significant while the coefficient on the interaction term equals -1.21 and is significant at the 5% level.

Table 1.7: Business Combination Laws and Operating Performance
Robustness

This table presents estimated coefficients from variants of regression [2] in Table 1.6. Only the coefficients on the BC dummy and on the interaction term are reported. In row [1], we sort firms into two equal-sized groups based on asset tangibility computed in their year of entry in the sample. In row [2], we sort firms into two equal-sized groups based on the asset tangibility of their respective 48 Fama-French industry. Industry asset tangibility is computed by taking the mean asset tangibility of all firms in Compustat for each 48 Fama-French industry. In rows [3] and [4], we split the sample into two groups based on the sample HHI median. HHI is the Herfindahl-Hirschman index, which is computed as the sum of squared market shares of all firms in a given 3 digit SIC codes industry. Market shares are computed from Compustat based on firms' sales. In row [5] (resp. row [6]), we sort firms into two groups based on goodwill-adjusted tangibility (resp. cash-adjusted tangibility). Goodwill-adjusted tangibility is property, plant and equipment over total assets minus goodwill). Cash-adjusted tangibility is property, plant and equipment over total assets minus cash holdings. In row [7], we exclude Hi-Tech firms (SIC codes 3570–3579, 3622, 3660–3692, 3694–3699, 3810–3839, 7370–7379, 7391, 8730–8734). In row [8], we exclude Utilities (SIC codes 4900–4949). We exclude firms with total assets below $1 million in row [9], incorporated in Delaware in row [10], incorporated in a state that never passed a BC law in row [11]. In row [12], we use operating income after depreciation and amortization (item OIBDP minus item DP) over total assets as an alternative measure of operating performance. Standard errors, presented in parenthesis, are clustered at the state of incorporation level. The sample period is from 1976 to 1995. The coefficients are multiplied by 100 for expositional convenience. *, ** and *** denotes significance at the 10%, 5% and 1%, respectively.

Dependent Variable:	ROA		
	BC	BC * Intangible	Obs.
[1] Asset Tangibility (Initial value)	−0.226	−1.045***	97,469
	(0.440)	(0.371)	
[2] Industry Asset Tangibility	−0.127	−1.232***	97,539
	(0.410)	(0.263)	
[3] Competitive Industries	−0.411	−1.332**	49,054
	(0.327)	(0.530)	
[4] Non-competitive Industries	0.151	−1.186***	48,461
	(0.553)	(0.325)	
[5] Goodwill-adjusted Tangibility	0.111	−1.599***	77,556
	(0.520)	(0.274)	
[6] Cash-adjusted Tangibility	−0.117	−1.244***	97,513
	(0.445)	(0.360)	
[7] Excluding Hi-Tech	−0.086	−1.320***	80,776
	(0.487)	(0.408)	
[8] Excluding Utilities	−0.038	−1.300***	90,815
	(0.501)	(0.326)	
[9] Assets > 1 MM	0.332	−1.417***	95,118
	(0.326)	(0.291)	
[10] Non-Delaware	0.163	−1.734**	49,969
	(0.415)	(0.660)	
[11] "Eventually BC"	0.279	−1.323***	82,675
	(0.299)	(0.351)	
[12] ROA After Depreciation	−0.213	−1.131***	97,484
	(0.492)	(0.283)	

Robustness. We first repeat some of the robustness checks run with firm-level takeover defenses. In row [1], we sort firms into two equal-sized groups based on their initial asset tangibility; in row [2], we sort 3-digit SIC codes industries into tangible and intangible industries. In both cases, we find very similar results. Then, we investigate in rows [3] and [4] whether competitive pressure disciplines intangible firms. For this, we split the sample into competitive and non-competitive industries following the same methodology as in section 1.3.2, except that industries are defined as in Giroud and Mueller (2010) at the 3-digit SIC codes level. The introduction of a BC law is associated with a drop in the performance of intangible firms in both competitive and non-competitive industries. In row [5] (in row [6]), we adjust asset tangibility for goodwill (for cash); again, we obtain very similar results. We then check whether our results are not driven by any specific industry. We obtain similar results if we exclude any of the 10 Fama-French industries. For the sake of brevity, we present the results only for the exclusion of the "Hi-Tech" industry in row [7], and for the exclusion of utilities in row [8].

Then, following common practice in this literature, we exclude in row [9] very small firms (with asset size lower than $ 1 million); in row [10] all firms incorporated in Delaware. Another concern is that the treated and the control group might differ along some uncontrolled dimensions. We therefore limit in row [11] the sample to firms incorporated in states that eventually passed a BC law. In the tree cases, the estimated coefficients are comparable to those obtained in the main regression. Finally, in row [12], we find similar results when ROA after depreciation is used as an alternative measure of operating performance.

The results presented in this section confirm those obtained with data on takeover defenses: a reduction in takeover vulnerability has an economically and statistically significant effect only on the performance of intangible firms.

1.4.3 Event-study

Press announcements of BC laws. An alternative strategy for testing the impact of takeover vulnerability on the performance of tangible and intangible firms is to examine abnormal returns around press announcements of BC laws. For this, we use the same press announcements as in Giroud and Mueller (2010).[17] As abnormal returns of firms incorporated in the same state are likely to be correlated, we do not compute returns at the firm level but we form state of incorporation portfolios as in Karpoff and Malatesta (1989) and Giroud and Mueller (2010). For each state portfolio, we use the following market model:

[17] They found press announcements for 19 of the 30 BC laws in the sample. We thank Xavier Giroud and Holger Mueller for sharing the data.

$$R_{kt} = \alpha_k + \beta_k R_{mt} + \epsilon_{kt} \tag{1.6}$$

R_{kt} is the daily return of the equally weighted portfolio of all firms incorporated in state k and R_{mt} is the daily return on the equally weighted CRSP market portfolio. As in Giroud and Mueller (2010), the market model is estimated over the interval from 241 to 41 trading days before the event date. We then use the estimates of the market model $\hat{\alpha_k}$ and $\hat{\beta_k}$ to construct abnormal returns in the event window as:

$$AR_{kt} = R_{kt} - (\hat{\alpha_k} + \hat{\beta_k} R_{mt}) \tag{1.7}$$

Finally, we take the sum of the abnormal returns over the event window to obtain *cumulative abnormal returns* (CAR). We follow the same procedure to compute CAR for tangible and intangible state portfolios. For this, we first divide each state portfolio into two equal-sized portfolios based on firms' asset tangibility.

Table 1.8: Press Announcements of BC laws

This table presents cumulative abnormal returns (CAR) around press announcements of BC laws. Abnormal returns are computed after estimating, for each state of incorporation portfolio, a market model over the interval from 241 to 41 trading days before the announcement date. The market factor is the daily return on the equally weighted CRSP market portfolio. The announcement date is the date of the first newspaper report about the BC law. Column [1] reports the average CAR across the 19 state portfolios. The 19 states are Arizona, Connecticut, Delaware, Georgia, Illinois, Kentucky, Maryland, Massachusetts, Minnesota, New Jersey, New York, Ohio, Oklahoma, Pennsylvania, Tennessee, South Carolina, Virginia, Washington, and Wisconsin. The two-day event window is denoted by $[-1, 0]$. In columns [2] and [3], we first split each state portfolio into two equal-sized portfolios based on firms' asset tangibility. We then compute for intangible and tangible portfolios the average CAR across all state portfolios. In columns [4] to [9], we first split each state portfolio into two equal-sized portfolios based on their HHI median, and then repeat the same procedure as above. z-Statistics are in parenthesis. *, ** and *** denotes significance at the 10%, 5% and 1%, respectively.

	CAR								
				Competitive industries			*Non-competitive industries*		
	All firms [1]	Intangible [2]	Tangible [3]	All firms [4]	Intangible [5]	Tangible [6]	All firms [7]	Intangible [8]	Tangible [9]
$[-3, -2]$	0.000	−0.069	0.020	0.107	0.024	0.133	−0.170	−0.104	−0.186
	(0.00)	(0.23)	(0.09)	(0.48)	(0.06)	(0.39)	(0.55)	(0.28)	(0.46)
$[-1, 0]$	-0.445^{***}	-0.807^{***}	−0.061	−0.288	−0.379	−0.184	-0.604^{***}	-1.095^{***}	0.144
	(3.07)	(4.64)	(0.40)	(1.24)	(1.28)	(0.71)	(3.76)	(3.53)	(0.42)
$[1, 2]$	0.224	0.148	0.334	0.069	0.111	−0.019	0.619	0.210	1.307
	(1.23)	(0.54)	(1.23)	(0.30)	(0.34)	(0.08)	(1.24)	(0.49)	(1.35)

Table 1.8 presents the results. CAR in the two-day event window ($CAR[-1,0]$) equals -0.445, which is close to the estimate (-0.32) in Giroud and Mueller (2010). Columns [2] and [3] report CAR for intangible and tangible state portfolios. $CAR[-1,0]$ equal -0.807 and are significant at the 1% level for the intangible state portfolios, whereas they are small and insignificant for the tangible state portfolios. These results are consistent with the fact that the market was pricing the anticipation of a decline in the performance of intangible firms at the announcement of BC laws. Finally, we look at the interaction of these results with the fact that firms in competitive industries experienced no significant price impact at the announcement of BC laws (Giroud and Mueller (2010)). For this, we first split into two equal-sized portfolios based on their HHI median, and then repeat the same procedure as above. Columns [4] to [9] present the results. Interestingly, we find that the drop in stock prices is significant only for intangible firms in non-competitive industries. These firms are precisely those for which a drop in takeover discipline is expected to have the strongest effect on performance.

An alternative explanation to the above results is that acquisitions in intangible industries create more value than acquisitions in tangible industries. In that case, the difference in the stock price reactions is not due to the anticipation of a larger decline in the performance of intangible firms but rather reflects – as stated by Giroud and Mueller (2010) – "the capitalized value of higher forgone value gains". If this alternative story were true,[18] we should be able to find in the data a negative relationship between acquirer returns and industry asset tangibility.

Acquirer returns. To investigate this point, we estimate acquirer CAR in a 5-day event window ($CAR[-2,2]$) around acquisition announcements. For this, we extract from SDC Platinium the acquisitions made by firms that meet the following criteria: i) the acquisition is completed; ii) the acquirer owns more than 50% of the target's shares after the transaction and iii) the deal value represents more than 1% of the bidder's equity market value (calculated at the 11^{th} trading day before the announcement date). The market model is estimated over the interval from 210 to 10 trading days before the announcement date, using the equally weighted CRSP return as the market return. We restrict our attention to non-diversifying acquisitions, defined as transactions in which the target and the acquirer belong to the same 3-digit SIC code industry.

[18]This alternative story also applies to the results in Table 1.2, in that a low tobin's Q may reflect a low probability of being acquired.

Table 1.9: Asset Tangibility and Acquirer Returns

This table presents estimated coefficients from regressions of five day acquirer CAR around announcements of non-diversifying acquisitions on industry asset tangibility and control variables. Announcement dates are from SDC Platinium. Industry asset tangibility, leverage and tobin's Q are computed by taking the mean asset tangibility, leverage and tobin's Q of all Compustat firms that belong to the same 3-digit SIC code industry for each fiscal year. All cash deal is a dummy variable that equals one if the deal has been financed only by cash. Relative deal size is defined as deal value over the acquirer market value of equity computed at the 11^{th} trading day prior to the announcement date. Regressions include year-fixed effects. Standard errors, presented in parenthesis, are clustered at the acquirer and year levels. The coefficients are multiplied by 100 for expositional convenience. *, ** and *** denotes significance at the 10%, 5% and 1%, respectively.

	$CAR[-2,2]$		
	1980-2007	1980-1995	1990-2007
Industry Asset Tangibility	0.0122	0.272	-0.038
	(0.183)	(0.170)	(0.207)
Industry Leverage	0.469	0.611*	0.411
	(0.295)	(0.369)	(0.344)
Industry Tobin's Q	-0.081	0.016	-0.082
	(0.049)	(0.071)	(0.054)
Acquirer Size	-0.137***	-0.158***	-0.136***
	(0.0160)	(0.033)	(0.017)
Acquirer Age	0.095***	0.087**	0.100***
	(0.029)	(0.043)	(0.031)
All Cash Deal	0.063	-0.059	0.097
	(0.063)	(0.116)	(0.069)
Relative Deal Size	0.216***	0.178**	0.318***
	(0.074)	(0.084)	(0.070)
Year Fixed Effects	Yes	Yes	Yes
R^2	0.04	0.04	0.04
Observations	5,602	2,226	4,846

Table 1.9 presents the results of regressing acquirer $CAR[-2,2]$ on industry asset tangibility. We include industry Tobin's Q, industry leverage, firm size, firm age, an all cash dummy and relative deal size as control variables. Industry asset tangibility, leverage and tobin's Q are computed by taking the mean asset tangibility, leverage and tobin's Q of all Compustat firms that belong to the same 3-digit SIC code industry for each fiscal year.[19] All cash deal is a dummy variable that equals one if the deal has been financed only by cash. Relative deal size is defined as deal value over the acquirer market value of equity computed at the 11^{th} trading day prior to the announcement date.

[19]We obtain similar results i) if we include instead industry-median asset tangibility, Tobin's Q and leverage; or ii) if we compute industry asset tangibility, Tobin's Q and leverage for each 48 Fama-French industry and fiscal year.

Regressions also include year-fixed effects. Finally, standard errors are clustered at the acquirer and year levels.

We find no evidence in Table 1.9 that $CAR[-2,2]$ are negatively correlated with industry asset tangibility. The coefficient on industry asset tangibility is not statistically significant at conventional levels, and the economic effect is low and either positive or negative.[20] This suggests that the results in Table 1.8 – and in Table 1.2 – are not due to higher forgone value gains in intangible industries.

1.5. The Threat of Bankruptcy

To get further confidence on the fact that the threat of bankruptcy is a substitute for good external corporate governance, we investigate in this section whether takeover vulnerability has a different effect in low-leverage firms and high-leverage firms. For this, we estimate Equation (1.1) (Equation (1.5)) except that we interact here the E index (the BC dummy) with a low-leverage dummy which equals 1 if the firm has a mean leverage over the sample period below the median. This median equals 24.8% in the takeover defenses sample and 26.4% in the BC law sample. Leverage is used as a proxy for the threat of bankruptcy. For the regressions concerning takeover defenses (BC laws), the control variables are the same as in Equation (1.1) (Equation (1.5)) except that we exclude leverage.

Columns [1] to [4] of Table 1.10 present the results for the takeover defenses sample. In columns [1] and [2] (in columns [3] and [4]), we find that the E index has a larger effect on the industry-adjusted Tobin's Q (ROA) of low-leverage firms. The results for the BC laws sample presented in columns [5] and [6] mirror those for the takeover defenses sample. The introduction of a BC law has no significant effect on the ROA of high-leverage firms, whereas it is associated with a significant drop in the ROA of low-leverage firms. As a robustness check, we replace the low-leverage dummy with a 100% equity dummy which equals 1 if the firm is financed only by equity. The results (not presented) are similar to those obtained with low-leverage firms. We also obtain similar, although statistically weaker, results (not presented) if we use credit ratings as an alternative proxy for the threat of bankruptcy.

[20] A one-standard increase in industry asset tangibility is associated with an increase (decrease) in acquirer $CAR[-2,2]$ of about 0.09% (0.012%) in 1980-1995 (1990-2007).

Table 1.10: Business Combination Laws – Threat of Bankruptcy

Panel A of this table presents estimated coefficients from variants of regression [2] in Table 1.2. The Low-leverage dummy equals 1 if the firm has a mean leverage over the sample period below the median. Control variables are the same as in Table 1.2, except that we exclude leverage. Regressions include year and industry fixed effects. Standard errors, presented in parentheses, are clustered at the firm level. The sample period is from 1990 to 2007. Panel B presents estimated coefficients from variants of regression [2] in Table 1.6. Control variables are the same as in Table 1.6, expect that we exclude leverage. Regressions include year and firm fixed effects. Standard errors, presented in parentheses, are clustered at the state of incorporation level. The sample period is from 1976 to 1995. *, ** and *** denotes significance at the 10%, 5% and 1%, respectively.

	Panel A: Takeover Defenses				*Panel B: BC Law*	
Dependent Variable:	Q [1]	Q [2]	ROA [3]	ROA [4]	ROA [5]	ROA [6]
E	-2.193^{*}	-	0.103	-	-	-
	(1.250)		(0.127)			
E * Low-leverage $\{0,1\}$	-6.778^{***}	-	-0.577^{***}	-	-	-
	(2.467)		(0.211)			
E * Leverage(Low)	-	-11.00^{***}	-	-0.631^{***}	-	-
		(2.944)		(0.231)		
E * Leverage(Intermediate)	-	-3.132^{*}	-	-0.115	-	-
		(1.707)		(0.156)		
E * Leverage(High)	-	-2.191	-	0.185	-	-
		(1.489)		(0.160)		
BC	-	-	-	-	-0.019	-
					(0.425)	
BC * Low-leverage $\{0,1\}$	-	-	-	-	-1.831^{***}	-
					(0.310)	
BC * Leverage(Low)	-	-	-	-	-	-2.234^{***}
						(0.438)
BC * Leverage(Intermediate)	-	-	-	-	-	-0.633
						(0.412)
BC * Leverage(High)	-	-	-	-	-	0.070
						(0.426)
Firm Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	No	No
Firm Fixed Effects	No	No	No	No	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.18	0.18	0.32	0.32	0.64	0.64
Observations	19,544	19,552	20,953	20,961	97,735	97,735

1.6. Conclusion

Using evidence from takeover defenses and BC laws, we examine the effect of takeover vulnerability on tangible and intangible firms. We document that higher takeover vulnerability is associated with higher performance only in intangible firms. Our favorite explanation is that tangible firms are already disciplined by debt. Consistent with this hypothesis, we find that higher takeover vulnerability has a positive impact on the performance of low-leverage firms, whereas it has no significant impact on the performance of high-leverage firms. Overall, our findings suggest that the appropriate disciplinary mechanism between debt and takeovers depends on the firm asset tangibility. This has important implications for governance design, e.g. owners of intangible firms should avoid installing takeover defenses at the IPO.

Chapter 2

Bottom-Up Corporate Governance

2.1. Introduction

Academics and practitioners have known for long that in the absence of tight monitoring, CEOs of large publicly held firms may take actions that are detrimental to their shareholders. To set up counter-powers to the CEO, the consensus has been to rely on a strong board of directors, independent from the management. The academic literature confirms that board independence improves governance.[1] Yet, there is no evidence that board independence affects the profitability or even the value of corporate assets.[2]

This paper proposes a new, easily implementable, measure of governance based on the degree of independence of the CEO's immediate *subordinates*. It shows that, unlike board independence, subordinates' independence is a strong predictor of performance in US data. From the earlier governance literature, we retain the insight that independence matters, but shift the focus to the executive suite. After all, CEOs have to face their subordinates on a daily basis, whereas boards of directors only meet a few times every year. In order to capture top executives' independence from the CEO, we compute the fraction of top ranking executives who joined the firm *before* the current CEO was appointed. As CEOs are typically involved in the recruiting of their subordinates, executives hired during their tenure are more likely to share the same preferences and/or have an

[1]Independent boards of directors seem to pay more attention to corporate performance when it comes to CEO turnover or compensation (Weisbach, 1988; Dahya et al., 2002). The stock market hails the appointment of independent directors with abnormal returns (Rosenstein and Wyatt, 1990).

[2]In fact, the correlation is negative. A likely reason for this is that poorly performing firms tend to appoint more outside directors (Kaplan and Minton, 1994).

incentive to return the favor. Similarly, executives who have experienced the leadership of previous CEOs are more likely to challenge the current management.

We first provide evidence on corporate performance: we find that high internal governance (high fraction of independent executives) predicts high future performance, measured through accounting ratios or market valuation. Conversely, poor performance does *not* lead to a decrease in internal governance, suggesting a causal effect of internal governance on performance. Our findings are not affected when we control for traditional, mostly board-based, corporate governance measures. We also show that our results are not driven by the departure of executives "leaving a sinking boat", i.e. quitting due to the anticipation of the firm's future decline.

We then look at the impact of internal governance on the quality of decision making. To do this, we focus on acquisitions, which are large investment projects with measurable value effects. We show that a lower fraction of independent executives is associated with significantly lower returns for the acquirer's shareholders. By contrast, regular indices of *external* governance are not correlated with the long-term shareholders' losses made after an acquisition. The board of directors, takeover pressure or the design of corporate charters seem less efficient at preventing bad/expensive acquisitions from happening.

These empirical results echo the theory we develop in a companion paper (Landier et al., 2009), where we show that dissent in the chain of command may, in some cases, be good for the quality of decision-making.[3] In our model, a decision-maker chooses between two projects, but has a preference (bias) for one of them. The decision maker also receives objective information (a signal) about which project is most likely to succeed. Successful completion of the project also requires effort from subordinates. Subordinates may have a preference for the same project as the CEO (monolithic chain of command) or for the other project (dissent). We show that dissenting subordinates can be useful because they force the decision-maker to internalize their motivation. If he wants the project to succeed, he needs to give in less to his bias. Subordinates know this and expect the order to be more objective: they make more effort as a result. Overall better, more objective, decisions are made. As a by-product of our theoretical analysis, we also show that dissent is more likely to be optimal when product market uncertainty is high. We provide some evidence consistent with this prediction in this paper.

[3]See also Acharya et al. (2011) for a related analysis.

At a more general level, we believe an important contribution of our paper is to exhibit an organizational firm-level variable with strong systematic predictive power on future performance. Our internal governance variable might simply capture the extent of CEO power over the firm: "powerful CEOs" might be both prone to do inefficient acquisitions and to replace executives with their own friends with no link between the two. The novelty of this measure is, however, that it is the first one to exhibit a robust correlation with corporate performance. In this respect, it does better than traditional measures of "CEO power" such as whether the CEO is chairman of the board, or whether many directors are insiders. As it turns out, internal governance as we measure it exhibits no correlation at all with standard "external" governance measures.

Our study may have two normative implications for practitioners dealing with corporate governance. First, our statistical analysis indicates that the intensity of internal governance can be at least partly observed and could be included in the various measures of the quality of a firm's corporate governance. This implication does not depend on a specific interpretation of our results: be it the sign of a "non-autocratic" CEO, or of the healthy discipline of having to convince one's subordinates, the share of independent executives as we measure it does predict performance. A second implication hinges on our "bottom-up governance" interpretation: in addition to management monitoring and advising, a key role of the board should also consist in designing the optimal balance of power within the firm. Put differently, the human resource role of the board is not limited to the usually emphasized CEO succession problem, but extends to the rest of the executive suite. Such a role could be particularly important in industries where the management of extreme risk is important, like the financial industry. For instance, Ellul and Yerramilli (2010) show that banks with more independent risk managers (i.e. well paid relative to the CEO) have done better during the 2007-2008 financial crisis.

The paper has five more sections. Section 2.2 describes the datasets we use and how we construct our index of internal governance. Section 2.3 looks at the relationship between internal governance and corporate performance. Section 2.4 looks at the costs of acquisitions. Section 2.5 discusses the relation between our internal governance index and usual corporate governance measures. Section 2.6 concludes on theoretical questions raised by our findings.

2.2. Data and Measurement Issues

We first describe the datasets we use to conduct our study. We then discuss the construction of our measures of internal governance.

2.2.1 Datasets

We use five datasets. EXECUCOMP provides us with the firm-level organizational variables with which we proxy for internal governance. COMPUSTAT provides us with firm-level accounting information. IRRC's corporate governance and director data allows us to obtain standard measures of external corporate governance. Acquisitions are drawn from SDC Platinum, and stock returns from CRSP.

Internal Governance

The first data set is the EXECUCOMP panel of the five best paid executives of the largest American corporations. We use this data source to measure the extent of "internal governance" in the firm. We do this by computing the fraction of executives hired *after* the CEO took office (i.e. the fraction of non-independent executives). Thus, internal governance is said to be poor when this fraction is high.

Initially, each observation is an executive (or the CEO) in a given firm in a given year. Our sample period is from 1992 to 2009. In the raw dataset, there are 195,890 observations, which correspond to approximately 1,850 firms per year (33,375 firm-years) with an average of six executives each (including the CEO). 4,142 firm-year observations have no CEO (using the CEOANN dummy variable indicating which executive is the CEO). In some cases, it is possible to infer the CEO's identity because, for one of the executives, the BECAMECEO variable (date at which the executive became CEO) is available, even though the CEOANN dummy is missing (misleadingly indicating that the executive is not the CEO). By filling in these gaps, we save an additional 3,053 firm year observations, and end up with 32,286 firm-years for which we know the identity of the CEO (a total of 190,869 observations in the executive-firm-year dataset).

To compute the fraction of non-independent executives, we will need to compare the CEO's tenure to the executives' seniorities within the company. A first approach is to rely on the seniority (within the firm) and tenure (within the position) variables reported in EXECUCOMP. The BECAMECEO variable gives us, for the current CEO, the precise date at which he (she) was appointed as CEO whether he (she) was hired from inside or outside the firm. Other executives' seniorities can be recovered using the JOINED_CO variable, which reports the date at which the executive actually joined the firm. Focusing on observations for which both BECAMECEO and JOINED_CO are non-missing for at least one executive, we lose more than half of the sample, and end up with 14,907 firm-years, from 1992 to 2009, for which we can now compute the fraction of executives hired *after* the current CEO's appointment. We call this measure of executive dependence $FRAC1$.

Overall, we lose 32,286-14,907=17,379 firm-year observations in the process of constructing our measure of internal governance, mostly because many executives do not report their seniority within the firm. In 7,022 of our remaining 14,907 firm-years, internal governance is measured by comparing the CEO's tenure with the seniority of only one executive. This means that $FRAC1$ will be a very noisy measure of executive dependence; while this does not create an obviously spurious correlation with corporate performance or returns to acquisitions, it is going to bias our estimates of the effect of internal governance downwards, as measurement error often does.

A second approach is to make direct use of the fact that we can follow individuals in the EXECUCOMP panel. To remove left censorship (the panel starts in 1992), we need to restrict ourselves to firms where we observe at least one episode of CEO turnover. Once the new CEO has been appointed at a given firm, we can compute the fraction of executives that were *not* listed in the dataset as employees of that firm*before* the new CEO started (we name this alternative variable $FRAC2$). The main advantage of this approach is that we can dispense of the JOINED_CO variable, which is often missing. The need to observe CEO turnover restricts the number of firm-years to 16,219. This is more that the 14,907 observations available to compute $FRAC1$. However, focusing on firms with at least one CEO turnover over the course of eighteen years may mechanically overweight firms facing governance problems. Moreover, executives enter the panel when they either (1) are hired by the firm, (2) make it into the five best paid people list, or (3) the firm decides to report their pay in its annual report/proxy. Hence, entry in the panel provides only a noisy measure of seniority.

In spite of its shortcomings, the second (panel based) variable $FRAC2$ has a correlation coefficient of 0.47 with the first (seniority based) variable $FRAC1$. We present our results with both

$FRAC1$ and $FRAC2$.

We also use EXECUCOMP to construct CEO and executives characteristics to be included as controls in our regressions: (1) CEO seniority, which is the number of years since the executive has been appointed as the CEO (using BECAMECEO variable); (2) a dummy which equals one if the CEO comes from outside the firm – i.e., if the BECAMECEO variable coincides with the JOINED_CO variable or when at least one of the two variables is missing, if the first year of presence of the executive in the EXECUCOMP database has been as CEO of the firm; (3) executive's seniority which is the average number of years since executives have been working for the company (using JOINED_CO variable or entry in the EXECUCOMP database); (4) the fraction of executives appointed within one year of the CEO nomination – i.e., in the year of the CEO nomination or the next one; (5) the firm-level fraction of executives whose seniority is reported – i.e., for which the JOINED_CO variable is non-missing. We discuss and show how these variables correlate with $FRAC1$ and $FRAC2$ in section 2.2.2.

Corporate Accounts

For each firm-year observation in our EXECUCOMP sample, we retrieve firm level accounting information from COMPUSTAT; we match by GVKEY identifier. We compute profitability as return on assets (ROA).[4] We construct Market to book as the ratio of the firm's assets market value to their book value, as in Gompers et al. (2003).[5] In robustness checks, we use return on equity (ROE) and Net margin as alternative measures of performance.[6] We proxy firm size by taking the logarithm of total assets. We proxy firm age by taking the logarithm of one plus the number of years since the firm has been in the COMPUSTAT database. In robustness checks, we also proxy firm age by taking the logarithm of one plus the number of years since the firm has been in the CRSP database. We construct the 48 Fama-French industry dummies using the firm's 4 digit SIC industry code.[7] We also include the number of business segments – obtained from the COMPUSTAT segment files – and cash-flow volatility in our regressions. Cash-flow volatility is

[4]Return on assets is operating income before depreciation (item OIBDP) minus depreciation and amortization (item DP) over total assets (item AT).

[5]Market to book is the ratio of market to book value of assets (item AT). The market value is computed as total assets (item AT) plus the number of common shares outstanding (item CSHO) times share price at the end of the fiscal year (item PRCC) minus common equity (item CEQ) minus deferred taxes (item TXDB).

[6]ROE is net income (item NI) over common equity. Net margin is net income over sales (item SALE).

[7]For this, we use the conversion table in the Appendix of Fama and French (1997).

defined as in Zhang (2006). Variable definitions are presented in detail in the Appendix B. Table 2.1 presents summary statistics on our measures of executive dependence and CEO, executives and firm characteristics. Finally, we trim our measures of performance (ROA, Market to book, ROE and Net margin) at the 1% and 99% levels.

Table 2.1: Summary Statistics

This table presents summary statistics on our measures of executive dependence and CEO, executives and firm characteristics. The sample consists of 23,670 firm-years in the period from 1992 to 2009 for which we are able to construct at least one measure of executive dependence. FRAC1 is the fraction of executives hired after the CEO constructed with the JOINED_CO EXECUCOMP variable. FRAC2 is the fraction of executives hired after the CEO constructed through entry and exit in the EXECUCOMP database. Executives turnover measures the fraction of the firms executives who are no longer reported as working for the company the following year in the EXECUCOMP database. Firm size is the logarithm of the book value of assets (COMPUSTAT item AT). Firm age is the logarithm of one plus the number of years since the firm has been in the COMPUSTAT database. Return on assets (ROA) is operating income after depreciation and amortization (item OIBDP minus item DP) divided by total assets in the current year. Market to book is the market value of assets divided by the book value of assets, where the market value of assets is the book value of assets plus the market value of common stock (item CSHO item PRCC_F) minus the sum of the book value of common stock (item CEQ) and balance sheet deferred taxes (item TXDB). ROA and Market to book are trimmed at the 1% and 99% levels. The number of business segments is obtained from the COMPUSTAT segment files. Cash-flow volatility is defined as in Zhang (2006). ROA and Market to book are trimmed at the 1% and 99% levels.

				Distribution		
	Obs	Mean	SD	10^{th}	50^{th}	90^{th}
Fraction of executives hired after the CEO						
FRAC 1 (using JOINED_CO) (%)	14,907	26.5	24.5	0	20	60
FRAC 2 (using entry/exit in EXECUCOMP) (%)	16,219	60.6	35.8	0	66.6	100
CEO characteristics						
CEO seniority	23,670	5.574	6.347	0	4	13
CEO from outside $\{0, 1\}$	22,550	0.327	0.469	0	0	1
Executives characteristics						
Executives mean seniority (using JOINED_CO)	14,907	6.831	8.786	0	3.5	19
Executives mean seniority (entry in EXECUCOMP)	16,219	3.345	2.083	1	3	6.2
Executives whose seniority is reported (%)	14,907	40.7	24.9	16.6	33.3	80
Executives turnover (%)	23,670	13,1	16,3	0	0	33.3
Firm characteristics						
Firm size (Log of assets $ Million)	23,371	7.444	1.831	5.222	7.302	9.898
Firm age (Log)	23,371	2.965	0.787	1.946	2.996	3.912
ROA (%)	22,306	8.62	8.72	0.30	8.43	18.97
Market to book	20,151	1.930	1.257	0.985	1.490	3.464
Nb of business segments	22,259	2.227	1.789	1	1	5
Cash-flow volatility	19,920	0.081	0.165	0.018	0.049	0.146

External Governance

We will also look at how our measures of internal governance correlate with traditional corporate governance measures. Thus, for each firm-year observation, we gather information on corporate governance from IRRC's corporate governance and directors dataset. This dataset provides us with commonly used proxies for corporate governance, namely, the fraction of independent directors, the number of directors sitting on the board and the fraction of former employees sitting on the board. These variables are available for the 1996-2001 period only, and mostly for large firms. Out of 23,670 firm-year observations where we can measure internal governance (either through $FRAC1$ or $FRAC2$), only 5,722 observations have information from IRRC.

We will also look at the Gompers et al. (2003) index of corporate governance (GIM index), which compiles various corporate governance provisions included in the CEO's compensation package, in the corporate charter and the board structure. The GIM index is available for 1990, 1993, 1995, 1998, 2000, 2002, 2004 and 2006. In other years, we assume that it takes the value that it had in the most recent year where it was non missing.

Acquisitions

We obtain the list of firms who made significant acquisitions from SDC Platinium (deals of value larger than \$ 10 million). SDC provides us with the bidder's CUSIP and the transaction value of the deal. We focus on completed deals where the bidder bought at least 50% of the target's shares.

For each firm-year observation in our EXECUCOMP sample, we compute the number of targets acquired during that year and the overall amount spent on the deal(s). In our base sample of 23,670 firm-years where at least one measure of internal governance is available, 34% of the observations correspond to firms making at least one acquisition (with value larger than \$ 10 million): 1997 to 2000 are the peak years, with more than 37% of firms making at least one acquisition. 57% of the acquirers make only one deal per year, but there are a few serial acquirers (three percent of the observations correspond to at least five deals carried out during the year).

Stock Returns

To see whether having more "independent" top ranking executives in a firm induces better strategic decisions by the CEO, we focus on the effect of internal governance on the firm's acquisitions' performance. We restrict ourselves to large acquisitions (whose value exceeds $300 million) and we compute for each deal, long run abnormal stock returns following the acquisition.

We merge the above SDC extract with our base sample from EXECUCOMP. We end up with a list of 1,813 deals for which we know the acquirer, the date of the acquisition, and either $FRAC1$ or $FRAC2$ (the share of executives appointed after the CEO took office). Serial acquirers are overrepresented. Out of 1,813 deals, 372 involve one time buyers, while 947 involve firms carrying out at least four large deals. Overall, our sample features 717 different acquirers.

We then match this deal dataset with the acquirer's stock returns as provided by CRSP. More precisely, we retrieve monthly acquirer stock returns from a period extending 48 months prior to each acquisition to 48 months after the deal. We remove deals with less that 48 months of acquirer returns history before the acquisition. This reduces our sample size to 1,334 deals. We then estimate a four factor Fama-French model *for each acquirer* using the 48 pre-acquisition months available. We use the returns of the MKTRF, SMB, HML and UMD portfolios from Kenneth French's web site. We then use this model to compute abnormal returns both before and after the deal.

2.2.2 Internal Governance and CEO/Executives Characteristics

The assumption underlying the internal governance measures is that the CEO is directly or indirectly involved in the recruitment process of top executives. Hence, executives appointed during his tenure are more likely to be loyal to him and/or share his preferences than executives who were picked by a predecessor.

However, one needs to be careful with the CEO or executives characteristics that are likely to be correlated with $FRAC1$ or $FRAC2$ and to independently affect firm performance. As a CEO's seniority increases, a larger fraction of executives have (mechanically) been appointed during his tenure. Conversely, executives who have been with the firm longer are on average more likely to have been hired before the current CEO. This suggests that $FRAC1$ and $FRAC2$ are positively correlated with CEO tenure, and negatively correlated with executive seniority. Also, externally appointed CEOs often have the mandate to arrange a shake-out of the executive suite. Hence, $FRAC1$ and $FRAC2$ should be mechanically larger in the presence of outsider CEOs. Finally, a new CEO's appointment is sometimes followed by immediate waves of executive departures and arrivals that might be unrelated to internal governance (for example, top executives who were hopeful of being appointed at the top job might leave the firm).

It might be tempting to see these sources of variation in the proportion of aligned executives as exogenous shocks to internal governance, but they might be related to firm performance for reasons orthogonal to internal governance. For example, CEO tenure may directly affect corporate performance simply because experience on the job matters. Also, if the firm is in really bad shape, a new CEO will have to inject more "fresh blood" into the corporate suite (Hayes et al., 2005), which mechanically increases executive turnover. We therefore include as controls in our performance regressions these CEO and executives characteristics alongside with either $FRAC1$ or $FRAC2$.

To observe the strength of these mechanical correlations, we first regress our measures of internal governance, $FRAC1$ and $FRAC2$, on CEO and executives characteristics in order to investigate how they correlate. We estimate:

$$\begin{aligned} FRAC1_{it} &= \alpha_1 + \alpha_2 * CEOTEN_{it} + \alpha_3 * EXECSEN_{it} + \alpha_4 * OUTSIDE_{it} \\ &\quad + \alpha_5 * KNOWN_{it} + \alpha_6 * FRAC1\_1Y_{it} + (Firm\ controls)_{it} + \varepsilon_{it} \qquad (2.1) \end{aligned}$$

$$\begin{aligned} FRAC2_{it} &= \beta_1 + \beta_2 * CEOTEN_{it} + \beta_3 * EXECSEN_{it} + \beta_4 * OUTSIDE_{it} \\ &\quad + \beta_5 * FRAC2\_1Y_{it} + (Firm\ controls)_{it} + \varepsilon_{it} \qquad (2.2) \end{aligned}$$

where, for firm i in year t, $CEOTEN_{it}$ stands for CEO's tenure, $EXECSEN_{it}$ for average executive seniority within the firm, $OUTSIDE_{it}$ is a dummy indicating whether the CEO comes from outside the firm, $KNOWN_{it}$ is the fraction of executives for which seniority is reported in the data, $FRAC1\_1Y_{it}$ and $FRAC2\_1Y_{it}$ are the fraction of executives that arrived within a year of the CEO's nomination. We also add firm level controls: firm size, firm age, the number of business segments and cash-flow volatility. We include cash-flow volatility to control for the fact that performance variation may trigger turnover of top executives. Finally, we include in our regressions year fixed effects and either industry or firm fixed effects. We cluster standard errors at the firm level to account for serial correlation of the error term within the same firm. It is important to notice that *high* values of $FRAC1$ or $FRAC2$ mean *poor* internal governance (consistently with the convention adopted by the Gompers et al. (2003) external governance index).

The regression results are reported in Table 2.2. Columns 1 to 3 (respectively columns 4 to 6) present the results when internal governance is $FRAC1$ (respectively $FRAC2$). Columns 1 and 4 include only year dummies and the CEO/Executives characteristics as independent variables. When internal governance is $FRAC1$, we also include the fraction of executives for which seniority is actually reported in EXECUCOMP ($KNOWN$, which we include to control for potential selection biases). Columns 2, 3, 5 and 6 add the firm level controls. Columns 2 and 5 include industry fixed effects, whereas columns 3 and 6 include firm fixed effects.

The empirical correlations between the CEO/Executives characteristics and either $FRAC1$ or $FRAC2$ turn out to have the expected sign. $FRAC1$ and $FRAC2$ are positively and strongly correlated with CEO tenure and negatively correlated with executive tenure. They are also positively associated with the presence of outside CEOs, although the relation is significant only in the specifications of columns 1 and 2. There are at least two possible interpretations for this. First, outside CEOs are often given a mandate to reshuffle top management, and as a result the fraction of executives who joined the company with them is large. Second, the appointment of outside CEOs triggers the departure of talented executives who were hoping to get the top job. Another possibility could simply be that management shake-ups tend to happen when the firm is doing badly, which may also generate departures. Notice also that $FRAC1$ is positively correlated with the fraction of executives whose seniority is reported: Hence, more "transparent" firms tend to have executives appointed after the CEO. Finally, firm-level variables are not strongly correlated with our measures of internal governance, except for firm age that is negatively and strongly correlated with $FRAC1$ (but not with $FRAC2$).

Table 2.2: Internal Governance and CEO/Executives Characteristics

Internal governance is regressed on CEO and executives characteristics. Internal governance is FRAC1 in columns (1) to (3), and FRAC2 in columns (4) to (6). CEO characteristics are CEO seniority and whether the CEO is an outsider. Executives characteristics are the mean seniority of executives and the number of executives appointed in the first year following the CEO nomination. When internal governance is FRAC1, we add the fraction of executives whose seniority is reported. In columns (2), (3), (5) and (6), we include firm age, firm size, the number of business segments and cash-flow volatility as controls. Standard errors, presented in parenthesis, are clustered at the firm level. *, ** and *** means statistically different from zero at 10%, 5% and 1% level of significance. The sample period is from 1992 to 2009.

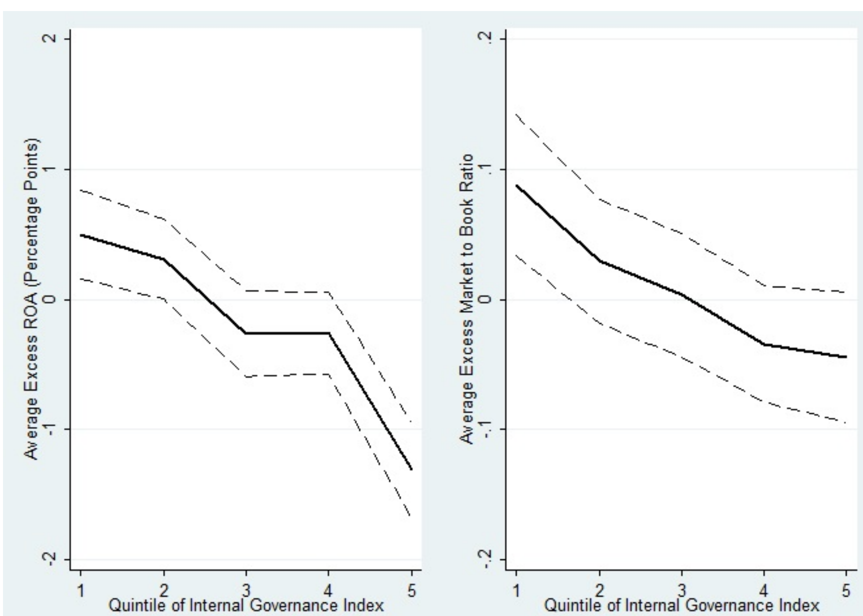
	Fraction of executives appointed after the CEO (×100)					
		FRAC1			FRAC2	
	(1)	(2)	(3)	(4)	(5)	(6)
CEO seniority	1.116***	1.115***	1.273***	9.323***	9.308***	9.145***
	(0.052)	(0.055)	(0.079)	(0.104)	(0.112)	(0.150)
CEO from outside	1.591***	1.349**	1.473	0.787	0.669	0.508
	(0.578)	(0.616)	(1.014)	(0.437)	(0.481)	(0.833)
Executives' mean seniority	-0.842***	-0.832***	-0.589***	-7.606***	-7.739***	-8.334***
	(0.031)	(0.034)	(0.044)	(0.162)	(0.175)	(0.192)
Fraction of executives appointed in the year foll. the CEO nomination (×100)	0.442***	0.419***	0.416***	0.668***	0.667***	0.645***
	(0.019)	(0.021)	(0.028)	(0.007)	(0.008)	(0.010)
Fraction of executives whose seniority is reported (×100)	0.514***	0.528***	0.558***	-	-	-
	(0.019)	(0.020)	(0.022)			
Firm age	-	-1.470***	-9.923***	-	0.813**	-0.241
		(0.457)	(1.828)		(0.376)	(1.981)
Firm size	-	0.206	-0.386	-	0.114	0.473
		(0.194)	(0.555)		(0.155)	(0.569)
Nb of business segments	-	0.020	-0.017	-	-0.093	-0.130
		(0.139)	(0.171)		(0.112)	(0.183)
Cash-flow volatility	-	0.458	-3.126	-	0.159	-1.142
		(0.918)	(2.491)		(0.913)	(2.364)
Industry fixed effects	No	Yes	No	No	Yes	No
Firm fixed effects	No	No	Yes	No	No	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.68	0.68	0.86	0.87	0.86	0.92
Observations	14,117	11,752	11,772	15,758	13,478	13,485

Last, one possible concern is that $FRAC1$ and $FRAC2$ might be correlated with intense merger activity in the past. After mergers, top executives from the targets often join the executive suite, mechanically increasing our indexes. And, if the firm still has trouble "digesting" its past acquisitions, it is likely to underperform on both accounting and stock price measures. The insignificant correlation between the number of business segments and $FRAC1$ or $FRAC2$ already partially alleviates this concern. To further address this point, we correlated $FRAC1$ and $FRAC2$ with the number of past acquisitions for a cross section of firms in 2000. We found *no* evidence that high $FRAC1$ or $FRAC2$ firms had bought a particularly large number of firms in the 1990s. This is robust to various controls and to the year chosen. Our indexes are thus not proxies for M&A "indigestion."

2.3. Internal Governance and Corporate Performance

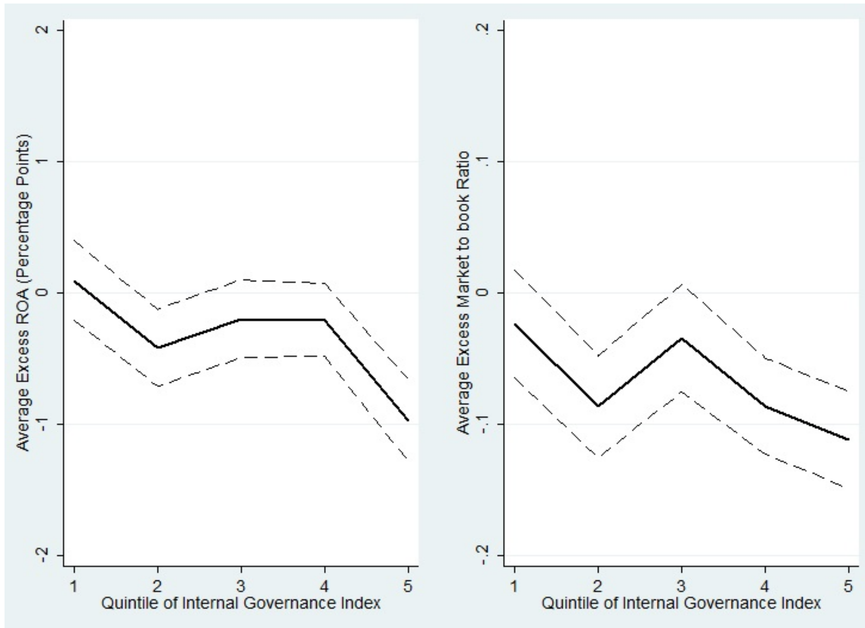
Figure 2.1 provides a first look at the relationship between internal governance and corporate performance. We first filter out the mechanical effects of CEO/Executives characteristics from $FRAC1$ and $FRAC2$ by taking the residuals of regressions (1) and (4) in Table 2.2. We then split the sample distribution of the residuals into five quintiles, and we compute for each quintile the mean industry adjusted performance[8], as well as the 95% confidence band assuming normality. Performance is measured through ROA (left panels) and Market to book (right panels). Figure 1 shows a positive and statistically significant association between good internal governance (low values of the residuals) and corporate performance.

Figure 2.1: Abnormal Performance by Quintile of Governance Index



(a) FRAC1

[8]We used the Fama-French 48 industries.



(b) FRAC2

2.3.1 Basic Results

We now move to the multivariate analysis. We run the following regression:

$$Y_{it} = \alpha + \beta * IG_{it-1} + (IG\ controls)_{it} + (Firm\ controls)_{it} + \varepsilon_{it} \tag{2.3}$$

where Y_{it} measures corporate performance (ROA, Market to book). IG_{it-1} is our measures of internal governance (either $FRAC1$ or $FRAC2$), lagged one period.[9] We use the same control variables as in Equations (2.1) and (2.2). As already mentioned, we include the CEO and executives characteristics (IG controls) since it may be argued that they directly affect corporate performance (CEO tenure, mean executive seniority, share of executive hired right after the CEO, a dummy indicating if the CEO is an insider or not). When internal governance is $FRAC1$, we also include the fraction of executives for which seniority is reported in the data. Because $FRAC1$ and $FRAC2$ are strongly persistent, it is likely that the ε_{it} are not independent from different observations of the same firm i. We therefore cluster standard errors at the firm level to account for serial correlation of the error term within the same firm.

[9] We seek to partially avoid obvious simultaneity biases, such as the ones we discuss below. We obtain similar results if our measures of internal governance are lagged two periods.

Table 2.3: Performance and Internal Governance - ROA

ROA is regressed on internal governance and control variables. Internal governance is FRAC1 in columns (1) and (2), and FRAC2 in columns (3) and (4). Columns (1) and (3) include industry and year fixed effects. Columns (2) and (4) include firm and year fixed effects. ROA is trimmed at the 1% and 99% levels. Standard errors, presented in parenthesis, are clustered at the firm level. *, ** and *** means statistically different from zero at 10%, 5% and 1% level of significance. The coefficients are multiplied by 100 for expositional convenience. The sample period is from 1992 to 2009.

	ROA			
	(1)	(2)	(3)	(4)
FRAC 1 (lagged 1 year)	-3.283***	-1.135	-	-
	(0.881)	(0.839)		
FRAC 2 (lagged 1 year)	-	-	-1.488***	-0.896***
			(0.356)	(0.344)
CEO seniority	0.121***	0.067***	0.166***	0.123***
	(0.025)	(0.026)	(0.047)	(0.040)
CEO from outside	-0.093	-0.278	-0.386	-0.251
	(0.371)	(0.503)	(0.310)	(0.363)
Executives' mean seniority	0.049***	0.024	0.335***	0.180***
	(0.017)	(0.018)	(0.073)	(0.066)
Fraction of executives appointed	-1.308	-1.334	0.741*	-0.053
in the year foll. CEO nomination	(1.295)	(1.332)	(0.448)	(0.421)
Fraction of executives whose	0.066	-1.116	-	-
seniority is reported	(0.869)	(0.896)	-	-
Firm age	-0.286	-4.039***	-0.007	-1.628
	(0.292)	(1.246)	(0.269)	(1.072)
Firm size	0.811***	0.100	0.765***	-0.025
	(0.161)	(0.411)	(0.133)	(0.346)
Number of business segments	-0.411***	-0.223**	-0.150**	-0.135*
	(0.091)	(0.094)	(0.071)	(0.076)
Cash-flow volatility	-11.01***	-2.922	-8.418***	-3.850***
	(2.391)	(2.051)	(2.280)	(1.401)
Industry fixed effects	Yes	No	Yes	No
Firm fixed effects	No	Yes	No	Yes
Year fixed effects	Yes	Yes	Yes	Yes
R^2	0.15	0.65	0.14	0.63
Observations	9,838	9,855	11,715	11,720

Table 2.3 presents the results when performance is measured through ROA. Columns 1 and 2 use $FRAC1$ as measure of internal governance whereas columns 3 and 4 use $FRAC2$. Columns 1 and 3 report regression results with year and industry fixed effects, whereas columns 2 and 4 report results with year and firm fixed effects. With industry fixed effects, an increase in either $FRAC1$ or $FRAC2$ is negatively and significantly (at the 1% level) associated with a drop in ROA. As for the economic significance of our findings, a one-standard deviation increase in $FRAC1$ is associated with a decrease of about 0.8 ROA percentage points (3.28∗0.245); a one-standard deviation increase

in $FRAC2$ is associated with a decrease of about 0.5 ROA percentage points. The explanatory power of this effect is not very large (9% of one standard deviation of ROA in the case of $FRAC1$ and 6% in the case of $FRAC2$), but, as we will see, it is consistently significant contrary to some of the usual "external" corporate governance measures. Also, the small size of our coefficients is not surprising given the noise of our internal governance measures (see section 2.2.1). Our results are robust to the introduction of firm fixed effects when internal governance is measured with $FRAC2$. When internal governance is $FRAC1$, the coefficient remains negative but it is not significant when Equation (2.3) is run with firm fixed effects.

Table 2.4: Performance and Internal Governance - Market to Book

Market to book is regressed on internal governance and control variables. Internal governance is FRAC1 in columns (1) and (2), and FRAC2 in columns (3) and (4). Columns (1) and (3) include industry and year fixed effects. Columns (2) and (4) include firm and year fixed effects. Market to book is trimmed at the 1% and 99% levels. Standard errors, presented in parenthesis, are clustered at the firm level. *, ** and *** means statistically different from zero at 10%, 5% and 1% level of significance. The coefficients are multiplied by 100 for expositional convenience. The sample period is from 1992 to 2009.

	MARKET TO BOOK			
	(1)	(2)	(3)	(4)
FRAC 1 (lagged 1 year)	-17.84	-2.503	-	-
	(12.71)	(10.95)		
FRAC 2 (lagged 1 year)	-	-	-11.36**	-8.708**
			(4.83)	(4.141)
CEO seniority	0.591	1.007**	1.745***	1.106**
	(0.441)	(0.423)	(0.622)	(0.547)
CEO from outside	6.657	6.043	-0.086	1.256
	(5.575)	(7.046)	(4.259)	(4.789)
Executives' mean seniority	0.854***	0.621**	2.820***	3.731***
	(0.288)	(0.286)	(1.028)	(0.976)
Fraction of executives appointed	-0.345	-13.28	8.769	4.798
in the year foll. CEO nomination	(20.05)	(20.68)	(6.589)	(6.155)
Fraction of executives whose	6.182	-6.776	-	-
seniority is reported	(12.33)	(12.31)		
Firm age	-19.79***	-91.50***	-12.71***	-41.25***
	(4.655)	(17.67)	(3.990)	(14.21)
Firm size	-1.132	-33.29***	-2.541	-36.45***
	(2.469)	(5.103)	(1.832)	(4.972)
Number of business segments	-5.760***	-2.013	-2.713***	-1.187
	(1.507)	(1.456)	(1.032)	(1.072)
Cash-flow volatility	-5.558	21.22	1.797	9.361
	(9.128)	(34.32)	(8.209)	(13.30)
Industry fixed effects	Yes	No	Yes	No
Firm fixed effects	No	Yes	No	Yes
Year fixed effects	Yes	Yes	Yes	Yes
R^2	0.22	0.70	0.22	0.70
Observations	9,098	9,116	10,831	10,836

Table 2.4 presents the results when performance is measured through Market to book. With industry fixed effects, an increase in $FRAC1$ or $FRAC2$ is associated with a lower Market to book. However, this relation is not significant in the case of $FRAC1$. As for the economic significance of our findings, a one-standard deviation increase in $FRAC1$ or $FRAC2$ is associated with a decrease in Market to book of about 5 percentage points. Again, the explanatory power of the effect is small (3% of one standard deviation of Market to book). Finally, our results are again robust to the introduction of firm fixed effects when internal governance is measured with $FRAC2$.

2.3.2 Robustness Checks and Causality

Table 2.5 presents robustness checks. Rows 1 to 3 (respectively rows 4 to 6) report regression results from variants of Equation (2.3), measuring performance by ROA (respectively Market to book). In rows 1 and 4, we proxy firm age with the number of years since the firm has been in CRSP instead of COMPUSTAT. In rows 2 and 5, we replace the number of business segments by a diversification dummy which equals 1 if the firm reports more than one business segment, and 0 otherwise. In rows 3 and 6, we include the square of all control variables as additional controls to check whether our results are not driven by the fact that $FRAC1$ and $FRAC2$ are correlated with some CEO and executives characteristics in a non-linear way. In all specifications, the results are similar to those in Tables 2.3 and 2.4. Finally, in rows 7 and 8, we re-estimate the specification of Equation (2.3) except that the dependent variable is Net margin and ROE. The coefficients on $FRAC1$ and $FRAC2$ are always negative. Moreover, for $FRAC2$, the coefficients are significant with both industry (column 3) and firm fixed effects (column 4).

In the Appendix B (Table B1), we report results for year-by-year cross-sectional regressions. We also report Fama-MacBeth estimates. For both $FRAC1$ and $FRAC2$ and for both measures of performance (ROA and Market to book), the Fama-MacBeth estimate is negative and significant.[10]

[10] When internal governance is $FRAC1$, we exclude the years 2007, 2008 and 2009 because the JOINED_CO variable is very rarely reported from 2007 onwards. When internal governance is $FRAC2$, we exclude the years 1993 and 1994. For these years, by construction, the correlation between $FRAC2$ and the fraction of executives appointed within a year of the CEO's nomination is close to one.

Table 2.5: Performance and Internal Governance - Robustness

This table presents coefficients on internal governance from variants of the regressions in Table 2.3 and Table 2.3. Internal governance (lagged one year) is FRAC1 in panel A and FRAC2 in panel B. In columns (1) and (2), the control variables (not reported for brevity) are the same as in Table 2.3, column (1). In columns (3) and (4), the control variables are the same as in Table 2.3, column (3). In rows (1) and (4), we proxy firm age by taking the logarithm of the number of years since the firm has been in the CRSP database, instead of the COMPUSTAT database. In rows (2) and (5), we replace the number of business segments by a diversification dummy as control. The diversification dummy equals one if the firm reports more than one business segment. Rows (3) and (6) include the square of all control variables as additional controls. In rows (7) and (8), we use alternative measures of performance as dependent variable, namely Net margin – defined as net income (item NI) over sales (item SALE) – and return on equity (ROE) – defined as net income over common stock (item CEQ). For regressions with ROE, observations for which common stock is negative are excluded. ROA, Market to book, Net margin and ROE are trimmed at the 1% and 99% levels. Standard errors, reported in parenthesis, are clustered at the firm level. *, ** and *** means statistically different from zero at 10%, 5% and 1% level of significance. The coefficients are multiplied by 100 for expositional convenience. The sample period is from 1992 to 2009.

	Panel A: FRAC 1		*Panel B: FRAC 2*	
	Industry Fixed Effects	Firm Fixed Effects	Industry Fixed Effects	Firm Fixed Effects
	(1)	(2)	(3)	(4)
	Dependent variable: ROA			
(1) Firm age CRSP	-3.231***	-0.946	-1.489***	-0.855**
	(0.881)	(0.839)	(0.356)	(0.345)
(2) Diversification dummy	-3.316***	-1.145	-1.504***	-0.907***
	(0.882)	(0.838)	(0.356)	(0.345)
(3) The square of control variables	-3.002***	-1.331	-1.534***	-1.015***
	(0.860)	(0.832)	(0.348)	(0.345)
	Dependent variable: MARKET TO BOOK			
(4) Firm age CRSP	-14.59	1.791	-10.48**	-7.643*
	(12.71)	(10.90)	(4.810)	(4.164)
(5) Diversification dummy	-18.42	-2.551	-11.99**	-8.925**
	(12.72)	(10.93)	(4.817)	(4.157)
(6) The square of control variables	-18.35	-1.410	-12.80***	-9.149**
	(12.54)	(10.79)	(4.838)	(4.162)
	Dependent variable: Alternative performance measures			
(7) Net margin	-4.058***	-1.649	-2.206***	-1.307*
	(1.433)	(1.694)	(0.627)	(0.697)
(8) ROE	-2.929	-0.467	-3.812***	-2.933**
	(1.920)	(2.426)	(1.042)	(1.232)

There are several economic mechanisms consistent with the relation between our measures of internal governance and performance found in Tables 2.3 and 2.4. Our favored interpretation is that strong internal governance is a way for shareholders to "hold the CEO on a tight leash" and prevent the CEO from undertaking negative Net Present Value projects or indulging in inefficient empire building. One could argue, however, that the causality runs in the opposite direction: declining performance may actually trigger an increase in $FRAC1$ or $FRAC2$ (i.e. a drop in our internal governance quality measures). One plausible story could be based on management turnover. In most firms, poor performance triggers a change in the management team. In this scenario, internal governance worsens *because* performance declines, not the contrary.

While we have no "smoking gun" to assess the causal relation between internal governance and corporate performance, we can at least reduce the likelihood of reverse causation through two additional tests. First, we look at the joint dynamics of internal governance and corporate performance. Do changes in corporate performance happen before or after changes in internal governance? To test this, we estimate the following two regressions:

$$Y_{it} = \alpha_1 + \alpha_2 * IG_{it-1} + \alpha_3 * Y_{it-1} + (controls)_{it} + \varepsilon_{it} \quad (2.4)$$

$$IG_{it} = \beta_1 + \beta_2 * IG_{it-1} + \beta_3 * Y_{it-1} + (controls)_{it} + \varepsilon_{it} \quad (2.5)$$

where Y_{it} is the firm's corporate performance at date t (ROA or Market to book), while IG is one of our two measures of internal governance (either $FRAC1$ or $FRAC2$). If changes in corporate performance tend to lead changes in IG, we should not be able to reject that $\beta_3 > 0$.

Estimates of Equations (2.4)-(2.5) are reported in the Appendix B (Table B2). All regressions include the same control variables as in Equation (2.3). Columns 1 and 3 report the estimates of α_2 and α_3 of Equation (2.4), while columns 2 and 4 report the estimates of β_2 and β_3 from (2.5). The results suggest that changes in internal governance tend to happen *before* changes in corporate performance as estimates of β_3 are never significantly different from zero, while estimates of α_2 always are.

Another endogeneity concern, which is not ruled out by our time-series evidence is the following: executives might tend to leave companies when they anticipate poor performance (for example because they want to avoid the danger of getting fired), while the CEO stays on board to steer the ship through bad times. If executives have private information on future performance, internal governance would worsen *before* performance declines. This would mechanically happen because "independent" executive would be replace by new ones which would de facto be less senior than the CEO. One justification for such anticipation effects is that executives can observe the CEO's ability, or changes in product-market conditions, before they materialize in corporate accounts. As a consequence, $FRAC1$ and $FRAC2$ might be simply proxying for executives turnover, which would itself be a predictor of performance decline.

We thus add to Equation (2.3) the fraction of executives that left the firm in the previous year as a control. This turnover control is constructed as the fraction of the firm's year $t-1$ executives who are no longer reported as working for the company at year t in the EXECUCOMP data. A limitation of this measure is that executives can drop out of our sample either because they are no longer employees of the company, or because they do not belong any more to the most paid employees of the company. EXECUCOMP does not allow us to measure executive departures more accurately. Controlling for such measure of executive turnover means that we compel the estimation to not reflect the most recent changes in the executive suite.

We present the new estimation results in Table 2.6, using the same controls as in Equation (2.3). As it turns out, executive turnover indeed has a significant negative impact on firm performance, confirming the idea that unexpectedly high executive turnover is an early sign of bad performance. Nevertheless, adding this control does not affect – actually slightly increases – the magnitude and significance of the impact of our internal governance measures on performance (either measured as ROA or Market to book). Overall, our results point toward a causal link going on from poor Internal Governance (high values of $FRAC1$ and $FRAC2$) to bad performance.

2.3.3 The Role of Uncertainty

In our companion paper (Landier et al., 2009), we provide a model where independent subordinates can improve the quality of decisions made at the top of the hierarchy. A testable prediction of this model is that organizational dissent is more effective when the firm faces uncertain product market conditions. As suggested by a large literature in sociology of organizations (see our theory paper for references), turbulent product markets, either because of demand instability or competitive pressure, are particular circumstances where it is important to make "objective" choices (as opposed to choices driven by private benefits or biases). And in our model, independent subordinates improve the likelihood of an "objective" decision being taken, since they force the CEO to give in less to her bias. In other words, dissenting organization are more reactive to new information.

Table 2.6: Performance and Internal Governance - Controlling for Executives Turnover

Measures of performance is regressed on internal governance, executives turnover and control variables. Performance is measured through ROA in Panel A and through Market to book in Panel B. Executives turnover at year $t-1$ measures the fraction of the firm's year $t-1$ executives who are no longer reported as working for the company at year t in the EXECUCOMP data. In regressions (1) and (2) of Panel A and B, the control variables (not reported for brevity) are the same as in Table 2.3, column (1). In regressions (3) and (4) of Panel A and B, the control variables are the same as in Table 2.3, column (3). ROA and Market to book are trimmed at the 1% and 99% levels. Standard errors, presented in parenthesis, are clustered at the firm level. *, ** and *** means statistically different from zero at 10%, 5% and 1% level of significance. The coefficients are multiplied by 100 for expositional convenience. The sample period is from 1992 to 2009.

Panel A:	ROA			
	(1)	(2)	(3)	(4)
FRAC 1 (lagged 1 year)	-3.717***	-1.530*	-	-
	(0.879)	(0.840)		
FRAC 2 (lagged 1 year)	-	-	-1.904***	-1.174***
			(0.362)	(0.353)
Executives turnover	-7.829***	-4.397***	-4.722***	-2.412***
(lagged 1 year)	(0.720)	(0.649)	(0.541)	(0.458)
CEO/Executives characteristics	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	No	Yes	No
Firm fixed effects	No	Yes	No	Yes
Year fixed effects	Yes	Yes	Yes	Yes
R^2	0.16	0.65	0.15	0.63
Observations	9,838	9,855	11,714	11,719

Panel B:	MARKET TO BOOK			
	(1)	(2)	(3)	(4)
FRAC 1 (lagged 1 year)	-21.67*	-7.163	-	-
	(12.75)	(10.99)		
FRAC 2 (lagged 1 year)	-	-	-15.66***	-12.30***
			(4.566)	(3.771)
Executives turnover	-70.85***	-47.00***	-48.99***	-30.83***
(lagged 1 year)	(9.827)	(8.511)	(6.612)	(5.322)
CEO/Executives characteristics	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	No	Yes	No
Firm fixed Effects	No	Yes	No	Yes
Year fixed Effects	Yes	Yes	Yes	Yes
R^2	0.22	0.70	0.23	0.70
Observations	9,098	9,116	10,830	10,835

To test this complementarity between uncertainty and executives' independence, we check if our measure of bottom-up governance has a stronger impact on performance, when measured uncertainty is higher. We implement this test in Table 2.7: following the asset pricing literature, we measure uncertainty through the dispersion of analysts' earnings EPS forecasts, normalized by the stock price. We define a dummy equal to 1 if this dispersion is above median. We then regress our corporate performance measures on our proxies $FRAC1$ and $FRAC2$, interacted with the uncertainty dummy. In Panel A, we measure performance through ROA; in panel B, we use Market to book. In both panels, the specifications in columns 1 and 2 use $FRAC1$: looking at these columns, we find that performance is indeed more strongly correlated with internal governance when forecast dispersion is higher. This suggests that in more uncertain environments, independent subordinates tend to be a particularly important factor of performance. In columns 3 and 4, we use our second performance proxy $FRAC2$. There, results are insignificant, but point in the same direction.

2.4. Internal Governance and Acquisitions

To test whether internal governance increases the quality of CEOs decision-making by constraining their choices, a natural place to look is the firm's acquisition policy. There is a long-lasting debate among financial economists as to whether long-run acquisition returns are positive or negative for the acquiring firm. Loughran and Vijh (1997) find that the returns to long-run investors in acquiring firms are on average negative, in particular when the deal is financed with stock issues. Mitchell and Stafford (1999), among others, criticize their estimates, partly because post-acquisition returns tend not to be independent events, as acquisitions generally cluster around stock market booms. The main problem this literature has been dealing with, is that there is considerable heterogeneity among types of acquisitions and their performance. Thus, researchers lose substantial information on their entire distribution by focusing on average returns and average profitability. In an attempt to reduce this heterogeneity, some recent papers have outlined the size of acquisitions as a key factor for success or failure (Moeller et al., 2005; Bradley and Sundaram, 2006). The evidence they present is consistent with small acquisitions being value-creating, and large ones being value-destroying. Following up on these papers, we look at the effect of internal governance on shareholder losses (gains) in large acquisitions.

Table 2.7: Performance and Internal Governance - Interaction with Uncertainty

Measures of performance is regressed on internal governance, analysts' earnings forecasts dispersion and control variables. Performance is measured through ROA in Panel A and through Market to book in Panel B. Uncertainty is a dummy which equals one for firm-year observations with analysts' forecasts dispersion above the median. The data on analysts' earnings forecasts are taken from the Institutional Brokers Estimate System (I/B/E/S). For each stock and fiscal year, we keep only the last forecast of each analyst. Dispersion is then defined as the ratio of the standard deviation of analysts' earnings forecasts normalized by the fiscal year's stock price. In regressions (1) and (2) of Panel A and B, the control variables (not reported for brevity) are the same as in Table 2.3, column (1). In regressions (3) and (4) of Panel A and B, the control variables are the same as in Table 2.3, column (3). ROA and Market to book are trimmed at the 1% and 99% levels. Standard errors, presented in parenthesis, are clustered at the firm level. *, ** and *** means statistically different from zero at 10%, 5% and 1% level of significance. The coefficients are multiplied by 100 for expositional convenience. The sample period is from 1992 to 2009.

Panel A:	ROA			
	(1)	(2)	(3)	(4)
FRAC 1 (lagged 1 year)	-1.302	0.378	-	-
	(0.965)	(0.976)		
FRAC 1 (lagged 1 year) * Uncertainty	-3.945***	-3.863***	-	-
	(1.197)	(1.144)		
FRAC 2 (lagged 1 year)	-	-	-1.089**	-0.814**
			(0.458)	(0.385)
FRAC 2 (lagged 1 year)* Uncertainty	-	-	-0.055	0.023
			(0.605)	(0.489)
Uncertainty	-3.709***	-1.305***	-4.532***	-1.993***
	(0.362)	(0.312)	(0.347)	(0.269)
CEO/Executives characteristics	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	No	Yes	No
Firm fixed effects	No	Yes	No	Yes
Year fixed effects	Yes	Yes	Yes	Yes
R^2	0.22	0.67	0.21	0.66
Observations	7,204	7,204	8,886	8,886

Panel B:	MARKET TO BOOK			
	(1)	(2)	(3)	(4)
FRAC 1 (lagged 1 year)	-1.772	17.80	-	-
	(18.15)	(15.92)		
FRAC 1 (lagged 1 year) * Uncertainty	-28.93*	-48.97***	-	-
	(16.00)	(15.55)		
FRAC 2 (lagged 1 year)	-	-	-10.09	-6.837
			(7.297)	(5.475)
FRAC 2 (lagged 1 year)* Uncertainty	-	-	-1.144	-5.089
			(7.532)	(6.645)
Uncertainty	-48.38***	-16.92***	-45.57***	-19.00***
	(5.532)	(5.081)	(5.187)	(4.424)
CEO/Executives characteristics	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	No	Yes	No
Firm fixed Effects	No	Yes	No	Yes
Year fixed Effects	Yes	Yes	Yes	Yes
R^2	0.26	0.73	0.27	0.73
Observations	6,652	6,652	8,177	8,177

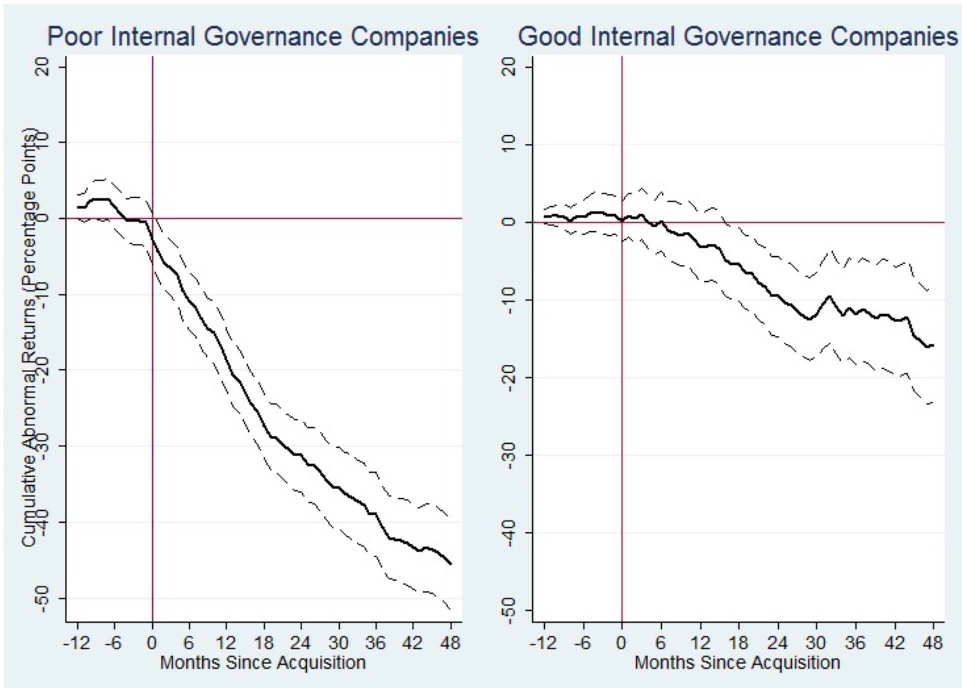
But before looking this issue, we first investigate the relation between internal governance and acquisition policy. In non-reported regressions, we find that firms with good internal governance do not make fewer acquisitions and that their acquisitions do not correspond to smaller purchases. We follow Gompers et al. (2003), and use SDC to compute, for each firm-year of our EXECUCOMP data: (1) the number of deals of more than $10 million in value and (2) the overall amount of all deals struck within the year (the sum of all transaction values if there are several deals), normalized by the acquirer's market capitalisation. None of these measures of acquisition intensity prove to be correlated with either $FRAC1$ or $FRAC2$. Moreover, we find that $FRAC1$ and $FRAC2$ are not correlated with the number of *past* acquisitions, which means that selecting firms with poor internal governance does not select "serial acquirers". Finally, we find that $FRAC1$ and $FRAC2$ are not correlated with method of payment of the deal – i.e. whether the deal is financed by cash or by stock.

We then turn to the impact of internal governance on acquisition *quality*. As mentioned above, we focus on large acquisitions (whose value exceeds $300 million). To measure the performance of acquisitions, we follow Loughran and Vijh (1997) and focus on the acquirer's long term abnormal stock returns, which we compute using a four factor pricing model (the Fama and French (1996) three factors plus momentum) estimated *at the firm level* in the 48 months preceding the acquisition. We restrict ourselves to the 1993-2009 period, in order to be able to use EXECUCOMP information.

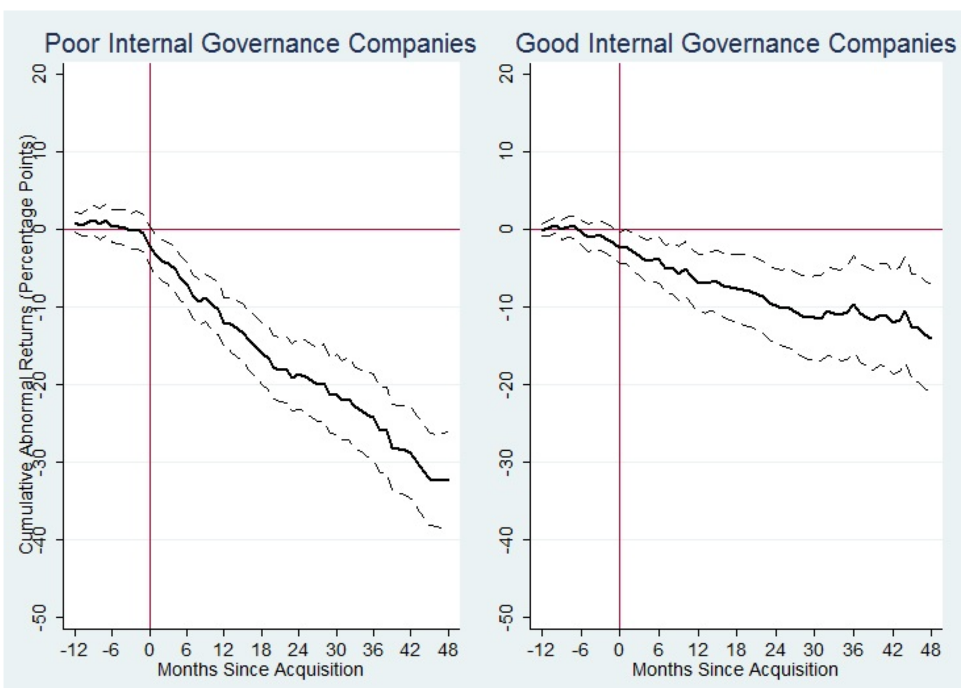
We then compute the average cumulative abnormal returns, starting 12 months before the deal up to 48 months after the deal. We winsorize cumulative abnormal returns at the 1% and 99% levels. Then, we split the sample of transactions into two parts: deals of acquirers with $FRAC1$ (respectively $FRAC2$) above the median – i.e., poor internal governance –, and deals of acquirers with $FRAC1$ (respectively $FRAC2$) below the median – i.e., good internal governance – in the year preceding the acquisition. Each part comprises around 400 deals when internal governance is $FRAC1$ and around 500 deals when internal governance is $FRAC2$. Columns 1 and 2 (respectively columns 4 and 5) of Table 2.8 report, separately for good and poor internal governance acquirers constructed from $FRAC1$ (respectively $FRAC2$), the average cumulative abnormal returns, starting 12 months before the deal up to 48 months after the deal. Column 3 (respectively column 6) reports the difference in cumulative returns for $FRAC1$ (respectively $FRAC2$), and tests for the equality of average returns using a standard t-test, without assuming equal variances. Figure 2.2 plots cumulative abnormal returns for each month, separately for poor (left panel) and good (right panel) internal governance acquirers. Internal governance is $FRAC1$

in Figure 2.2(a) and $FRAC2$ in Figure 2.2(b).

Figure 2.2: Long-Run Returns From Acquisitions: Good vs Poor Internal Governance



(a) FRAC1



(b) FRAC2

Table 2.8: Long Run Abnormal Returns Following a Major Acquisition

Abnormal returns are computed after estimating, for each acquirer, a Fama French 3 factor model + momentum on the 48 months preceding the acquisition. Cumulative abnormal returns, starting 12 months before the deal, are computed for each firm and are winsorized at the 1% and 99% levels. Internal governance is FRAC1 in columns (1) to (3), and FRAC2 in columns (4) to (6). Column (1) and (4) report, every 6 months, the average cumulative abnormal returns of acquirers with internal governance lower than median. Column (2) and (5) does the same for above-median internal governance acquirers, while column (3) and (6) report the difference. *, ** and *** means statistically different from zero at 10%, 5% and 1% level of significance, using a standard test of equality, assuming away the equality of variances. T-statistics are in parenthesis. The coefficients are multiplied by 100 for expositional convenience. The sample period is from 1992 to 2009.

	Internal Governance					
Months since	FRAC1			FRAC 2		
acquisition	Poor	Good	Difference	Poor	Good	Difference
	(1)	(2)	(3)	(4)	(5)	(6)
-6	1.470	0.613	-0.858	0.284	-0.440	-0.724
			(0.477)			(0.544)
0	-2.760	0.055	2.816	-2.281	-2.468	-0.187
			(1.314)			(0.117)
+6	-10.91	0.047	10.96***	-7.169	-3.991	3.178
			(4.040)			(1.520)
+12	-18.63	-3.343	15.28***	-12.11	-6.969	5.138**
			(4.969)			(2.058)
+18	-27.42	-5.504	21.92***	-16.04	-7.832	8.211***
			(6.743)			(2.737)
+24	-31.19	-9.686	21.51***	-18.76	-10.09	8.677***
			(5.997)			(2.594)
+30	-35.64	-12.01	23.63***	-21.57	-11.61	9.963***
			(6.068)			(2.661)
+36	-39.02	-12.05	26.97***	-24.50	-10.00	14.50***
			(6.192)			(3.413)
+42	-43.30	-13.06	30.23***	-29.13	-12.44	16.69***
			(6.707)			(3.758)
+48	-45.63	-16.09	29.54***	-32.70	-14.51	18.19***
			(6.171)			(3.841)

We find that firms with poor internal governance make largely underperforming acquisitions. When internal governance is measured by $FRAC1$, four years after the acquisition, firms with good internal governance have on average lost some 16% of shareholder value, which is significantly different from zero. However, firms with poor internal governance have lost around 45%, which is both significantly different from zero and from the wealth lost by shareholders of firms with good internal governance. This difference is robust to (1) the way we split the sample, on condition that each contains enough observations in each category (good/poor governance) and (2) to the pricing model (results are almost similar when we omit the momentum factor or if we simply use the CAPM). When internal governance is measured by $FRAC2$, the results are similar, although weaker in magnitude. Four years after the acquisition, firms with good internal governance have on average lost 15% of shareholder value against 32% for firms with poor internal governance.

One might be concerned that the difference in the cumulative abnormal returns between acquirers with poor and good internal governance is driven by an omitted variable bias. To partly address this point, we move to a multivariate analysis and regress cumulative abnormal returns at different time horizons on CEO/Executives characteristics, firm level controls and deal characteristics. We estimate the following cross sectional regressions:

$$CAR_{it} = \alpha + \beta * IG_{it_0-1} + (IG\ \ controls)_{it_0} + (Firm\ \ controls)_{it_0} + (Deal\ \ controls)_{it_0} + \varepsilon_{it} \quad (2.6)$$

where CAR_{it} are cumulative abnormal returns at $t = 0, 6, 12, 18, 24, 30, 36, 42$ and 48 months after the deal has been announced. IG_{it_0-1} is $FRAC1$ or $FRAC2$ of acquirer i, in the year before the acquisition. As for Equation (2.3), we include CEO/executives characteristics, firm age, firm size, the number of business segments and cash-flow volatility as control variables. We also include two deal characteristics as additional controls, namely the logarithm of the deal value and a dummy which equals 1 if the deal has been financed only by cash. Finally, we include year and industry fixed effects. Standard errors are clustered at the acquirer and year levels. This ensures that the results are not driven by overweighting some few acquirers making more than one deal over the sample period.

Table 2.9 presents the results of Equation (2.6) when internal governance is $FRAC1$ and Table 2.10 presents the results when internal governance is $FRAC2$. Consistent with the results in Table 2.8, the coefficients on either $FRAC1$ or $FRAC2$ are negative, significant (from 6 months after the deal for $FRAC1$ and from 12 months for $FRAC2$) and increase over time (in absolute terms). Four years after the acquisition, a one-standard deviation increase in $FRAC1$ is associated with a decrease in post-acquisition cumulative abnormal returns of about 21 percentage points ($84.20 * 0.245$). Consistent with the results in Table 2.8, the economic magnitude of the results is smaller for $FRAC2$: four years after the acquisition, a one-standard increase in $FRAC2$ is associated with a decrease in cumulative abnormal returns of about 14 percentage points.

Table 2.9: Long Run Abnormal Returns - Multivariate Analysis - FRAC1

Abnormal returns around acquisitions are regressed on FRAC1 and control variables. Abnormal returns are computed after estimating, for each acquirer, a Fama French 3 factor model + momentum on the 48 months preceding the acquisition. Cumulative abnormal returns, starting 12 months before the deal, are computed for each firm and are winsorized at the 1% and 99% levels. Standard errors, presented in parenthesis, are clustered at the acquirer and year levels. *, ** and *** means statistically different from zero at 10%, 5% and 1% level of significance. The coefficients are multiplied by 100 for expositional convenience. The sample period is from 1992 to 2009.

Months since	CUMULATIVE ABNORMAL RETURNS								
acquisition	0	6	12	18	24	30	36	42	48
FRAC 1 (lagged 1 year)	-3.394	-34.68***	-39.13**	-56.43***	-59.16***	-79.59***	-84.74***	-79.78***	-84.20***
	(14.34)	(11.90)	(19.57)	(13.92)	(19.14)	(14.13)	(22.57)	(12.13)	(18.30)
CEO seniority	-0.276	-0.090	0.116	-0.061	0.135	0.180	0.019	-0.113	0.131
	(0.332)	(0.246)	(0.376)	(0.284)	(0.462)	(0.389)	(0.441)	(0.428)	(0.568)
CEO from outside	1.732	3.079	0.574	1.420	2.379	6.251	5.574**	5.387	6.163
	(7.267)	(7.749)	(5.633)	(5.754)	(4.009)	(5.550)	(2.223)	(3.287)	(6.310)
Executives 'mean seniority	-0.254	0.143	0.150	0.031	0.056	-0.016	0.200	0.502	0.086
	(0.169)	(0.239)	(0.262)	(0.294)	(0.362)	(0.255)	(0.406)	(0.358)	(0.397)
% of executives appointed in	3.516	0.039	15.13	-1.100	19.91	4.728	-6.998	-10.76	4.056
the year foll. CEO nomination	(29.02)	(24.13)	(16.16)	(30.53)	(25.10)	(23.62)	(20.14)	(21.60)	(30.04)
% of executives whose	19.34**	38.62***	17.19*	21.48	27.69**	31.63**	32.23*	31.11*	20.30
seniority is reported	(9.375)	(12.67)	(9.345)	(14.71)	(13.15)	(14.89)	(18.79)	(17.57)	(18.84)
Firm age	1.576	3.139	4.497	7.263	15.01**	14.75***	14.69*	12.13**	10.94
	(2.859)	(4.323)	(3.101)	(4.523)	(6.448)	(5.565)	(7.751)	(6.091)	(7.293)
Firm size	-0.358	-0.979	-2.846	-2.104	-2.933	-5.244**	-3.979	-4.295*	-1.055
	(1.436)	(1.670)	(1.992)	(2.406)	(2.428)	(2.457)	(3.159)	(2.335)	(2.977)
Number of business segments	1.620**	1.753	2.303**	2.771**	1.777	2.663*	3.228*	2.166	3.542*
	(0.752)	(1.206)	(1.059)	(1.079)	(1.501)	(1.522)	(1.892)	(1.743)	(1.986)
Cash-flow volatility	-34.24***	-27.64*	-18.66	-12.70	-22.44	-1.179	12.16	14.62	21.39
	(9.035)	(14.76)	(26.01)	(34.50)	(27.06)	(22.64)	(19.11)	(21.05)	(18.85)
Deal size	0.592	1.991*	1.969	2.531	1.456	1.567	1.711	3.178**	4.243*
	(1.359)	(1.170)	(2.292)	(1.985)	(1.188)	(1.617)	(1.507)	(1.544)	(2.465)
All-cash deal	-0.403	1.619	4.991	4.885	5.667	10.60	9.002	14.25***	9.890
	(4.393)	(3.565)	(5.008)	(4.938)	(3.955)	(6.695)	(7.416)	(5.196)	(6.727)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.16	0.23	0.25	0.29	0.36	0.36	0.38	0.40	0.39
Observations	552	551	546	537	527	517	506	492	472

Table 2.10: Long Run Abnormal Returns - Multivariate Analysis - FRAC2

Abnormal returns around acquisitions are regressed on FRAC2 and control variables. Abnormal returns are computed after estimating, for each acquirer, a Fama-French 3 factor model + momentum on the 48 months preceding the acquisition. Cumulative abnormal returns, starting 12 months before the deal, are computed for each firm and are winsorized at the 1% and 99% levels. Standard errors, presented in parenthesis, are clustered at the acquirer and year levels. *, ** and *** means statistically different from zero at 10%, 5% and 1% level of significance. The coefficients are multiplied by 100 for expositional convenience. The sample period is from 1992 to 2009.

Months since	CUMULATIVE ABNORMAL RETURNS								
acquisition	0	6	12	18	24	30	36	42	48
FRAC 2 (lagged 1 year)	-4.352	-8.760*	-16.24***	-20.70***	-20.14***	-21.05**	-29.59***	-23.84**	-39.19***
	(4.269)	(5.222)	(6.078)	(5.711)	(6.083)	(9.822)	(7.465)	(12.05)	(11.74)
CEO seniority	0.635	0.563	1.113**	0.796*	0.499	0.00441	0.728	0.0619	2.349
	(0.396)	(0.610)	(0.566)	(0.426)	(0.846)	(0.633)	(1.430)	(1.018)	(1.781)
CEO from outside	-3.790	-3.405	-2.752	-0.430	-1.904	0.756	-1.976	-2.704	-2.929
	(2.740)	(3.139)	(3.840)	(3.926)	(4.770)	(3.915)	(5.690)	(4.251)	(6.039)
Executives' mean seniority	-0.0278	0.637	0.939	1.081	2.339	2.752	3.280	4.664**	4.671
	(0.574)	(1.115)	(1.046)	(1.859)	(1.776)	(2.287)	(2.939)	(2.289)	(2.918)
% of executives appointed in	12.32	10.62	15.27*	14.92*	22.95**	31.44***	35.32***	34.13***	39.46***
the year foll. CEO nomination	(7.627)	(7.526)	(7.871)	(8.019)	(9.076)	(9.874)	(10.01)	(10.88)	(15.19)
Firm age	4.479	8.440**	11.65***	16.77***	15.68***	16.85***	20.11***	19.38***	16.40***
	(2.747)	(3.608)	(3.719)	(4.086)	(4.554)	(3.638)	(4.625)	(4.245)	(4.260)
Firm size	-1.801*	-3.181***	-5.049***	-5.785***	-4.989***	-5.674**	-5.110*	-6.981***	-6.269*
	(1.033)	(1.019)	(0.981)	(1.249)	(1.465)	(2.257)	(2.711)	(2.201)	(3.802)
Number of business segments	0.486	0.440	0.482	0.371	0.730	2.150**	0.701	1.265	1.593
	(0.712)	(0.531)	(0.859)	(1.099)	(1.304)	(1.069)	(2.064)	(1.243)	(1.274)
Cash-flow volatility	-16.67**	-11.23	-5.065	1.256	-8.270	2.976	15.31	13.46	34.90
	(6.941)	(21.01)	(37.41)	(34.94)	(26.38)	(30.19)	(35.05)	(33.92)	(28.47)
Deal size	-0.150	0.565	1.893	1.748	1.790	0.443	0.196	1.046	2.143
	(0.625)	(1.223)	(1.232)	(2.176)	(2.237)	(1.992)	(2.773)	(2.403)	(2.503)
All-cash deal	-0.887	3.299	8.176*	9.507*	9.960**	9.383	10.34	9.662	6.714
	(2.448)	(3.643)	(4.439)	(4.868)	(5.002)	(5.878)	(6.956)	(6.504)	(6.785)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.11	0.17	0.20	0.22	0.26	0.26	0.26	0.29	0.28
Observations	793	793	787	743	722	690	658	612	557

2.5. External Versus Internal Governance

We have shown that our two measures of "internal governance" are significant predictors of (1) overall corporate performance and (2) the efficiency of some crucial strategy choices (acquisitions). However, one possible story consistent with such evidence is that we are proxying for corporate governance in the "traditional" sense: firms with weak shareholders, weak boards and powerful CEOs could also be the ones where the CEO has all the power to appoint faithful executives. Hence, a well-entrenched CEO is more likely to replace executives who do not show sufficient loyalty, which makes our measures of internal governance rise. At the same time, weak boards do not have the means to oppose large, wasteful acquisitions.

This alternative story puts external governance back to the fore: when "external" governance is poor, the firm performs less well, and most executives have had less time on the job than the CEO. If this were true, however, the existing literature on "external governance" should also find a positive statistical relation between corporate performance and measures of governance quality. Existing contributions have however repeatedly failed to find a positive correlation between the share of outsiders in the board and profitability (see Hermalin and Weisbach (2003) for a survey). Using corporate charter-based governance measures, Gompers et al. (2003) do not find a consistent correlation between investor-friendly firm-level institutions and operating performance. Thus, the available evidence casts doubts on internal governance being just a proxy for external governance in our regressions.

To look at this directly, we correlate our measures of internal governance with some measures of "external governance" that are used in the literature: More precisely, we regress our internal governance indexes on (1) the Gompers et al. (2003) index of governance, which takes large values for management-friendly corporate charters, (2) a dummy variable equal to 1 when the CEO is also the chairman of the board, which measures the CEO's degree of power on the board (see, for example, Adam et al., 2004), (3) the size of the board (as Yermack (1996) shows that firms with large boards are less efficient), (4) the fraction of board members who are currently employed by the firm, and (5) the fraction of board members who are former employees. Variable (1) is available for a subset of our main sample (the largest firms). Variable (2) is available for our whole sample (being extracted from EXECUCOMP). Variables (3) and (4) are extracted from IRRC's boards and directors database and so are available only for a subsample of our main dataset.

Table 2.11 presents the results. Overall, the evidence is not consistent with internal governance being a proxy of external governance. Neither $FRAC1$ nor $FRAC2$ are correlated with the charter-based GIM index (columns 1 and 4). $FRAC1$ is significantly higher when the CEO is chairman (column 2), suggesting that CEOs who are powerful inside the firm are also powerful in the boardroom. However, this relation does not hold when internal governance is measured with $FRAC2$ (the coefficient is reversed but not significant). The only significant relation holding for both $FRAC1$ and $FRAC2$ is more surprising: internal governance turns out to be better when there are more employees sitting on the board of directors. One possible interpretation is that monitoring by non-executive directors (external governance) or monitoring by subordinates (bottom-up governance) are to some extent substitute.

Table 2.11 suggests there might be some weak correlation between internal and external governance. We thus provide new estimates of Equation (2.3) in Table 2.12 including external governance measures as further controls. We also include the control variables used in Gompers et al. (2003) that are not in our other regressions, namely Delaware incorporation and a S&P500 dummy. Panel A focuses on ROA as a measure of performance, whereas Panel B looks at the effects on Market to book. In both panels, Columns 1 include the GIM index only, and firm-level controls. Columns 2 and 3 add $FRAC1$, whereas columns 4 and 5 add $FRAC2$. Columns 3 and 5 include the other external governance indexes. Consistent with Gompers et al. (2003), the GIM index is negatively and significantly correlated with Market to book, but not with operating performance. But the size and significance of the coefficients on $FRAC1$ and $FRAC2$ remains similar to those in Tables 2.3 and 2.4 once we include the GIM index.

The inclusion of the other external governance indexes shows that (1) most of them are not really correlated with corporate performance, which is consistent with the existing literature, (2) the share of inside directors is *positively* correlated with performance (consistent with Kaplan and Minton, 1994) and (3) the effect of $FRAC1$ or $FRAC2$ remains unaffected by the inclusion of these controls when performance is measured with ROA, even though they considerably reduce the sample size.

Table 2.11: Are Internal and External Governance Related?

Internal governance is regressed on various corporate governance indicators and control variables. Internal governance is FRAC1 in columns (1) to (3), and FRAC2 in columns (4) to (6). Columns (1) and (4) use the (mostly) corporate charter-based corporate governance index from Gompers et al. (2003). Columns (2) and (5) use a dummy which equals one if the CEO is also the chairman of the board. Columns (3) and (6) use Gompers et al. (2003) governance index, the chairman dummy, and add the number of directors on the board, the share of currently employed directors and the share of past employees on the board. The control variables (not reported for brevity) included in columns (1) to (3) are the same as in Table 2.3, column (1). The control variables included in columns (4) to (6) are the same as in Table 2.3, column (3). Standard errors, reported in parenthesis, are clustered at the firm level. *, ** and *** means statistically different from zero at 10%, 5% and 1% level of significance. The coefficients are multiplied by 100 for expositional convenience.

	FRAC 1			FRAC 2		
	(1)	(2)	(3)	(4)	(5)	(6)
GIM governance index	-0.018	-	-0.199	0.031	-	-0.081
	(0.115)	-	(0.161)	(0.101)	-	(0.124)
CEO is chairman	-	1.554**	0.809	-	-0.750	-1.087
		(0.621)	(0.809)		(0.510)	(0.807)
Board size (# directors)	-	-	-0.506***	-	-	0.041
			(0.186)			(0.162)
Fraction directors who are current employees	-	-	-15.97***	-	-	-6.822*
			(3.741)			(3.598)
Fraction ind. directors who are former employees	-	-	-0.152	-	-	-3.648
			(4.829)			(3.526)
CEO/Executives characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.67	0.68	0.67	0.87	0.86	0.92
Observations	7,788	11,145	2,916	9,154	13,316	2,803

To conclude our analysis, we also check that our results on post M&A long-run performance continue to hold when controlling for external governance: we re-estimate the specifications of Tables 2.9 and 2.10 including the GIM index as a control, and report the results in Table 2.13: Panel A uses $FRAC1$ as the measure of internal governance, and Panel B uses $FRAC2$. To save space, we do not report the coefficients of the basic controls of Tables 2.9 and 2.10, even though they are included in the estimation. Because the GIM index is not available for the entire sample, we lose about 20% of observations. Nonetheless, the estimates of internal governance coefficients and their statistical significance are unaffected by the external governance control. The GIM index has no predictive power on its own.

Table 2.12: Internal Versus External Governance - Performance

Performance is regressed on measures of internal and external governance and control variables. The control variables (not reported for brevity) in columns (1) of panel A and B are firm size, firm age, the number of business segments and cash-flow volatility. In columns (2) and (3), the control variables are the same as in Table 2.3, column (1). In columns (4) and (5), the control variables are the same as in Table 2.3, column (3). Delaware incorporation and a S&P dummy are included as additional controls in all regressions. All columns include industry- and year fixed effects. ROA and Market to book are trimmed at the 1% and 99% levels. Standard errors, reported in parenthesis, are clustered at the firm level. *, ** and *** means statistically different from zero at 10%, 5% and 1% level of significance. The coefficients are multiplied by 100 for expositional convenience.

Panel A:			ROA		
	(1)	(2)	(3)	(4)	(5)
FRAC 1 (lagged 1 year)	-	-3.177***	-4.135***	-	-
		(0.974)	(1.564)		
FRAC 2 (lagged 1 year)	-	-	-	-1.517***	-1.751**
				(0.397)	(0.685)
GIM governance index	-0.057	0.021	0.148	-0.009	0.039
	(0.055)	(0.076)	(0.108)	(0.061)	(0.092)
CEO is chairman	-	-	0.611	-	0.315
			(0.730)		(0.621)
Board size (# directors)	-	-	0.137	-	0.142
			(0.124)		(0.105)
Fraction directors	-	-	4.811**	-	3.638
who are current employees			(2.431)		(2.458)
Fraction ind. directors	-	-	4.021	-	2.653
who are former employees			(3.272)		(2.721)
CEO/Executives characteristics	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
R^2	0.16	0.19	0.21	0.19	0.20
Observations	12,391	6,800	2,565	8,050	2,408
Panel B:			MARKET TO BOOK (×100)		
	(1)	(2)	(3)	(4)	(5)
FRAC 1 (lagged 1 year)	-	-19.39	-23.98	-	-
		(14.16)	(24.11)		
FRAC 2 (lagged 1 year)	-	-	-	-16.02***	-2.827
				(5.664)	(10.32)
GIM governance index	-2.928***	-2.140*	-1.643	-3.314***	-3.997**
	(0.802)	(1.127)	(1.741)	(0.941)	(1.611)
CEO is chairman	-	-	-14.76	-	-9.926
			(10.62)		(9.078)
Board size (# directors)	-	-	-0.168	-	0.427
			(2.115)		(1.749)
Fraction directors	-	-	60.30	-	77.82*
who are current employees			(39.03)		(44.79)
Fraction ind. directors	-	-	-8.396	-	2.914
who are former employees			(49.10)		(39.93)
CEO/Executives characteristics	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
R^2	0.26	0.27	0.34	0.27	0.37
Observations	11,408	6,230	2,295	7,429	2,192

2.6. Conclusion

This paper shows that independence of top executives from the CEO has an impact on corporate performance. We measure independence by looking at whether an executive was appointed during or before the current CEO's tenure. Our rationale is that independently-minded executives impose more constraints on the CEO than executives who owe him their jobs. These constraints may prevent inefficient decisions from being taken, and have in general the useful effect of de-biasing the CEO's strategic choices. To play this positive role on the quality of CEO decisions, top executives need not disobey, or enter in open conflict with their boss: knowing that the firm's key executives might be less enthusiastic in their work when they disapprove decisions, the CEO has incentives to take their opinion into account.

The insight that the independence of the executive suite from the CEO affects the quality of corporate decisions has two normative implications for practitioners of corporate governance and organization behavior. First, the intensity of internal governance as we define it can be easily observed and could be included in the various indexes of the quality of a firm's corporate governance. This implication does not depend on our interpretation of our results: be it the sign of executives "leaving the sinking boat", of an autocratic CEOs, or of the healthy discipline of having to convince one's subordinates, the share of independent executives as we measure it predicts performance. A second implication hinges on our "bottom-up governance" interpretation: in addition to management monitoring and advising, a key role of the board should also consist in designing the optimal balance of power within the firm. Put otherwise, the human resource role of the board should not be limited to the usually emphasized CEO succession problem, but should also be concerned with the choice of key executives.

Table 2.13: Long Run Abnormal Returns - Multivariate Analysis - Controlling For External Governance

Abnormal returns around acquisitions are regressed on FRAC1 and control variables. Abnormal returns are computed after estimating, for each acquirer, a Fama French 3 factor model + momentum on the 48 months preceding the acquisition. Cumulative abnormal returns, starting 12 months before the deal, are computed for each firm and are winsorized at the 1% and 99% levels. Standard errors, presented in parenthesis, are clustered at the acquirer and year levels. *, ** and *** means statistically different from zero at 10%, 5% and 1% level of significance. The coefficients are multiplied by 100 for expositional convenience. The sample period is from 1992 to 2009.

	Cumulative Abnormal Returns								
Months since acquisition	0	6	12	18	24	30	36	42	48
Panel A: Using FRAC1 as the Measure of Internal Governance									
FRAC 1 (lagged 1 year)	-14.59	-32.61*	-27.52	-40.54**	-58.16**	-83.51***	-83.42***	-82.92***	-78.51***
	(9.165)	(16.68)	(27.25)	(19.70)	(23.97)	(25.14)	(31.04)	(21.62)	(27.53)
GIM governance index	-1.275**	-0.555	-0.495	0.502	0.929	0.497	1.598	2.383*	2.452**
	(0.613)	(0.386)	(1.136)	(1.089)	(0.763)	(1.445)	(1.082)	(1.373)	(1.237)
Controls as in Table 2.10	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.29	0.32	0.30	0.34	0.36	0.37	0.39	0.41	0.38
Observations	451	449	446	439	431	424	416	405	390
Panel B: Using FRAC2 as the Measure of Internal Governance									
FRAC 2 (lagged 1 year)	-2.827	-5.620*	-9.710*	-14.45***	-21.68***	-21.51*	-26.74***	-22.22	-32.97***
	(3.726)	(2.907)	(5.818)	(4.870)	(5.109)	(11.57)	(8.070)	(14.69)	(11.77)
GIM governance index	-1.126**	-0.845	-1.357**	-0.289	0.144	-0.044	0.893	1.439	1.413
	(0.479)	(0.658)	(0.575)	(0.889)	(0.719)	(1.324)	(1.409)	(1.818)	(1.901)
Controls as in Table 2.10	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.15	0.20	0.22	0.23	0.24	0.25	0.24	0.26	0.23
Observations	613	612	607	601	599	588	582	538	489

Chapter 3

Prosecution and Leniency Programs: The Role of Bluffing in Opening Investigations

"Io so. Ma non ho le prove. Non ho nemmeno indizi." Pier Paolo Pasolini. Il corriere della sera. 1974.

3.1. Introduction

Both the Department of Justice (DoJ) in the United States (US) and the Commission in the European Union (EU) have made a top priority of breaking up cartels. This is reflected in the recent sharp increase in the total amount of penalties inflicted on cartel members.[1] In the EU, the record fines of €1,383 million against car glass makers in 2008 is another illustration: these are the highest penalties the European Commission has ever imposed in a cartel case, both for an individual company (€896 million on Saint Gobain) and for a cartel as a whole.

A path-breaking development in the US antitrust policy was the revision of its corporate leniency program in 1993. In the initial version,[2] discretionary leniency was granted to confessors provided that the cartel was not already under investigation. The new program instead automatically guarantees full amnesty to the first firm who blows the whistle in this case; in addition, some leniency may be granted when an investigation has begun. Finally, the DoJ added a complementary

[1] In the US, corporate fines averaged $315 million per year between 1995 and 1999 and $628 million between 2005 and 2009. In the EU, the rise is even more impressive, going from €54 million per year between 1995 and 1999 to €1,951 million between 2005 and 2009 (data from the US Antitrust division and the European Commission).

[2] The DoJ introduced its first corporate leniency program in 1978.

individual leniency program in 1994 that protects individual informants from pecuniary fines or criminal sanctions.[3] Since its revision in 1993, the corporate leniency program has been the DoJ's most effective investigative tool; it helped to dismantle large global cartels such as the Vitamins or Graphite Electrodes cartels.[4] The commonly used argument to explain the success of the US leniency program is the implementation of first informant rules combined with large expected fines. This "stick and carrot" logic motivated the recent revisions (2002 and 2006) of the European leniency program which turns out to be also highly effective in fighting cartels.[5] In recent years, around two thirds of the successful investigations carried out by the European Commission have been initiated by a leniency application.

The theoretical literature, starting with Motta and Polo (2003) and Spagnolo (2004), has confirmed that a well-designed leniency scheme can significantly help destabilize cartels. Spagnolo (2004) and Rey (2003) note for example that leniency increases gains from deviations by allowing defecting cartel members to report and avoid facing the fine. Spagnolo (2004) moreover shows that granting the first informant a reward equal to the sum of the fines imposed on the other conspirators can achieve full deterrence. In parallel, Aubert, Rey and Kovacic (2006) argue that rewarding individuals also helps destabilize collusion since firm employees must then be "bribed" to be kept silent. Several papers however identify unwanted effects that may dilute deterrence. Leniency reduces expected sanctions and thus increases the value of "collude and report" strategies (Motta and Polo (2003), Spagnolo (2004)). Moreover, badly designed leniency programs may help reinforce collusion by giving cartel members a tool to punish deviators (Buccirossi and Spagnolo (2006) in the context of bilateral illegal transactions). Note that restricting eligibility to the first informant reduces the risk of these two unwanted scenarios.

The main obstacle to empirical analysis is that collusive agreements are secret. That is why the existing recent empirical literature uses indirect methods to assess the impact of leniency programs

[3] In the EU, violations of Article 81 and 82 are not punished with criminal fines. In particular, individuals are not subject to imprisonment.

[4] The vitamin cartel was cracked in 1999 by the cooperation of the company Rhône-Poulenc SA. The main co-conspirators Hoffmann-La Roche and BASF paid in the US fines of respectively $500 million and $225 million while the penalty was waived for Rhône-Poulenc. In the graphite electrodes case (1999), the cooperative firm played only a secondary role in the cartel but its initial information allowed the DoJ to gather additional evidence that led to the guilty pleas of the other conspirators. In total, firms paid $400 million and three individuals received jail sentences (from 9 to 17 months).

[5] For a discussion of the differences and similarities between the US and the EU leniency programs, see Spagnolo's review (2007).

on cartels' behavior (Brenner (2009), Harrington and Chang (2009), Miller (2009)).[6] Harrington and Chang (2009) develop a model of cartel formation and dissolution which enables them to test the efficiency of a new cartel enforcement tool. In particular, the deterrence effects of leniency may be assessed through the short-run changes in the duration of discovered cartels. The alternative framework of Miller (2009) allows him to infer changes in formation rates directly from changes in the number of detected cartels. He applies his findings to information reports issued by the DoJ between 1985 and 2005 and shows that the pattern of cartel discoveries around the revision in 1993 of the US corporate leniency program is consistent with enhanced cartel detection and deterrence capabilities. By contrast, Brenner (2009)'s work on European data shows that the introduction of a leniency policy in Europe in 1996 (without a first informant rule and full leniency) had no clear effect on deterrence. This suggests that the design of leniency schemes is a key element of success.

For cartels that are too stable to be deterred, antitrust authorities must try to detect and break them down. The conviction of the car-glass makers highlights the role of post-investigation leniency in the prosecution of cartels. According to the European Commission:

"The Commission started this investigation on its own initiative on the basis of reliable information provided by an anonymous informant. The information prompted the Commission to carry out surprise inspections in 2005 at several sites of car glass producers in Europe. After the inspections, the Japanese Asahi Glass Co. and its European subsidiary AGC Flat Glass Europe (formerly 'Glaverbel) filed an application under the 2002 Leniency Notice.... Asahi/Glaverbel co-operated fully with the Commission and provided additional information to help to expose the infringement and its fine was reduced by 50%."[7]

We can infer from the *Commission Notice on Immunity from Fines* (2006) that the inspections have not been entirely successful since the notice specifies that:

"in order to qualify [for reduction of a fine], an undertaking must provide the Commission with evidence of the alleged infringement which represents significant added value with respect to the evidence already in the Commission's possession".

[6] Note that experiments are another means to obtain empirical predictions. See for example Apesteguia et al. (2007), Bigoni et al. (2008) and Hinloopen and Soetevent (2008).

[7] available at http://ec.europa.eu/competition/cartels/what_is_new/news.html, reference: IP/08/1685.

The period following an investigation is generally a fool's game. The antitrust authority may run an investigation against a cartel pretending that conviction is likely, in the hope that firms will denounce the cartel. We build our model to explore this idea.

Formally, we consider a standard supergame in which firms decide whether to compete or collude on the market. The Antitrust Authority cannot condemn the cartel without gathering hard evidence. When firms collude, the Antitrust Authority receives a binary signal (either good or bad) which determines the probability of convicting cartel members if an investigation is launched, a bad signal meaning a low probability. As cartel members do not observe the signal, they may confess their illegal activities even when the Antitrust Authority opens an investigation after receiving a bad signal. In such a case, the cartel is condemned even though the Antitrust Authority was unlikely to convict firms by its own means.

Our paper is related to Motta and Polo (2003). In their paper, offering leniency enables the Antitrust Authority to save on prosecution costs, and the freed resources reinforce detection capabilities. However, the leniency policy gives amnesty to all firms that apply for leniency, which has a negative impact on cartel deterrence. As a result, the leniency program is a second-best instrument: if the budget of the Antitrust Authority is large enough to deter cartel formation, leniency should not be offered. One important innovation in our paper is the incorporation of private information on the Antitrust Authority side. We show that this informational advantage, combined with leniency, raises the conviction rate and thereby enhances cartel desistance. The design of the leniency scheme – i.e., the choice of the informant rule – ensures that the increase in the conviction rate also materializes into higher deterrence.

Our work is also related to the literature on self-reporting (e.g. Malik (1993) and Kaplow and Shavell (1994)) as well as on plea bargaining. Reinganum (1988) considers for example a privately informed prosecutor offering plea bargains to a defendant; the prosecutor's offer then reveals the strength of the case against the defendant. In our paper, the AA is privately informed about the strength of a cartel case, and its investigation policy affects firms' decisions to report information.

Our paper has important policy implications. In particular, unlike the recommendations of the US and European leniency policies, our results suggest that leniency should be granted even when the risk of conviction is large.

The paper is organized as follows. Section 3.2 describes the model. Section 3.3 provides a benchmark where there is no information asymmetry between the Antitrust Authority and cartel members. Section 3.4 studies the case where the Antitrust Authority has private information about the strength of the cartel case. Section 3.5 derives the optimal informant rule. In section 3.6, we discuss the policy implications of the model. Finally, section 3.7 concludes. All proofs are in the appendix C.

3.2. The Model

3.2.1 Players

Firms

We consider a continuum of industries with unit mass. In each industry, $N \geq 2$ symmetric and risk-neutral firms play an infinitely repeated game. In each period, each firm decides whether to compete or collude. The gross profit of a firm is:

- 0 if firms compete,
- $\Pi^C > 0$ if firms collude,
- $\Pi^D \geq \Pi^C$ if the firm deviates from collusion – that is, if it competes when the other firm(s) collude.

For example, in a standard Bertrand oligopoly in which N firms produce an homogenous good with the same unit variable cost, static price competition drives profits to 0, the benefit from collusion is equal to a share $\frac{1}{N}$ of the monopoly profits ($\Pi^C = \frac{\Pi^M}{N}$) whereas a deviation brings the whole monopoly profits ($\Pi^D = \Pi^M$).

In order to analyze the impact of the antitrust policy on cartel formation, we will assume that industries are heterogenous with respect to the gains from deviating, Π^D. This can for instance reflect differences in market transparency.[8]

[8]Market transparency affects the probability that a firm which undercuts the collusive price is detected by the rivals (or for how long it can deviate before being detected), which in turn affects the gains from deviating.

We focus on explicit collusion, which is based on communication, meetings and so forth.[9] We therefore assume that collusion generates hard evidence that can be used to condemn the cartel. Finally, all firms have the same discount factor $\delta \in (0, 1)$ and maximize the expected discounted sum of their profits.

Antitrust Authority (AA)

The AA is aware of whether an industry colludes, but cannot condemn a cartel without gathering hard evidence.[10] In each period of collusion, the AA receives a binary signal, either good or bad, which determines the probability of finding hard evidence if it launches an investigation. Conditional on there being a cartel, the probability of receiving a good signal is ψ. If the signal is good, the AA knows that it will find hard evidence of collusion with probability $\mu \in (0, 1)$ if it runs an investigation. If instead the signal is bad, the AA has no chance of finding hard evidence on its own.[11]

When firms collude, the AA decides whether or not to run an investigation based on its signal. If the AA gathers evidence, the cartel is condemned and each member must pay a fine F, which is exogenously set by law.[12]

Leniency Program. For the sake of exposition, we will assume that a firm which deviates from collusion faces no risk of being convicted. This rules out any role for pre-investigation leniency (see Spagnolo (2004) and Rey (2003)).[13] The AA can however offer a leniency rate q *during* investigations. Eligible firms then pay only a reduced fine (equal to $(1 - q)F$) if they report

[9] In their study of the Sugar Institute Case, Genesove and Mullin (2001) show that communication helps firms collude. The Sugar Institute rules and regular meetings were used to facilitate both the coordination on jointly profitable actions and the detection of secret price cuts. For theoretical works considering the role of communication in collusion, see e.g. Compte (1998), Athey and Bagwell (2001) and Aoyagi (2002).

[10] The assumption that the AA perfectly observes whether collusion occurs is made for simplicity. Our results are qualitatively unchanged if we assume instead that the AA receives signals strongly correlated with the presence of collusion. Our model similarly applies to organized crime (corruption, mafias, drug trafficking and so on) where prosecution – i.e., finding enough evidence to obtain a condemnation in court – is a relatively more important issue than detection.

[11] Section 3.6 discusses the case where the probability of finding evidence during an investigation is also positive in case of a bad signal.

[12] Alternatively, F may be viewed as the maximal punishment allowed by the law. In this case, Becker's (1968) argument applies: it is optimal to set fines as high as possible. An infinite fine combined with a positive, even arbitrarily low enforcement probability necessarily deters cartel formation.

[13] The previous version of the paper (Sauvagnat (2010)) assumes instead that deviating firms still face a risk of being convicted. Offering full amnesty in case of pre-investigation reports is then always optimal, because it allows defecting cartel members to report and avoid paying the fine.

information, in which case all cartel members are condemned with probability one. We assume that firms decide whether or not to report simultaneously, and restrict our attention to leniency rates lower than one.[14] Finally, we assume that following a condemnation, firms are forced to compete forever.[15,16] Enforcing competition can for example be achieved through either close monitoring of the industry[17] or higher fines for repeat offenders.[18]

The literature has shown that adopting a first informant rule (denoted hereafter FI rule) – i.e., restricting eligibility to the first confessor – is preferred to granting leniency to all informants. This is also the case in our model.[19] To facilitate the exposition of the results, we therefore directly assume in sections 3.3 and 3.4 that leniency is granted only to the first informant.[20] We however show in section 3.5 that the AA can do better than adopting a FI rule when the set of feasible schemes allows leniency rates to be contingent on the number of informants.

Interpretation of the signal. In practice, the signal may be obtained during a sector inquiry. According to the European Commission:

"The Commission may decide to start a sector inquiry when a market does not seem to be working as well as it should. This might be suggested by evidence such as limited trade between Member States, lack of new entrants on the market, the rigidity of prices, or other circumstances suggest that competition may be restricted or distorted within the common market".

Alternatively, the realization of the signal may be interpreted as whether the AA received some

[14] Well-designed reward schemes are very effective in fighting collusion (see Spagnolo (2004) and Aubert, Rey and Kovacic (2006)). Authorizing rewards in our setting would also deter collusion in all industries. However, in practice, it is generally politically unfeasible.

[15] This assumption, which follows Harrington (2008), is made for simplicity. Our results are qualitatively unchanged if we assume instead that, following a condemnation, firms are forced to compete only for a finite length of time.

[16] Using event study techniques, Aguzzoni et al. (2009) find that EU surprise investigations and infringement decisions have a negative effect on firm's share price. Moreover, they show that the antitrust fine accounts for less than one third of the share price decrease, suggesting that most of the loss is due to the cessation of the illegal activity. As their sample is composed mostly by cartels, their evidence supports our assumption that firms cease colluding once condemned.

[17] In the context of organized crime, imprisonment can also stop an illegal practice.

[18] Higher fines for repeat offenders are incorporated in US and European antitrust laws.

[19] The reason is the same as in Harrington (2008): *"If the other firms are colluding then a firm that cheats and applies for amnesty will necessarily be the first firm to come forward. Offering leniency to more than the first firm does not then enhance the payoff to cheating [...]. However, it does boost the payoff to continuing to collude since, when all firms decide to discontinue colluding and apply for amnesty, allowing more than one firm to receive it reduces expected penalties [...]."*

[20] As in the literature, we assume that if m firms (simultaneously) apply for leniency, they are equally likely to be the first informant and thus face an expected fine equal to $(1-\frac{q}{m})F$.

initial incriminating evidence from third parties.[21,22] Accordingly, ψ is likely to vary in practice with the efficiency of existing schemes designed to encourage whistleblowing. In particular, sentencing individuals to imprisonment[23] or offering bounties[24] to informants strongly incentivize third parties' cooperation.[25] The US Amnesty Plus Program, which gives strong financial incentives to firms already under prosecution for denouncing cartels in other markets,[26] is also an efficient instrument for raising the probability of obtaining initial evidence on separate cartels.[27] As for μ, it is likely to vary with technological progress, for instance the use of digital forensics.

3.2.2 Strategies

We focus on stationary strategies.[28]

Antitrust Authority. We assume that the AA can commit to an overall probability of inves-

[21]Third parties can be internal employees, buyers' complaints or local agencies. In the US, internal whistleblowing is encouraged by the Individual Leniency Program, and several recent cases, such as the graphite electrodes and the stainless steel cartels, were initiated by buyers' complaints. Infiltration may complement individual whistleblowing: a well-known example is the use of covert cameras, facilitated by a cooperating witness, to tape cartel meetings leading to the conviction of the international Lysine cartel; see Hammond (2005).

[22]We could furthermore assume that the initial evidence is more or less reliable, which would justify the stationarity of the model. Suppose for example that a good signal means that the initial evidence is reliable with probability μ, in which case an investigation will be successful for sure, and is otherwise unreliable, in which case an investigation cannot succeed. If the AA launches an investigation, either the cartel is condemned and the game thus ends for that industry, or the investigation fails and the AA will then infer that its initial evidence was not reliable.

[23]e.g. Hammond (2007):

"The Division has long emphasized that the most effective way to deter and punish cartel activity is to hold culpable individuals accountable by seeking jail sentences".

The Antitrust Criminal Penalty Enhancement and Reform Act of 2004 raised the maximum jail term available under the Sherman Act from three to ten years. Nonetheless, the US (and Canada) are nearly alone in the world in sending cartel managers in jail. The possibility of fining individuals is also written into the law of other countries (for example Germany, France, Japan) without being applied.

[24]In practice, very few jurisdictions offer financial rewards for whistleblowers. Notable exceptions are the UK and South Korea. The UK's Office of Fair Trading has been offering since March 2008 rewards of up to £100,000 for information about cartels. The Informant Reward System has been introduced in April 2005 by the Korean Fair Trade Commission and recompenses those who report competition law violations. In June 2005 a first reward of 66,87 million won (about \$ 63,700) was paid to an anonymous person who provided decisive evidence (names of executives of the 6 cartel members, meeting places and details of agreements) in a welding rod cartel case. In the US, Kovacic (2001) proposes expanding the existing Civil False Claims Act (which, adopted by the Congress in 1863 and reinforced in 1986, offers rewards in exchange of information given to the government in procurement fraud cases) to price-fixing violations.

[25]Spagnolo (2007) mentions the sociology literature documenting that whistleblowers experience a terrible working, social and private life after reporting. This suggests that whistleblowing is very unlikely without high rewards.

[26]Disclosing a second cartel lead to amnesty for the second offense, together with a substantial reduction in the fine for the participation in the first cartel.

[27]see e.g. Griffin (2003):

"Roughly half of the Division's current international cartel investigations were initiated by evidence obtained as a result of an investigation of a completely separate market."

[28]However, it is important to stress that non-stationary strategies are theoretically very powerful in deterring cartels. See Frezal (2006).

tigation, $\tilde{\sigma}$. It will then find it optimal to open an investigation with probability one after receiving a good signal, and to open an investigation with probability σ – such that $\psi + (1-\psi)\sigma = \tilde{\sigma}$ – after receiving a bad signal.[29]

When the signal is public, cartel members will not report information if the AA launches an investigation after having received a bad signal, since they do not face any risk of conviction. In this scenario, the only policy variable is q. When instead the signal is privately observed by the AA, there is scope for bluffing – i.e. choosing $\sigma > 0$ – as firms may fear that the investigation could be successful. In that case, the policy variables are q and σ. We will consider both scenarios below.

Firms. We focus on grim trigger strategies in which any deviation from collusion is punished by reverting forever to competition, which is here the minmax and thus constitutes the most severe punishment. We consider two modes of (symmetric) collusive equilibrium, in which firms either "collude and remain silent", or "collude and report in case of investigation".[30]

In both cases, firms collude in every period until a deviation occurs or the cartel is condemned, and if a firm deviates on the market, then firms revert to competition forever. If the AA opens an investigation, firm remain silent in "collude and remain silent" and report in "collude and report in case of investigation". If the AA finds evidence or one firm reports, the cartel is condemned and firms compete forever. Otherwise, firms go on colluding.

In order to be sustainable, both collusive strategies must therefore resist unilateral deviations on the market – i.e., the expected value of future collusion must exceed the gains from deviating on the market, Π_D. The strategy "collude and remain silent" must moreover be incentive-compatible, that is, robust to unilateral reporting deviations: no firm should gain by reporting in case of investigation when the other firms remain silent. If both collusive strategies are sustainable, we assume that firms select the Pareto-dominant collusive strategy – i.e., the most profitable one.

Let us denote by $\gamma \in \{0,1\}$ firms' decision to report information in case of investigation, and by ϕ the conviction rate faced by firms when they collude. When firms collude, the AA runs an

[29]Commitment about $\tilde{\sigma}$ (and thus σ) may be made credible by legislation or disclosure rules, or by the AA's desire to establish a reputation in a repeated game. We discuss some commitment devices in section 3.6.

[30]This is without loss of generality. First, since the antitrust policy is stationary, if collusion is sustainable then the best collusive strategy consists in colluding in every period until a deviation occurs or the cartel is condemned. Second, if the AA offers leniency ($q > 0$), the equilibrium reporting strategies are necessarily symmetric since a firm is better off reporting whenever at least one other firm reports.

investigation with probability $\psi + (1-\psi)\sigma$. Then either firms report, in which case the cartel is condemned with certainty, or no firm reports, and the cartel is condemned only if the investigation is successful – i.e. with probability $\psi\mu$. Therefore, the conviction rate is:

$$\phi(\sigma, \gamma) = (\psi + (1-\psi)\sigma)\gamma + \psi(1-\gamma)\mu.$$

Let us summarize the framework. The antitrust rules ψ, μ and F, which are taken as given by the AA, are common knowledge; the realization of the signal is also common knowledge in section 3.3, and instead privately observed by the AA in section 3.4. At the beginning of the game, the AA announces the policy variables q and σ, and sticks to this policy afterwards. Then, in each period, the timing of the game, summarized in Figure 3.1, is as follows:

- Stage 1. Each firm chooses whether to enter into a collusive agreement. If at least one firm chooses not to collude, competition takes place and the game moves to the next period. If all firms enter into a collusive agreement, this decision leaves hard evidence of collusion and the game proceeds to stage 2.

- Stage 2. Each firm chooses whether to respect the agreement and collude, or to deviate and compete on the market. The game then proceeds to stage 3.

- Stage 3. The AA receives the signal S and decides whether or not to run an investigation. This decision is publicly observed by firms. If the AA runs an investigation, the game proceeds to stage 4.

- Stage 4. Each firm decides simultaneously whether to apply to the leniency program. If at least one firm reports, the cartel is condemned; in that case the fine is reduced to $(1-q)F$ for the eligible firms. Otherwise, the game proceeds to stage 5.

- Stage 5. If the AA received a good signal, it finds hard evidence and can thus condemn the cartel with probability μ. If the signal is bad, the AA has no chance of gathering evidence of collusion.

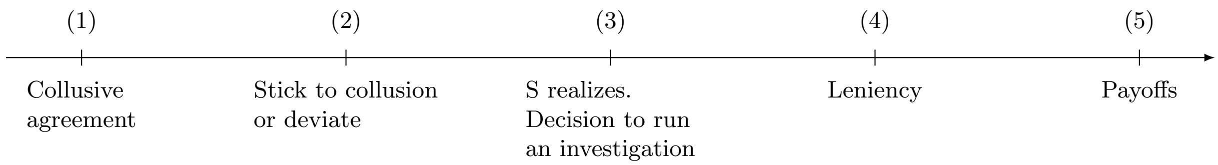


Figure 3.1: The stage game

3.2.3 Welfare

The AA is benevolent and maximizes total welfare, or equivalently minimizes the social cost of collusion.[31] Society incurs a per-period deadweight loss $L > 0$ when firms collude. For notational convenience, society has the same discount factor δ as firms.

Let us denote by V the value of collusion, which depends on whether firms report or not in case of investigation. We will assume that collusion arises whenever it is sustainable, that is, whenever $V \geq \Pi^D$. Gains from deviating, Π^D, are distributed across industries according to a cumulative distribution function G defined over the support $[\Pi^C, +\infty[$. As already mentioned, this can reflect differences in market transparency. The antitrust policy has an impact on V and thus affects the initial proportion of collusive industries in the economy, $G(V)$. For industries in which cartel formation is not deterred – i.e., for which Π^D is relatively low –, the antitrust policy improves welfare when cartel members are condemned and collusion is interrupted. We are now able to express the social cost of collusion in the economy, C, which is such that:

$$C = G(V)\hat{C}$$

where $\hat{C}$ denotes the social cost of a cartel, when it is formed; it satisfies:

$$\hat{C} = L + \delta(1 - \phi(\sigma, \gamma))\hat{C},$$

and is thus given by:

[31]We treat the fine as a transfer from the firms to the AA, which thus does not affect welfare. The collected fines could however enter the objective function when the AA faces a budget constraint. The European Commission indeed argues that the penalties paid go to the Community budget and, therefore, contribute to financing the European Union.

$$\hat{C} = \hat{C}(\sigma, \gamma) \equiv \frac{L}{1 - \delta(1 - \phi(\sigma, \gamma))}.$$

When firms collude, society incurs the loss L. The AA opens an investigation with probability $\psi + (1 - \psi)\sigma$, which allows the conviction of cartel members with probability $\phi(\sigma, \gamma)$. When condemned, firms compete forever, otherwise, society incurs again the social cost of the cartel in the following period.

An antitrust policy has a positive effect on cartel deterrence if it reduces the proportion of collusive industries. It has a positive effect on cartel desistance if it reduces the social cost of a cartel ($\hat{C}$).

3.3. Optimal Policy under Public Signals

As already mentioned, when cartel members observe the AA's signal, they will never report if the AA receives a bad signal and thus opening an investigation is immaterial in that case. The only policy variable is thus the leniency rate q. Cartel members may want to apply for leniency when the AA opens an investigation after receiving a good signal, since they then face a risk of being condemned.

"Collude and report in case of investigation" (R). If firms report when the AA runs an investigation after receiving a good signal ($\gamma = 1$), the cartel is then condemned with probability 1 instead of μ. *Ex ante*, the (expected) conviction rate is therefore $\phi(0, 1) = \psi$, the probability that the AA receives a good signal. If the leniency rate is q, each firm faces an expected reduction rate $\frac{q}{N}$, since leniency is granted only to the first informant. Therefore, the value of collusion, V_B^R (where B stands for Benchmark), solves $V_B^R = \Pi^C - \psi(1 - \frac{q}{N})F + (1 - \psi)\delta V_B^R$, that is:

$$V_B^R(q) = \frac{\Pi^C - \psi(1 - \frac{q}{N})F}{1 - \delta(1 - \psi)}$$

"Collude and be silent" (S). If all firms choose to remain silent when the AA carries out an investigation ($\gamma = 0$), the cartel is dismantled only if, having received a good signal, the AA succeeds in uncovering hard evidence during the investigation. The conviction rate is then only

$\phi(0,0) = \psi\mu$ but, when convicted, firms pay the full fine F. Therefore, the value of collusion, V^S, is:

$$V^S = \frac{\Pi^C - \psi\mu F}{1 - \delta(1 - \psi\mu)}$$

As already mentioned, the collusive path S faces an incentive-compatibility (IC_B) constraint: no firm should gain by instead reporting information when an investigation is ongoing, in which case it pays only a reduced fine $(1-q)F$ but foregoes future collusion. If instead firms stick to S, with probability μ the investigation is successful in which case cartel members pay F and then compete forever, whereas with probability $(1-\mu)$ the investigation fails and cartel members' discounted continuation payoffs are δV^S. The incentive-compatibility constraint is therefore:

$$-\mu F + (1-\mu)\delta V^S \geq -(1-q)F \qquad (IC_B)$$

Firms choose S instead of R only if it is both incentive-compatible and more profitable. Lemma 1 derives the firms' decisions as a function of q.

Lemma 1. *There exists a threshold,* $\hat{q} \equiv (1-\mu)\frac{\delta\Pi^C + (1-\delta)F}{(1-\delta+\mu\psi\delta)F}$*, such that:*

for $q \leq \hat{q}$*,*

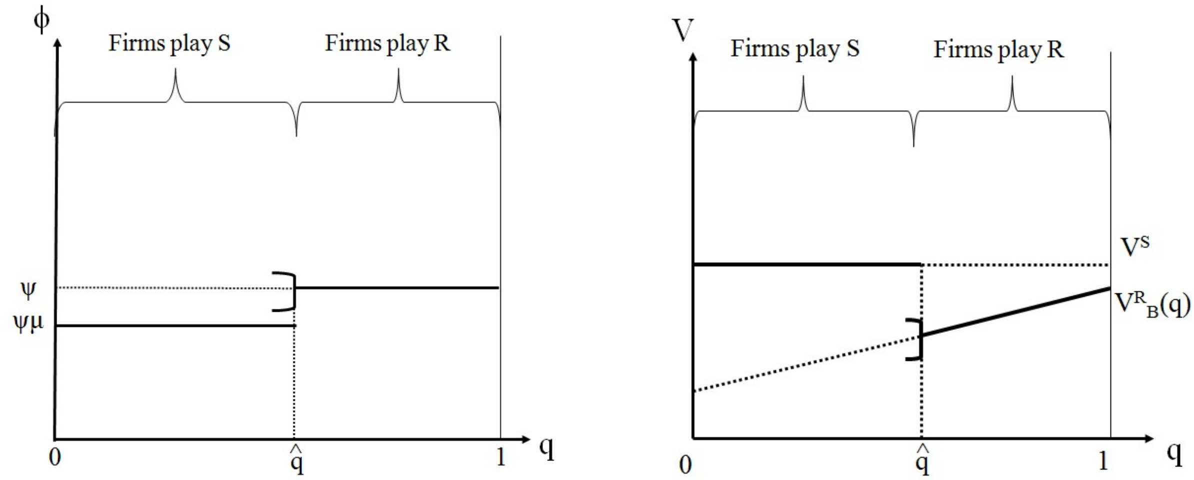
firms collude and remain silent if $V^S > \Pi^D$*, and compete otherwise.*

for $q > \hat{q}$*,*

firms collude and report in case of investigation if $V_B^R(q) > \Pi^D$*, and compete otherwise.*

The threshold $\hat{q}$ is lower than 1 if μ is higher than a threshold $\underline{\mu} < 1$. Figure 3.2(a) represents the conviction rate and Figure 3.2(b) the value of collusion as a function of q for the case $\mu > \underline{\mu}$.[32]

[32] On Figure 3.2(b), $V_B^R(1)$ is either below or above V^S.



(a) Conviction rate.

(b) Value of collusion.

Figure 3.2: Benchmark

The optimal antitrust policy consists in choosing the leniency rate q which minimizes the social cost of collusion C.

Desistance. Cartel desistance is enhanced when firms report information, since in that case, conviction is obtained for sure during an investigation instead of being uncertain. The AA has to set the leniency rate above $\hat{q}$ in order to force cartel members to report. When $\mu < \underline{\mu}$, it is however impossible to induce reporting if rewards are ruled out (i.e., if $q \leq 1$).[33] For the rest of the paper, we assume $\mu \geq \underline{\mu}$. Introducing a leniency rate $q > \hat{q}$ suffices to optimize desistance,[34] and raises the conviction rate from $\psi\mu$ to ψ.

Deterrence. The value of collusion is minimized when the AA sets q just above $\hat{q}$ (see Figure 3.2(b)). Offering more leniency is pro-collusive: this reduces expected sanctions without increasing any further the conviction rate.

Choosing q just above $\hat{q}$ optimizes both cartel desistance and cartel deterrence and thus forms the optimal antitrust policy. Proposition 1 summarizes the analysis:

Proposition 1 (Public signals)**. *Leniency policy.*** *The optimal leniency rate, granted only to the first informant, is just above* $\hat{q}$*.*

[33] Obviously if rewards were allowed, reporting could be induced for any value of μ.

[34] Formally, optimizing desistance in the benchmark requires minimizing $\hat{C}(0,\gamma)$. As $\hat{C}(0,1) < \hat{C}(0,0)$, desistance is optimized when cartel members report information in case of an investigation.

Welfare. *Introducing leniency is desirable both from a deterrence and a desistance perspective. The initial proportion of collusive industries drops from $G(V^S)$ to $G(V_B^R(\hat{q}))$ and the conviction rate increases from $\psi\mu$ to ψ.*

In what follows, we assume that collusion is not deterred in all industries in the absence of leniency. This implies that:[35]

$$\psi\mu F < \delta\Pi^C(1-\psi\mu) \tag{H1}$$

3.4. Optimal Policy under Private Signals

Suppose now that firms do not observe the signal. When the signal is bad, the AA has no chance of condemning the cartel through its own investigations. Still, the AA may want to run an investigation in the hope that cartel members will themselves denounce the cartel.

In this section, the policy variables are q and σ. If cartel members report in case of an investigation, "bluffing" – that is, choosing $\sigma > 0$ – enhances both cartel desistance and cartel deterrence. However, increasing σ has a shadow cost: it dilutes the risk of conviction if cartel members remain silent. By Bayes rule, the probability of prosecutorial success in case of an investigation becomes $\frac{\psi\mu}{\psi+(1-\psi)\sigma}$, which decreases in σ. As we will see, because of this *dilution* effect, the optimal investigation policy σ^* is interior, so as to keep inducing cartel members to report.[36] As in the preceding section, let us compute the value of R and S.

"Collude and report in case of investigation" (R). When firms do not observe the AA's signal and report in case of investigation ($\gamma = 1$), they are condemned even when the AA received a bad signal. The conviction rate is therefore $\phi(\sigma, 1) = \psi + (1-\psi)\sigma$, and the value of collusion, $V^R(\sigma, q)$, is then:

$$V^R(\sigma, q) = \frac{\Pi^C - \phi(\sigma, 1)(1-\frac{q}{N})F}{1-\delta(1-\phi(\sigma, 1))}$$

[35] Π^D is drawn from $[\Pi^C, +\infty[$ and thus, collusion is not deterred in all industries if $V^S > \Pi^C$. Replacing V^S by its value gives (H1).

[36] Commitment has value because of this dilution effect. In the absence of commitment, the AA may prefer bluffing with probability one in order to raise the conviction rate. However, this would undo cartel members' incentives to report.

"Collude and be silent" (S). The value of collusion remains V^S because the AA can find hard evidence only after receiving a good signal. S is again subject to an incentive-compatibility (IC) constraint: no firm should be willing to betray the cartel by reporting during an investigation, which is the case if:

$$(1 - \frac{\psi\mu}{\psi + (1-\psi)\sigma})\delta V^S - \frac{\psi\mu}{\psi + (1-\psi)\sigma} F \geq -(1-q)F \tag{IC}$$

Again, firms choose S instead of R only if it is both incentive-compatible and more profitable. Lemma 2 derives the firms' decisions as a function of q and σ.

Lemma 2. *For $q \leq \hat{q}$, $\forall\sigma$,*

firms collude and remain silent if $V^S > \Pi^D$, and compete otherwise.

For $q > \hat{q}$, there exists a threshold $\sigma^*(q) \in (0,1)$ such that:

for $\sigma < \sigma^*(q)$,

firms collude and report in case of investigation if $V^R(\sigma, q) > \Pi^D$, and compete otherwise.

for $\sigma \geq \sigma^*(q)$,

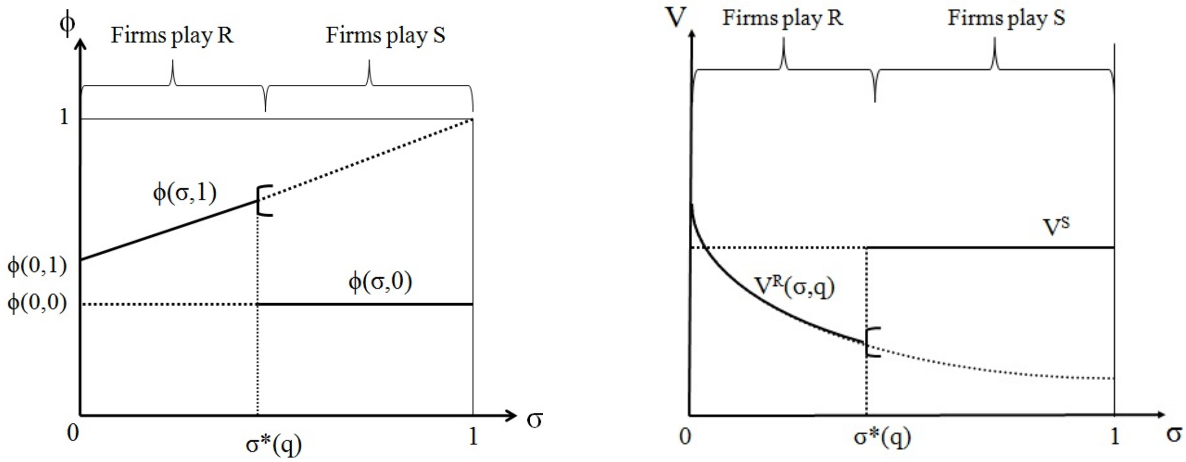
firms collude and remain silent if $V^S > \Pi^D$, and compete otherwise.

For $q \leq \hat{q}$, cartel members do not report information in the absence of bluffing (see the benchmark case). As bluffing dilutes the risk of being condemned when there is an investigation, they will not report *a fortiori* when $\sigma > 0$.

Suppose now that $q > \hat{q}$. In that case, there exists a threshold $\sigma^*(q) \in (0,1)$ such that for $\sigma < \sigma^*(q)$, S is not incentive-compatible and therefore firms report in case of investigation.

Figure 3.3(a) represents the conviction rate and Figure 3.3(b) the value of collusion as a function of σ when $q > \hat{q}$.[37]

[37] On Figure 3.3(b), $V^R(0, q)$ is either below or above V^S.



(a) Conviction rate.

(b) Value of collusion.

Figure 3.3

The optimal antitrust policy consists in choosing the leniency rate q and the investigation policy σ which minimize the social cost of collusion C.

Desistance. Formally, optimizing desistance requires minimizing $\hat{C}(\sigma, \gamma)$. $\hat{C}(\sigma, 0)$ is constant in σ, and $\hat{C}(\sigma, 1)$ is decreasing in σ. Moreover, $\hat{C}(0, 1) < \hat{C}(0, 0)$. Therefore, $\forall$ σ and $\overline{\sigma}$, $\hat{C}(\sigma, 1) < \hat{C}(\overline{\sigma}, 0)$. It follows that optimizing desistance boils down to ensuring that cartel members report in case of investigation ($\gamma = 1$) if that is possible, and to maximizing σ under this constraint.

For $q \leq \hat{q}$, cartel members always choose $\gamma = 0$ (see Lemma 2) and therefore, bluffing does not have any effect. For $q > \hat{q}$, cartel members choose $\gamma = 1$ only if $\sigma < \sigma^*(q)$ and thus, desistance is optimized when the AA chooses σ just below $\sigma^*(q)$. Intuitively, if the AA chooses σ low enough – i.e., below the threshold $\sigma^*(q)$ – it is likely to have received a good signal when it launches an investigation; consequently firms prefer to report. In contrast, when the AA chooses σ above $\sigma^*(q)$, the risk of conviction is too low to induce firms to denounce the cartel. By bluffing, the AA dilutes the risk of conviction, possibly to the point of discouraging leniency applications.

Optimizing desistance turns out to be equivalent to maximizing the conviction rate (see Figure 3(a)). If the AA chooses σ above $\sigma^*(q)$, firms remain silent during investigations and the conviction rate drops to $\psi\mu$. Opening investigations too frequently with a bad signal creates a negative externality on the efficiency of investigations with a good signal because this discourages cartel members from reporting information.

Deterrence. The increase in the conviction rate is also beneficial in terms of deterrence. For σ just below $\sigma^*(q)$, cartel members would be collectively better off by remaining silent in case of investigation. However, this is again not incentive-compatible and thus cartel members are forced to report, which materializes *ex ante* into a lower (expected) value of collusion (see Figure 3(b)).

The following proposition characterizes the optimal cartel policy.

Proposition 2 (Private signals). ***Leniency policy.*** *It is optimal to grant full amnesty ($q = 1$) to the first informant.*

Investigation policy. *The optimal investigation policy is to fix σ just below $\sigma^*(1)$.*

Welfare. *Bluffing is welfare-enhancing. The initial proportion of collusive industries, here equal to $G(V^R(\sigma^*(1), 1))$, is lower and the conviction rate, here equal to $\phi(\sigma^*(1), 1)$, is higher compared to the benchmark.*

Increasing the leniency rate allows the AA to open more investigations while still ensuring that firms report, which enhances desistance ($\sigma^*(q)$ is increasing in q). Deterrence is simultaneously improved because the value of collusion $V^R(\sigma^*(q), q)$ is decreasing in q. Intuitively, the increase in the conviction rate outweighs the pro-collusive effect of offering more leniency when the AA adopts a FI rule. The leniency policy not only triggers applications as in the benchmark case but it also gives more room for bluffing. This second effect explains why full amnesty is optimal here.[38]

The following comparative statics are summarized in Table 3.1.

Proposition 3 (Comparative statics). *i) The probability of bluff, $\sigma^*(1)$, is decreasing in the private gain from collusion, Π^C, and is increasing in the fine, F, the probability to have initial evidence, ψ, and the efficiency of investigations, μ. It is unaffected by the social loss from collusion, L.*

ii) Welfare is decreasing in the private gain from collusion, Π^C, and the social loss from collusion, L, and is increasing in the fine, F, the probability to have initial evidence, ψ, and the efficiency of investigations, μ.

[38] Again, rewards would raise further the probability of bluff which is desirable both in terms of desistance and deterrence. In particular, if the AA offers the reward $\tilde{q} > 1$ such that $\sigma^*(\tilde{q}) = 1$, it can bluff with probability one while still ensuring that cartel members report. When the leniency scheme is well-designed, rewards guarantee that collusion is deterred at no cost in all industries. Observe that deterrence here is based on *post-investigation* rewards whereas Spagnolo (2004)'s result rests on *pre-investigation* rewards.

Table 3.1: Comparative Statics

Increase in	**Effect on** **Probability of bluff** $\sigma^*(1)$	**Welfare**
Private gain from collusion, Π^C	Lower	Lower
Social loss from collusion, L	No Effect	Lower
Fine, F	Higher	Higher
Probability to have initial evidence, ψ	Higher	Higher
Efficiency of investigations, μ	Higher	Higher

As usual, a higher stake of collusion tilts the balance in favor of the cartel and makes prosecution more difficult. In contrast, a more generous carrot (i.e., a higher q) or a harsher stick (i.e., a higher fine F, a higher μ or a higher ψ) reinforce firms' incentives to betray the cartel. In our setting, this enables the AA to raise the probability of bluff, which has a positive effect on welfare.[39]

Comparative statics with respect to ψ confirm the complementary role of individual leniency programs and whistleblowing schemes. Firms are more prone to report when the AA is more likely to be informed by third parties about their illegal activities.

3.5. The Single Informant Rule

The AA can do better than implementing a FI rule. Intuitively, an optimal informant rule should destabilize the strategy "collude and be silent", S, while minimizing the reduction in fines imposed on cartel members.

Let us allow the leniency rate to be fully flexible with respect to the number of informants. A leniency scheme is a N-tuple $Q = (q_1, \dots, q_N)$ where $q_l \in [0, 1]$ for $l \in \{1, \dots, N\}$; if the AA receives l leniency applications, each informant is eligible to the leniency rate q_l. Offering the leniency rate q to all informants is equivalent to the leniency scheme $(q, \dots, q)$ whereas adopting a FI rule boils down to offer the leniency scheme $(q, \frac{q}{2}, \dots, \frac{q}{N})$. We again assume that firms decide whether or not to report simultaneously.

The strategy "collude and report in case of investigation", R, has value:

[39] A lower Π^C, a higher F or a higher ψ, by directly decreasing the value of collusion, have also a positive effect on welfare.

$$V^R(\sigma, Nq_N) = \frac{\Pi^C - \phi(\sigma,1)(1-q_N)F}{1-\delta(1-\phi(\sigma,1))};$$

and the (IC) constraint rewrites:

$$(1 - \frac{\psi\mu}{\psi+(1-\psi)\sigma})\delta V^S - \frac{\psi\mu}{\psi+(1-\psi)\sigma}F \geq -(1-q_1)F$$

As $(1-q_1)F$ is decreasing in q_1, the optimal leniency scheme imposes $q_1^* = 1$. As $V^R(\sigma, Nq_N)$ is increasing in q_N, the optimal leniency scheme imposes q_N^* arbitrarily close to 0 [40] q_1^* maximizes the internal conflict of interest between cartel members (formally, this tightens the (IC) constraint) and q_N^* minimizes the value of R. The optimal leniency scheme involves a *single informant* rule (denoted hereafter SI rule), that is, amnesty should be given only if a single cartel member reports information.

When the AA adopts a SI rule, it wins on both counts: firms are forced to play R (S is not robust to single reporting deviations when the AA sticks to σ just below $\sigma^*(1)$ and offers $q_1^* = 1$) and they end up paying the full fine. It follows that choosing to adopt a SI rule instead of a FI rule enhances deterrence (both rules have the same effect in terms of desistance). The initial proportion of collusive industries drops to $G(V^R(\sigma^*(1), 0)) < G(V^R(\sigma^*(1), 1))$.[41]

The following proposition summarizes the analysis:

Proposition 4. *When the AA offers leniency rates that are contingent on the number of informants:*

Leniency policy. *It is optimal to grant full amnesty only if a single firm reports (SI rule).*

Investigation policy. *The optimal investigation policy is to fix σ just below $\sigma^*(1)$.*

Welfare. *Welfare is enhanced compared with a FI rule: the initial proportion of collusive industries drops to $G(V^R(\sigma^*(1), 0))$.*

[40] q_N^* must be positive to ensure that reporting is a (strictly) dominant strategy. Observe that the optimal leniency scheme also requires q_l^* to be arbitrarily close to 0 for $l \in \{2, \ldots, N-1\}$ when the number of cartel members is initially unknown. Therefore, when at least two cartel members report, the effective reduction in the fine is arbitrarily close to 0. In order to facilitate the exposition, we assume it is equal to 0.

[41] The SI rule also outperforms the FI rule in the benchmark. The initial proportion of collusive industries equals $G(V^R(0,0))$ under the SI rule and $G(V^R(0,\hat{q}))$ under the FI rule. Observe also that if the AA implements a SI rule, any q strictly above $\hat{q}$ is optimal.

3.6. Policy Implications

We discuss here the policy implications of our model.

Real world leniency policy. In the benchmark case, when the AA implements a FI rule, the optimal leniency rate tends to zero if μ tends to one (see Lemma 1). Offering leniency in this case would be pro-collusive. This is the standard argument for refusing to grant leniency when the probability of winning the case in the absence of firms' confessions is high. This recommendation is implemented by antitrust authorities in the US and in Europe. Section B of the Corporate Leniency Policy grants post-investigation leniency to the first informant provided that the DoJ,

"at the time the corporation comes in, does not yet have evidence against the company that is likely to result in a sustainable conviction".

Similarly, the latest (European) Commission Notice (2006) on immunity from fines specifies that:

"In order to qualify [for reduction of a fine], an undertaking must provide the Commission with evidence of the alleged infringement which represents significant added value with respect to the evidence already in the Commission's possession".

Our analysis challenges this common view that leniency is pro-collusive when the risk of conviction is large.[42] First, note that in the benchmark, if the AA implements a SI rule instead of a FI rule, offering full amnesty does not dilute deterrence even if μ is close to one. Again, this stresses that the design of the eligibility rules is crucial in determining the deterrence effect of leniency.

More importantly, and contrary to what the above motion suggests, it is optimal to maintain $q = 1$ even when μ is large, so as to implement the investigation policy $\sigma^*(1)$.

Miscoordination among cartel members. By assuming that cartel members can coordinate themselves on the Pareto-dominant collusive path, we have chosen the *equilibrium selection* which is the most "favorable" to firms, and by the same token, the most "detrimental" to the AA. Even in this case, we have shown that bluffing is welfare-enhancing. If instead cartel members cannot

[42] Harrington (2008) also provides examples where it is optimal to award amnesty even though the chances of a conviction are already quite high; however, in his model, amnesty "*should not be provided when the antitrust authority's case is sufficiently strong*" (see p.218). By contrast, in our model, it is *always* optimal to award amnesty whenever $\mu > \underline{\mu}$.

perfectly coordinate their reporting decisions, the AA could raise the investigation policy σ above $\sigma^*(1)$ and still obtain confessions. In particular, when one firm believes that at least one other firm will apply for leniency, it reports information even when the AA chooses the investigation policy $\sigma = 1$.

Positive risk of conviction in case of a bad signal. Until now, we have assumed that the AA has no chance of finding evidence when it opens an investigation after receiving a bad signal. Suppose instead that in such a case, the AA can find hard evidence with probability $\mu_L > 0$. In the absence of leniency, when there is a cartel, the AA might then want to open an investigation in every period.

When the signal is private information, the AA is actually better off lowering the probability of opening an investigation in case of a bad signal, in order to induce cartel members to report information. Perhaps surprisingly, in that case the introduction of leniency – i.e., moving from no leniency to the optimal leniency scheme under private signals – raises the overall conviction rate and thus welfare, but lowers the number of cartel cases, even in the short run.[43]

From an empirical perspective, an important corollary is that *antitrust activity* is not necessarily a good proxy for assessing the efficiency of the antitrust policy: our analysis shows that a drop in the number of cartel cases around the introduction of leniency may well correspond to an improvement of cartel policies.

Commitment devices. We assumed that the AA can commit to a given investigation policy. A potential tool to credibly commit is *ex post* transparency. In our case, the AA should report cartel cases where it refrained from opening (or postponed) an investigation due to the insufficiency of initial evidence against the cartel. Alternatively, the AA budget can be used to put a cap on the number of investigations opened in each period.

***Single Informant* rule.** Spagnolo (2007) discusses the objective of an optimal leniency program:

"*This means that a well-designed program must maximize incentives to betray the cartel by reporting important information to the Antitrust Authority, while at the same time limiting as*

[43] That is, abstracting from the deterrence effect of leniency which also goes in the direction of reducing the number of cartel cases.

much as possible the reduction in fines imposed on the whole cartel. This objective can be achieved by maximizing the benefits an individual cartel member can receive from reporting under the leniency program, but restricting such maximal benefit to one and only one reporting party, the first comer."

We fully agree with the diagnosis. However, our analysis challenges the optimal response: in order to minimize the reduction in fines imposed on the whole cartel, the SI rule outperforms the FI rule. Briefly stated, our results embrace and complement the view that an optimal leniency scheme combines both strong generosity (q as large as possible) and strict eligibility (even stricter than the FI rule).

The SI rule may however be risky to implement in practice; in particular, any cartel members might then threaten to report if another firm reports first, thereby eliminating any gain from reporting in the first place.[44] To minimize this risk, the SI rule should be applied during a period over which the privacy of leniency applications could be guaranteed. Note also that the success of the SI rule rests on the assumption that cartel members compete forever once condemned. When instead firms go on colluding after being condemned, the SI rule is equivalent to the FI rule: in both cases, when firms choose the collusive path "collude and report in every period", they will take turns in reporting and obtaining leniency.

3.7. Concluding Remarks

The literature on leniency programs does not consider private information on the AA side. We have shown that taking it into account has important implications for leniency policies.

When it is privately informed about the strength of a cartel case, the AA may obtain confessions even when it is unlikely to find evidence on its own. However, the AA should carefully choose its investigation policy as prosecuting a cartel when the success probability is low dilutes the average risk of conviction faced by cartel members and therefore lowers the likelihood of leniency applications. In other words, when the AA decides whether or not launching an investigation with a low probability of success, there is a tradeoff between a desistance effect – i.e., if one firm reports, the investigation leads to the cartel condemnation – and a dilution effect – i.e., this reduces

[44] This threat does not occur in our model as firms make their reporting decisions simultaneously.

firms' incentives to report. The dilution effect arises only if private information on the AA side is assumed since otherwise there is no linkage between investigations. Offering more leniency is desirable because it counterbalances the dilution in the risk of conviction, and thus allows the AA to open more successful investigations. As a result, the optimal leniency rate is the highest possible, in our case full amnesty.

We also investigate whether the AA can simultaneously improve cartel deterrence by properly designing the leniency scheme. When the AA is allowed to offer leniency rates contingent on the number of informants, the optimal scheme involves a single informant rule, that is, amnesty should be given only if a single cartel member reports. When the AA adopts the single informant rule, amnesty is a lure, since all cartel members face the same unilateral incentives to cheat on the cartel. One interesting direction for future research would be to investigate the robustness of the single informant rule, for instance when there is asymmetry between cartel members.

Chapter 4

Leniency Programs and Prosecution Effort

4.1. Introduction

This note studies the impact of leniency programs on prosecution effort. In Motta and Polo (2003), leniency facilitates the collection of incriminating evidence, which allows antitrust authorities to spend less resources in prosecution. We show that it might however be optimal to raise prosecution effort when introducing leniency.

For this, we compare antitrust policies in a framework where conviction probabilities are endogenous. Section 4.2 presents the model. Section 4.3 characterizes optimal effort in the absence of leniency and section 4.4 when leniency is allowed. We also study the relationship between prosecution effort and prosecution efficiency. Section 4.5 concludes.

4.2. Framework

We consider an industry with $N \geq 2$ firms playing an infinitely repeated Bertrand game. The static profit of a firm is 0 if firms compete and Π if they collude. All firms have the same discount factor $\delta \in (0, 1)$ and maximize the expected discounted sum of their profits.

The Antitrust Authority (AA) audits the industry with probability α. If firms collude, the AA runs an investigation. By exerting observable effort $e \in [0, \overline{e}]$ at an increasing and convex cost $\Psi(e)$

during the investigation, the AA gathers evidence of collusion with probability $p(e, \theta)$, where $p(e, \theta)$ is increasing and concave in e and increasing in θ for $e \in (0, \bar{e})$; for all θ, $p(0, \theta) = 0$ and $p(\bar{e}, \theta) = 1$. $\theta \in [\underline{\theta}, \overline{\theta}]$ represents the intrinsic efficiency of investigation and is common knowledge. If the AA gathers evidence of collusion, the cartel is condemned, in which case each firm pays a fine F and is forced to compete forever.[1]

If leniency is offered, the first firm that reports information pays only a reduced fine $(1 - q)F$, where q denotes the leniency rate, and all cartel members are condemned with probability one. We rule out rewards, so that $q \leq 1$. As in Motta and Polo (2003), we consider two modes of (symmetric) collusive equilibrium, in which firms either "collude and remain silent", or "collude and report in case of investigation".

Finally, we focus on cartel desistance. We therefore assume the existence of a cartel and characterize the optimal level of prosecution effort both in the presence and in the absence of leniency.

4.3. Optimal Effort in the Absence of Leniency

Society incurs a loss, L, when firms collude. With probability α, the AA runs an investigation and finds evidence with probability $p(e, \theta)$, in which case firms are condemned and compete forever. Otherwise, society incurs again the social cost of the cartel in the following period. In the absence of leniency, the social cost of a cartel, C, is thus such that:

$$C = L + \alpha\Psi(e) + \delta(1 - \alpha p(e, \theta))C;$$

and the AA's objective is:

$$\min_e C(e) = \min_e \frac{L + \alpha\Psi(e)}{1 - \delta(1 - \alpha p(e, \theta))} \tag{4.1}$$

Assuming $\Psi(0) = 0$, $\Psi'(0) = 0$ and $\Psi'(\bar{e})$ arbitrarily large ensures that problem (1) has a unique interior solution denoted e^*. The associated social costs are denoted C^*.

[1] This assumption follows Harrington (2008). Our results are qualitatively unchanged if we assume instead that, following a condemnation, firms are forced to compete only for a finite length of time.

Proposition 5. *In the absence of leniency:*

- *An increase in F has no effect on the social cost of a cartel, C^*, and on effort, e^*.*
- *An increase in θ reduces the social cost of a cartel. It decreases effort if $\frac{\partial^2 p(e^*,\theta)}{\partial\theta\partial e}$ is below a threshold $k > 0$ and increases effort otherwise.*

Proof. By the envelope theorem, $\frac{\partial C^*}{\partial\theta} = -\frac{\alpha\delta \; \partial p(e^*,\theta)/\partial\theta}{(1-\delta+\alpha\delta p(e^*,\theta))^2} < 0$. The first order condition of (1) is $\frac{\partial\Psi(e^*)}{\partial e}(1 - \delta + \alpha\delta p(e^*,\theta)) - \delta\frac{\partial p(e^*,\theta)}{\partial e}(L + \alpha\Psi(e^*)) = 0$. By implicit differentiation of this condition, we get: $\text{sign}(\frac{\partial e^*}{\partial\theta}) = \text{sign}(\frac{\partial^2 p(e^*,\theta)}{\partial\theta\partial e}(L+\alpha\Psi(e^*)) - \alpha\frac{\partial\Psi(e^*)}{\partial e}\frac{\partial p(e^*,\theta)}{\partial\theta})$. $\frac{\partial e^*}{\partial\theta}$ is therefore negative if $\frac{\partial^2 p(e^*,\theta)}{\partial\theta\partial e} \leq k$ with $k = \frac{\alpha \; \partial\Psi(e^*)/\partial e \; \partial p(e^*,\theta)/\partial\theta}{L+\alpha\Psi(e^*)} > 0$, and positive otherwise.

□

Prosecution effort and efficiency are strategic substitutes ($\frac{\partial e^*}{\partial\theta} < 0$) when $\frac{\partial^2 p(e^*,\theta)}{\partial\theta\partial e}$ is not too large. While an increase in θ tends to raise e^* when $\frac{\partial^2 p(e^*,\theta)}{\partial\theta\partial e} > 0$, it also reduces the expected duration of a cartel which lowers the marginal benefit of exerting more effort. That is why e^* is increasing in θ only if $\frac{\partial^2 p(e^*,\theta)}{\partial\theta\partial e}$ is above the threshold $k > 0$ defined above. Finally, F, which is a transfer from firms to the AA, has no impact neither on optimal effort nor on the social cost of a cartel.

4.4. Optimal Effort Under Leniency

We first characterize whether collusive firms remain silent or report in case of investigation given the leniency and effort policies chosen by the AA; then, we solve for the optimal leniency and effort policies. If firms remain silent when they collude, the probability of finding evidence in case of an investigation is $p(e,\theta)$. When convicted, firms pay F and compete forever. V, the value of collusion is then such that $V = \Pi - \alpha pF + \delta(1-\alpha p)V$, that is:

$$V(p) = \frac{\Pi - \alpha pF}{1 - \delta(1-\alpha p)} \tag{4.2}$$

$V(p)$ is decreasing in p. To be sustainable, the strategy "collude and remain silent" requires that no firm should gain by reporting when an investigation is ongoing, in which case it pays only a reduced fine $(1-q)F$. If instead firms remain silent, with probability p, the investigation is successful and the cartel is condemned, and with probability $(1-p)$, the investigation fails and firms' discounted continuation payoffs are $\delta V^S(p)$. The sustainability constraint is therefore:

$$-pF + (1-p)\delta V(p) \geq -(1-q)F \tag{4.3}$$

If "collude and be silent" is not sustainable, firms can opt for "collude and report in case of investigation". Otherwise, we assume that firms coordinate themselves on the most profitable collusive equilibrium. Lemma 3 derives the firms' decisions as a function of p and q.

Lemma 3. *There exists a threshold, $\underline{p}(q) \in (0,1]$, decreasing in q, such that:*

- *for $p \leq \underline{p}(q)$, firms remain silent in case of investigation;*
- *for $p > \underline{p}(q)$, firms report in case of investigation.*

Proof. Firms choose "collude and remain silent" (S) instead of "collude and report in case of investigation" (R) if S is both sustainable and more profitable than R. After some computations, we obtain that constraint (3) is satisfied only if $p \geq \underline{p}(q)$ with $\underline{p}(q) = \frac{\delta\Pi + (1-\delta)(1-q)F}{\delta\Pi + (1-\delta)F + \alpha\delta q F}$. Let us show that S is more profitable than R in that case. The value of R is such that $V^R = \Pi - \alpha(1-\frac{q}{N})F + (1-\alpha)\delta V^R$ as leniency is granted only to the first informant, and thus $V^R(q) = \frac{\Pi - \alpha(1-\frac{q}{N})F}{1-\delta(1-\alpha)}$. After some computations, we obtain that $V(\underline{p}(q)) > V^R(q)$ if and only if $N > 1$. As $N \geq 2$ and $V(p)$ is decreasing in p, $V(p) > V^R(q)$ for all $p \leq \underline{p}(q)$.

□

Let us denote by $\underline{e}(\theta, q)$ the effort sufficient to implement the conviction probability $\underline{p}(q)$. By choosing q arbitrarily large, the AA obtains reporting without providing any effort. It suffices to grant a reward of $\frac{\delta\Pi}{1-\delta}$ in exchange of confessions (which is the value of $(q-1)F$ such that $\underline{e}(\theta, q) = 0$). Leniency and prosecution effort are alternative instruments to condemn cartel members. Offering more leniency is more efficient since it is not costly from a social perspective.

However, as we rule out rewards, the highest feasible and thus optimal leniency rate is $q = 1$. This implies that a positive effort is required to induce reporting. Denote e^R, the effort sufficient to obtain reporting when $q = 1$ and C^R, the social cost of a cartel when leniency is offered. We have $e^R \equiv \underline{e}(\theta, 1)$, and $C^R = \frac{L + \alpha\Psi(e^R)}{1-\delta(1-\alpha)}$.[2] Is it possible to enhance desistance with a leniency policy? This amounts to comparing C^* and C^R.

[2] C^R solves $C^R = L + \alpha\Psi(e^R) + (1-\alpha)\delta C^R$.

Lemma 4. *If $C^R < C^*$, the AA exerts effort e^R and firms report in case of investigation. Otherwise, the AA exerts e^* and firms never report.*

Introducing leniency is welfare-enhancing if $C^R < C^*$. This condition is fulfilled when $e^* \geq e^R$, in which case, offering full amnesty both raises the conviction rate and decreases prosecution effort. When $e^R > e^*$, leniency improves desistance if the benefit of increasing the conviction probability outweighs the cost of increasing effort from e^* to e^R. A direct implication is that introducing leniency might lead the AA to exert more effort.

Proposition 6. *When leniency is desirable (i.e. when $C^R < C^*$), an increase in either θ or F lowers the social cost of a cartel and prosecution effort, e^R.*

Proof. From Lemma 3, $\underline{p}(1)$ and therefore e^R is decreasing in F. Moreover, as $\underline{p}(1)$ does not depend on θ and $p(e, \theta)$ is increasing in θ and e, it follows that e^R is decreasing in θ. Finally, as C^R is increasing in e^R, C^R is decreasing in F and in θ. □

We mentioned that F has no impact on effort when leniency is not allowed. By contrast, when leniency is offered, increasing F reduces the effort needed to induce reporting, which in turn encourages the AA to induce firms to report. We have also seen that, in the absence of leniency, the intrinsic efficiency θ and the effort e could be strategic substitutes or complements. By contrast, here an increase in θ reduces the effort needed to induce reporting. Under leniency, the behavior of the AA can be described as "satisficing behavior": it exerts the minimal effort which triggers reporting. That is why prosecution effort and efficiency are, in that case, always strategic substitutes.

4.5. Conclusion

We show in this paper that introducing leniency does not always lead the AA to exert less prosecution effort. Consistent with our result, Brenner (2009) finds no statistically significant relationship between the duration of investigations and firms' cooperation under the 1996 EU Leniency Program.[3] We also show that prosecution effort and efficiency are strategic substitutes when leniency

[3]Brenner's analysis is well-suited for our analysis since the 1996 EU Leniency Program triggered mainly post-investigation leniency applications, which is the focus of our note.

is offered. It is not the case in the absence of leniency. A challenge of the European Commission has been to face a surge in cartel cases following the adoption of leniency programs. This motivated the introduction in 2008 of a *settlement procedure* which *"aims at simplifying and expediting the procedure leading to the adoption of a formal decision, thereby allowing for procedural savings and the internal redeployment of enforcement resources"*.[4] Our analysis suggests that the AA might be gradually able to save on enforcement resources as it becomes more efficient in prosecution.

[4]Under this procedure, inspired by plea bargaining in the United States, the fine can be reduced by 10 % if parties aknowledge their involvement in the cartel.

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Appendix A

Takeover Discipline and Asset Tangibility

A.1. Additional Table

Table A1: Takeover Defenses and ROA

This table presents estimated coefficients from panel regressions of (industry-adjusted) ROA on the E index and control variables. Control variables are a Delaware dummy, an S&P 500 dummy, firm size, firm age, cash holdings, capital expenditure, and book leverage. The intangible dummy equals one if the firm is an intangible firm, that is if the firm has a mean asset tangibility over the sample period below the median. In panel B, the sample is restricted to Democracies ($E = 0$) and Dictatorships ($E \geq 4$). Regressions include year and industry fixed effects. Standard errors, presented in parenthesis, are clustered at the firm level. The sample period is from 1990 to 2007. The coefficients are multiplied by 100 for expositional convenience. *, ** and *** denotes significance at the 10%, 5% and 1%, respectively.

Dependent Variable:		ROA				
		Panel A: All Sample		Panel B: Democracies versus Dictatorships		
E	-0.182*	-0.057	-	Dict $\{0,1\}$	-0.675	0.178
	(0.109)	(0.116)			(0.562)	(0.630)
E * Intangible $\{0,1\}$	-	-0.280	-	Dict $\{0,1\}$ *	-	-1.788*
		(0.211)		Intangible $\{0,1\}$		(1.046)
E * Tangibility Quartile= 1	-	-	-0.613**		-	-
			(0.266)			
E * Tangibility Quartile= 2	-	-	-0.086		-	-
			(0.244)			
E * Tangibility Quartile= 3	-	-	-0.085		-	-
			(0.193)			
E * Tangibility Quartile= 4	-	-	0.031		-	-
			(0.116)			
Intangible $\{0,1\}$	-	-0.0460	-	Intangible $\{0,1\}$	-	1.331
		(0.673)				(1.030)
Tangibility Quartile= 2	-	-	-0.356		-	-
			(1.018)			
Tangibility Quartile= 3	-	-	0.468		-	-
			(0.982)			
Tangibility Quartile= 4	-	-	-1.952**		-	-
			(0.941)			
Size	0.734***	0.721***	0.762***	Size	0.785**	0.811**
	(0.186)	(0.187)	(0.186)		(0.334)	(0.330)
Age	-0.216	-0.238	-0.340	Age	-0.410	-0.369
	(0.255)	(0.254)	(0.257)		(0.396)	(0.396)
Delaware	-0.907***	-0.874***	-0.873***	Delaware	-1.887***	-1.873***
	(0.300)	(0.302)	(0.299)		(0.543)	(0.541)
S&P 500	1.454***	1.464***	1.486***	S&P 500	0.776	0.736
	(0.411)	(0.413)	(0.412)		(0.647)	(0.646)
Cash	-8.920***	-8.817***	-8.566***	Cash	-8.254***	-8.577***
	(1.414)	(1.409)	(1.394)		(2.538)	(2.517)
Leverage	-10.61***	-10.71***	-10.48***	Leverage	-13.33***	-13.23***
	(1.061)	(1.061)	(1.056)		(2.067)	(2.066)
Capital Expenditure	47.30***	45.31***	46.78***	Capital Expenditure	39.43***	40.29***
	(2.938)	(2.908)	(2.897)		(5.373)	(5.158)
Industry Fixed Effects	Yes	Yes	Yes	Industry Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Year Fixed Effects	Yes	Yes
R^2	0.33	0.33	0.33	R^2	0.35	0.35
Observations	20,900	20,900	20,900	Observations	5,578	5,576

Appendix B

Bottom-Up Corporate Governance

B.1. Additional Tables

Table B1: Performance and Internal Governance - Year by Year Results

Regressions of performance on internal governance and controls are run separately each year. Performance is measured through ROA in the first columns of panel A and panel B, and through Market to book in the second columns of panel A and panel B. The coefficients on FRAC1 (lagged one period) are reported in panel A, while the coefficients on FRAC2 (lagged one period) are reported in panel B. In panel A, the control variables are the same as in Table 2.3, column (1). In panel B, the control variables are the same as in Table 2.3, column (3). Regressions include industry-fixed effects. The bottom row indicates the Fama-Mac Beth estimate. ROA and Market to book are trimmed at the 1% and 99% levels. Standard errors are reported in parenthesis. *, ** and *** means statistically different from zero at 10%, 5% and 1% level of significance. The coefficients are multiplied by 100 for expositional convenience. The sample period is from 1992 to 2009.

	Panel A: FRAC 1		*Panel B: FRAC 2*	
	ROA	MARKET TO BOOK	ROA	MARKET TO BOOK
	(1)	(2)	(3)	(4)
1993	-4.282	-37.57	-	-
	(2.755)	(41.62)		
1994	-2.621	0.812	-	-
	(2.320)	(27.96)		
1995	-1.322	8.376	-1.454	-45.94**
	(1.946)	(27.82)	(1.712)	(22.05)
1996	-4.367**	-21.97	-5.310***	-8.106
	(1.931)	(26.43)	(1.609)	(20.80)
1997	-2.729	-11.13	-0.017	-1.163
	(1.894)	(29.29)	(1.407)	(22.39)
1998	-4.071**	-14.69	0.553	25.27
	(1.865)	(30.22)	(1.357)	(19.56)
1999	-4.109**	-24.77	-1.381	-19.50
	(1.845)	(32.66)	(1.339)	(22.00)
2000	-4.875***	-82.54***	-1.163	-32.19
	(1.863)	(31.44)	(1.188)	(20.59)
2001	-3.528*	0.356	-1.274	21.71
	(1.938)	(29.21)	(1.166)	(16.52)
2002	-4.094**	-44.98**	-2.485**	-20.10
	(1.872)	(21.99)	(1.198)	(13.68)
2003	-4.639**	-53.87*	-2.259*	-32.29**
	(1.939)	(28.08)	(1.150)	(15.80)
2004	-2.371	-24.22	-1.102	-23.98*
	(2.103)	(29.01)	(1.033)	(14.02)
2005	-1.926	24.64	-0.935	-25.12*
	(2.379)	(32.78)	(0.964)	(13.55)
2006	-3.440	-8.566	-2.146**	-16.39
	(2.536)	(34.96)	(0.921)	(11.76)
2007	-	-	-1.075	-12.71
			(1.017)	(13.94)
2008	-	-	-2.102*	-2.313
			(1.193)	(11.09)
2009	-	-	-1.794	1.714
			(1.217)	(12.00)
Fama-Mac Beth	-3.455***	-20.72***	-1.596***	−12.74**
	(0.291)	(7.379)	(0.338)	(5.052)

Table B2: Performance and Internal Governance - Granger Causality

In panel A and B, columns (1) and (3) report the result of a regression of performance on one-year lagged internal governance and one-year lagged performance. Columns (2) and (4) report the result of a regression of internal governance on one-year lagged internal governance and one-year lagged performance. Performance is measured through ROA in panel A, and through Market to book in panel B. Internal governance is FRAC1 in columns (1) and (2), and FRAC2 in columns (3) and (4). In columns (1) and (2), the control variables (not reported for brevity) are the same as in Table 2.3, column (1). In columns (3) and (4), the control variables are the same as in Table 2.3, column (3). Regressions include industry- and year-fixed effects. ROA and Market to book are trimmed at the 1% and 99% levels. Standard errors, reported in parenthesis, are clustered at the firm level. *, ** and *** means statistically different from zero at 10%, 5% and 1% level of significance. The sample period is from 1992 to 2009.

Panel A:	ROA (1)	FRAC 1 (2)	ROA (3)	FRAC 2 (4)
FRAC 1 (-1)	-1.593***	50.34***	-	-
	(0.503)	(1.367)		
FRAC 2 (-1)	-	-	-0.638***	23.36***
			(0.222)	(0.695)
ROA (-1)	60.26***	1.065	62.36***	-1.114
	(3.459)	(1.019)	(2.242)	(1.313)
CEO/Executives characteristics	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes
Industry-fixed effects	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes
R^2	0.55	0.81	0.56	0.88
Observations	9,812	10,106	11,710	11,976

Panel B:	MARKET TO BOOK (1)	FRAC 1 (2)	MARKET TO BOOK (3)	FRAC 2 (4)
FRAC 1 (-1)	-16.86*	50.02***	-	-
	(9.527)	(1.432)		
FRAC 2 (-1)	-	-	-5.624*	23.03***
			(2.978)	(0.722)
Market to book (-1)	31.65***	0.065	52.79***	-0.041
	(6.410)	(0.076)	(5.221)	(11.03)
CEO/Executives characteristics	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes
Industry-fixed effects	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes
R^2	0.42	0.81	0.58	0.88
Observations	8,954	9,345	10,671	11,037

B.2. Definition of Variables

Variable	Description
	Panel A: Governance variables
FRAC 1	Fraction of executives hired after the CEO constructed with the JOINED_CO EXECUCOMP variable. High values mean poor internal governance.
FRAC 2	Fraction of executives hired after the CEO constructed through entry and exit in the EXECUCOMP database. High values mean poor internal governance.
GIM index	Gompers et al. (2003) index of corporate governance, based on 24 antitakeover provisions. High values of GIM index mean poor external governance.
CEO is chairman	Dummy variable: 1 if the CEO is also chairman of the board, 0 otherwise.
Board size	Number of directors sitting on the board.
	Panel B: CEO/Executives characteristics
CEO seniority	Number of years since the executive has been appointed as the CEO (using BECAMECEO EXECUCOMP variable).
CEO from outside	Dummy variable: 1 if the CEO has been appointed from the outside, 0 otherwise.
Executive's seniority	Number of years since the executive has been working for the company (using the JOINED_CO EXECUCOMP variable or entry in the EXECUCOMP database).
% of executives whose seniority is reported	% of executives for which the JOINED_CO variable is non-missing.
Executives turnover	Fraction of executives who are no longer reported as working for the company the following year in the EXECUCOMP database.
	Panel C: Firm Characteristics
Firm age	Logarithm of one plus the number of years since the firm has been in the COMPUSTAT database.
Firm size	Logarithm of book value of total assets (COMPUSTAT item AT).
ROA	Operating income after depreciation and amortization (OIBDP minus DP) divided by total assets (AT).
Market to book	Market value of assets over book value of assets (AT+(CSHO×PRCC)-CEQ-TXDB)/AT.
Cash-flow volatility	Defined as in Zhang (2006) – i.e., the standard deviation of cash flows from operations over the past five years, with a minimum of three years.
Number of business segments	Obtained from the COMPUSTAT segment files.
	Panel D: Deal Characteristics
Cumulative abnormal returns	Computed using a four factor model (Fama French factors + Momentum), estimated over the 48 months preceding the acquisition.
All-cash deal	Dummy variable: 1 if the deal has been financed only by cash, 0 otherwise (from SDC).
Deal size	Logarithm of deal value (from SDC).

Appendix C

Prosecution and Leniency Programs: The Role of Bluffing in Opening Investigations

C.1. Proof of Lemma 1

Firms choose S instead of R if and only if $V^S > V_B^R(q)$ and (IC_B) is satisfied. After some computations, we obtain that (IC_B) is satisfied if and only if $q \leq \hat{q}$. As $V_B^R(q)$ is increasing in q, it suffices to show that $V^S > V_B^R(\hat{q})$ to prove that $V^S > V_B^R(q)$ for $q \leq \hat{q}$.

$$V^S > V_B^R(\hat{q})$$

$$\Leftrightarrow (1-\delta+\delta\psi)(\Pi^C - \psi\mu F) > (1-\delta+\delta\psi\mu)(\Pi^C - \psi(1-\frac{\hat{q}}{N})F)$$

Replacing $\hat{q}$ by its value, we obtain that:

$$V^S > V_B^R(\hat{q}) \Leftrightarrow N > 1$$

C.2. Proof of Lemma 2

Firms choose S instead of R if and only if $V^S > V^R(\sigma, q)$ and (IC) is satisfied. To ease the presentation, define $\tilde{\sigma}^*(q) = \psi + (1-\psi)\sigma^*(q)$; (IC) rewrites:

$$(\tilde{\sigma}^*(q) - \psi\mu)(\delta V^S + F) = \tilde{\sigma}^*(q)qF$$

Replacing V^S by its value, we obtain after some computations:

$$\tilde{\sigma}^*(q) = \frac{\psi\mu(\delta\Pi^C + (1-\delta)F)}{\delta\Pi^C + (1-\delta)F - (1-\delta+\delta\psi\mu)qF}, \quad \text{and thus:}$$

$$\sigma^*(q) = \frac{\psi}{1-\psi}\left(\frac{\mu(\delta\Pi^C + (1-\delta)F)}{\delta\Pi^C + (1-\delta)F - (1-\delta+\delta\psi\mu)qF} - 1\right)$$

Observe that $\sigma^*(q)$ is positive if and only if $q > \hat{q}$. It follows that for $q \leq \hat{q}$, (IC) is satisfied for all σ. Moreover, we showed in the proof of Lemma 1 that $V^S > V_B^R(q)$ for $q \leq \hat{q}$. As $V^R(0,q) = V_B^R(q)$ and $V^R(\sigma, q)$ is decreasing in σ ($\frac{\partial V^R}{\partial \sigma} = \frac{(1-\psi)(-\delta\Pi^C - (1-\delta)(1-\frac{q}{N})F)}{(1-\delta+\delta\phi(\sigma,1))^2} < 0$), $V^S > V^R(\sigma, q)$ for all σ and therefore firms choose S instead of R when $q \leq \hat{q}$.

As $\sigma^*(q)$ is increasing in q, it suffices to show that $\sigma^*(1) < 1$ to prove that $\sigma^*(q) \in (0,1)$ for $q > \hat{q}$.

$$\sigma^*(1) < 1 \Leftrightarrow \mu \frac{\delta\Pi^C + (1-\delta)F}{\delta\Pi^C - \delta\psi\mu F} - 1 < \frac{1}{\psi} - 1 \Leftrightarrow \mu\psi F < \delta\Pi^C(1-\psi\mu)$$

The last inequality holds under (H1).

For $q > \hat{q}$, (IC) is not satisfied for $\sigma < \sigma^*(q)$ and therefore firms choose R instead of S. For $\sigma \geq \sigma^*(q)$, (IC) is satisfied. To complete the proof, let us show that in that case, S is more profitable than R. As $V^R(\sigma, q)$ is decreasing in σ, it suffices to show that $V^R(\sigma^*(q), q) < V^S$. (IC) rewrites:

$$(\tilde{\sigma}^*(q) - \psi\mu)\delta V^S - \psi\mu F = \tilde{\sigma}^*(q)(-(1-\frac{q}{N})F + \frac{N-1}{N}qF)$$

Adding Π^C on both sides, we obtain:

$$(\tilde{\sigma}^*(q) - 1)\delta V^S + \underbrace{\Pi^C + (1-\psi\mu)\delta V^S - \psi\mu F}_{=V^S} = \Pi^C + \tilde{\sigma}^*(q)(-(1-\frac{q}{N})F + \frac{N-1}{N}qF)$$

$$\Leftrightarrow V^S = \underbrace{\frac{\Pi^C - \tilde{\sigma}^*(q)(1-\frac{q}{N})F}{1-\delta+\delta\tilde{\sigma}^*(q)}}_{V^R(\sigma^*(q),q)} + \frac{\tilde{\sigma}^*(q)\frac{N-1}{N}qF}{1-\delta+\delta\tilde{\sigma}^*(q)}$$

$$\Leftrightarrow V^R(\sigma^*(q), q) = V^S - \frac{\tilde{\sigma}^*(q)\frac{N-1}{N}qF}{1-\delta+\delta\tilde{\sigma}^*(q)} < V^S$$

C.3. Proof of Proposition 2

We showed that σ just below $\sigma^*(q)$ is optimal. As $\sigma^*(q)$ is increasing in q, desistance is optimized for $q = 1$. Let us show that $V^R(\sigma^*(q), q)$ is decreasing in q in order to prove that $q = 1$ is also optimal from a deterrence perspective. We showed in the proof of Lemma 2 that $V^R(\sigma^*(q), q) = V^S - \frac{\tilde{\sigma}^*(q)\frac{N-1}{N}qF}{1-\delta+\delta\tilde{\sigma}^*(q)}$. The first derivative of $\frac{\tilde{\sigma}^*(q)q}{1-\delta+\delta\tilde{\sigma}^*(q)}$ is $\frac{(1-\delta)\tilde{\sigma}\prime^*(q)q + \tilde{\sigma}^*(q)(1-\delta+\delta\tilde{\sigma}^*(q))}{(1-\delta+\delta\tilde{\sigma}^*(q))^2}$ which is positive as $\tilde{\sigma}^*(q)$ is increasing in q. Hence, $V^R(\sigma^*(q), q)$ is decreasing in q.

C.4. Proof of Proposition 4

Firms choose R instead of S if either $V^R(\sigma, Nq_N) > V^S$ or (ii) $(1 - \frac{\psi\mu}{\psi+(1-\psi)\sigma})\delta V^S - \frac{\psi\mu}{\psi+(1-\psi)\sigma}F < -(1-q_1)F$ ((IC) not satisfied).

After some computations, we find that $V^R(\sigma, Nq_N) > V^S$ if and only if $\sigma < \sigma^*(q_N)$. Moreover, we have from the proof of lemma 2 that (IC) is not satisfied if and only if $\sigma < \sigma^*(q_1)$, and that $\sigma^*(q)$ is positive if and only if $q > \hat{q}$. It follows that firms choose R instead of S for any (σ, q_1, q_N) such that:

(i) $q_N > \hat{q}$, $\sigma < \sigma^*(q_N)$ and $q_1 \geq 0$

or (ii) $q_1 > \hat{q}$, $\sigma < \sigma^*(q_1)$ and $q_N > 0$.

The optimal policy minimizes the social cost of collusion, C.

When firms choose R, C equals $G(V^R(\sigma, Nq_N))\frac{L}{1-\delta(1-\phi(\sigma,1))}$, which are increasing in q_N and decreasing in σ. Thus, C is minimized in that case for $q_1^* = 1$, σ just below $\sigma^*(1)$ and q_N^* arbitrarily close to 0. To complete the proof, let us check that $G(V^R(\sigma^*(1), 0))\frac{L}{1-\delta(1-\phi(\sigma^*(1),1))}$ is lower that $G(V^S)\frac{L}{1-\delta(1-\psi\mu)}$, the social cost of collusion when firms choose S. This is the case as $V^R(\sigma^*(1), 0) < V^S$ and $\phi(\sigma^*(1), 1) > \psi\mu$.