

Godechot, Olivier; Horton, Joanne; Millo, Yuval

**Working Paper**

## Structural exchange pays off: Reciprocity in boards and executive compensations in US firms (1990-2015)

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Max Planck Sciences Po Center  
on Coping with Instability in Market Societies

**No. 19/1**

maxpo discussion paper

# Structural Exchange Pays Off

Reciprocity in Boards and Executive Compensations in US Firms  
(1990–2015)

**Olivier Godechot, Joanne Horton, and Yuval Millo**



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#### **About the authors**

**Olivier Godechot** is Co-director at the Max Planck Sciences Po Center on Coping with Instability in Market Societies, Paris. He is CNRS research fellow, affiliated with the Observatoire sociologique du changement, and holder of the AXA-Sciences Po Chair of Economic Sociology.  
Email: [olivier.godechot@sciencespo.fr](mailto:olivier.godechot@sciencespo.fr)

**Joanne Horton** is Professor of Accounting at Warwick Business School.  
Email: [joanne.horton@wbs.ac.uk](mailto:joanne.horton@wbs.ac.uk)

**Yuval Millo** is Professor at Warwick Business School.  
Email: [yuval.millo@wbs.ac.uk](mailto:yuval.millo@wbs.ac.uk)

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Max Planck Sciences Po Center on Coping with Instability in Market Societies  
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[www.maxpo.eu](http://www.maxpo.eu)  
[info@maxpo.eu](mailto:info@maxpo.eu)

## Abstract

We study the influence of the corporate board network on executive pay for 3,395 US firms over the period from 1990 to 2015. Drawing on structural anthropology and social exchange theory, we identify three elementary structures through which the interlocking network captures an obvious form of objective reciprocity between executives from different firms: *restricted exchange*, when two executives sit on each other's respective boards; *delayed exchange*, when  $y$  sits on the board of  $x$  after the end of  $x$ 's mandate on the board of  $y$ ; and *generalized exchange*, when  $x$  sits on the board of  $y$ , who sits on the board of  $z$ , who sits on the board of  $x$ . Our results suggest that these ties, although not very common, are more frequent than those calculated by chance. We also find that the three structures of reciprocity have a positive impact on executive pay, especially on bonuses and total cash. We use the Sarbanes-Oxley Act (2002) as a natural experiment to confirm our first findings. The impact on pay disappears after 2004, once these types of exchanges are constrained. Although linked to executive pay, these structures are not tied to any indicator of firm performance. This leads us to interpret them as a rent extraction phenomenon.

**Keywords:** executive pay, interlocks, social exchange, reciprocity, generalized exchange

## Résumé

Nous étudions l'influence du réseau des conseils d'administration sur la rémunération des dirigeants de 3 395 entreprises américaines entre 1990 et 2015. En nous appuyant sur l'anthropologie structurelle et la théorie de l'échange social, nous identifions trois structures élémentaires au sein du réseau interlock qui signent une forme évidente de réciprocité objective entre dirigeants d'entreprises différentes : *l'échange restreint*, lorsque deux dirigeants siègent aux conseils d'administration respectifs de l'autre ; *l'échange différé*, lorsque  $y$  siège au conseil d'administration de  $x$  à la fin du mandat de  $x$  au conseil d'administration de  $y$  ; *l'échange généralisé*, lorsque  $x$  siège au conseil d'administration de  $y$  qui siège au conseil d'administration de  $z$  qui siège d'administration au conseil de  $x$ . Nos résultats indiquent que ces liens, bien que peu communs, sont plus fréquents que ceux calculés par hasard. Nous constatons également que les trois structures de réciprocité ont un impact positif sur la rémunération des dirigeants, en particulier sur les primes et le total cash. Nous utilisons la loi Sarbanes-Oxley (2002) comme une expérience naturelle pour confirmer nos premiers résultats. L'impact sur les rémunérations disparaît après 2004, une fois ces types d'échange bridés. Bien qu'elles soient liées à la rémunération des dirigeants, ces structures ne sont liées à aucun indicateur de rendement de l'entreprise. Cela nous amène à les interpréter comme un phénomène d'extraction de rente.

**Mots-clés:** salaire des dirigeants, interlocks, échange social, réciprocité, échange généralisé

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# Structural Exchange Pays Off: Reciprocity in Boards and Executive Compensations in US Firms (1990–2015)

## 1 Introduction

Executive pay has been and continues to be a contentious topic in the corporate world and in the public sphere. Due to its high visibility, pay to executives is regarded by many as the symbol of rising inequalities at the top of the income distribution. This perception has been fueled by the dramatic increase in executive pay during the 1990s (Piketty and Saez 2003; Frydman and Saks 2010), peaking during the 2002 and 2008 economic downturns, when pay remained high despite poor corporate results.

This continuing controversy regarding the justification of executive compensation is also accompanied by debates surrounding the possible determinants of executive pay and the seemingly tenuous association between remuneration and firm performance. On the one hand, numerous scholars argue that levels of executive pay simply reflect the operation of an efficient market where executive talent and effort is duly compensated. This view is based on the underpinning assumption that the level of compensation provides a way of aligning the manager's incentives with the interests of the principal – i.e., the shareholders (Jensen and Meckling 1979). In turn, firms need to compensate outstanding human capital, which is now more transposable (Murphy and Zábojník 2004). Moreover, the small differences in marginal productivity and the skewed distribution of firms' size amplify the pay dispersion even further (Gabaix and Landier 2008). Conversely, a competing body of research argues that executive pay does not follow a pure market mechanism, but instead reflects directors' successful attempts to extract unjustified compensation. For instance, research finds that pay packages are often tied to factors beyond CEOs' influence (such as oil prices). CEOs are thus paid simply for good luck (Bertrand and Mullainathan 2001). Additionally, in order to increase their own pay, executives compare pay levels to those of their peers, producing a leapfrogging phenomenon (DiPrete, Eirich, and Pittinsky 2010; De Vaan, Elbers, and DiPrete 2018).

Detailed examination indicates that the interests of shareholders, directors, and executives are imperfectly aligned. In particular, it is argued that “independent” directors poorly represent shareholder interests because their appointment, renewal etc. depends in part on the CEOs whom they are supposed to control (Bebchuk and Fried 2004).

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We wish to thank Richard Benton, Ken-Hou Lin, Shi-Rong Lee, and Matthew Soener for their helpful comments on an earlier draft of this article.

For example, when faced with homophilic boards due to independent directors and executives being alumni of the same university, CEOs receive higher pay (Kramarz and Thesmar 2013).

An independent director's role, as noted in the corporate governance literature and described in the regulatory definitions, is purely one of monitoring and controlling the CEO. Therefore, the tie between the independent director and the CEO should be totally unidirectional. However, this type of tie is difficult to enforce in real life, as it is at odds with ordinary social exchange. Indeed, one of the most constant phenomena produced by social exchange is reciprocity (Mauss 2000; Lévi-Strauss 1969; Cropanzano and Mitchell 2005; Molm 2010). Lévi-Strauss's (1969) structural theory of kinship shows that the elementary rules organizing the exchange of women between masculine lineages along principles of reciprocity are of critical importance to communities both in helping them achieve a ban on incest and strengthening group solidarity. This reciprocity is also at the heart of social embeddedness in economic life (Granovetter 1985; Uzzi 1996; 1997). Enabling, even only ostensibly, some reciprocity in a tie fosters trust (Molm 2010) and increases its stability and resilience (Burt 2005). As with any social ties, those between independent directors and executives are also likely to produce various forms of reciprocity. And this reciprocity is likely to produce some social outcomes, such as a lack of appropriate monitoring and higher CEO pay.

Analyzing CEO pay as an outcome of board reciprocity builds a bridge with the classical literature on board interlocks. Indeed, interlocks can be one way of bypassing the demand for asymmetric independent-dependent board ties. However, despite forty years of research, we still do not completely understand the implications and impacts of these interlocks. For example, assessing the two first decades of research in this area, Mizruchi (1996) confesses that if interlocks matter, it might be more through their impact on the diffusion of management style – as shown by the diffusion of the poison pill (Davis 1991) – than through their impact on performance. One reason why interlocks, with network-wide measures such as density or centrality, are not the best tools for studying businesses' class power and cohesion (Mizruchi 2013) or firms' power within the economic field (Chu and Davis 2016), may be the fact that the social logic of underlying board appointments obeys neither class nor firms' long-term interests.

Recent research has been more successful in highlighting the impact of interlocks by paying greater attention to the micro and local mechanisms of board composition. These structures reflect local solidarity between directors rather than firms' global strategies, thus enabling managerial entrenchment and a reduction in shareholder pressure (Benton 2016). This is achieved through a board composition where executive directors align themselves with their directors' practices. For example, they converge in their degree or rejection of shareholders' proposals (Benton 2017); they use provisions against shareholders' interests (Benton 2016); they match their compensation packages upwards (Kim, Kogut, and Yang 2015); they conform in funding the same political party (Burriss 2005); and they engage in opportunity hoarding (Tilly 1998) in favor

of executives with similar educational backgrounds (Kramarz and Thesmar 2013). Benton (2016) also further shows that the cohesion of the local interlock network fuels managerial entrenchment and suggests that the “norms of reciprocity” in cohesive settings are at the heart of this process.

However, these studies do not specifically identify potential instances of reciprocity, as it is not easy to distinguish this from other network-expressed phenomena, including influence, imitation, conformity, and conflict avoidance. The classical design of most research in this area limits our understanding, as it generally uses board co-membership as the core tie for the network of directors. This design assigns the same importance to two different types of ties within boards: ties between non-executive directors on the one hand and ties between non-executive and executive directors on the other hand. Beyond the information shared through the tie, two non-executive directors do not typically depend on one another and tend not to engage in complex exchanges. On the contrary, ties between non-executive directors and executive directors are stronger and prove to be a richer set of social exchange, as they reflect appointment, control, payment, mutual respect, honor and favors (Bebchuk and Fried 2004). Consequently, such ties may go beyond the principal-agent relationship stated by corporate governance recommendations. Far from remaining only an asymmetric tie of control of the executive director by the independent director, this link is likely to produce some form of reciprocity which translates into increased executive pay.

Therefore, by using the control tie of executive director by non-executive directors (or reciprocally, the appointment tie of non-executive directors by executive directors) as the core tie of our network, we gain two significant advantages. Firstly, it enables us to reconcile the corporate governance view, which focuses on control, with the interlocking view, which focuses on network structure. Secondly, it permits us to identify much more precisely the reciprocity mechanisms – where reciprocity can be measured both in the selection of partners (I select you, you select me) and in the outcome of the exchange (I favor you, you favor me).

In this paper, we study the impact of board reciprocity on executive pay among 3,995 US firms between 1990 and 2015. We follow structural anthropology and social exchange theory and focus on three basic structural representations of reciprocal ties: *restricted exchange*, when two executives sit on each other’s respective boards; *delayed exchange*, when  $y$  sits on the board of  $x$  after the end of  $x$ ’s mandate on the board of  $y$ ; and *generalized exchange*, when  $x$  sits on the board of  $y$ , who sits on the board of  $z$ , who sits on the board of  $x$ . These three types of ties, although not very common, are more frequent than those calculated by chance. Our findings indicate that these three structural forms have a positive impact on board members’ and executives’ pay, especially on cash bonuses. Moreover, in order to corroborate our findings, we use the Sarbanes-Oxley Act (2002) as an exogenous shock (Chhaochharia and Grinstein 2009; Withers, Kim, and Howard 2018) on corporate regulation and show that the possibility to use *restricted* and *delayed exchange*, and the subsequent influence on pay, was reduced following the Act.



The paper is organized as follows: In the second section, we detail our theoretical approach in relation to the previous literature. In the third section, we describe the data and the modeling equations used. In the fourth section, we present our main results and in the last section, we provide a general discussion of our findings.

## 2 Theory: From elementary social exchange to executive solidarity

### Corporate remuneration: Research state of the art

Corporate governance rules state that the main duties of the board of directors are to monitor and govern the firm, to set optimal compensation contracts, and to protect the interests of the shareholders (Devers et al. 2008). Given this, academic research on corporate governance aiming to explain executive pay provides two main viewpoints. First, the *market view* (efficient contracting) argues that executives are paid for the services they provide to the firm (Murphy and Zábojník 2004; Gabaix and Landier 2008), while the *skimming view* (rent extraction) contends that executives transfer wealth from the shareholders by exploiting the managerial power that their corporate and inter-board positions provide (Bebchuk and Fried 2003; Bertrand and Mullainathan 2001).

Both views regard board independence as central to assessing and determining the efficacy of boards and the level of pay CEOs deserve. The fundamental assumption is that the more independent the boards are, the more likely they are to be effective monitors and thus set optimal compensation contracts. Conversely, non-independent boards might behave out of deference to the executives they are supposed to monitor, and therefore provide them with greater opportunities to rent extract. Empirical evidence supports this latter view. For example, Core et al. (1999) find that when the board of directors is less independent (i.e., when there is a larger board with a lower percentage of outside directors, the CEO is also the chairman, and the outside directors were appointed by the CEO), CEOs are paid significantly more. Similarly, recent regulation in 2002–2003 requiring, *inter alia*, that the compensation committee consist of only independent directors, has been found to reduce CEO pay (Chhaochharia and Grinstein 2009).

One stream of research investigates the implications of a director's social network on their ability to monitor and govern effectively. To date, this research has provided inconclusive evidence as to whether the association between network structure and compensation benefits shareholders. Several papers provide evidence to suggest that director networks enable the executives to rent extract. As Bebchuk and Fried (2003) and Benton (2016) argue, managers use their connections to increase CEO entrenchment and board dependence, which allows them to extract economic rents. Under these conditions, CEO compensation packages do not have the effect of serving the

strategic goals of the firm nor of enhancing shareholder value (Barnea and Guedj 2006; Kirchmaier and Stathopoulos 2008; Brown et al. 2012; Fich and White 2005). For instance, Hallock (1997; 1999) finds that reciprocal interlocks are associated with higher CEO cash compensation (although not total compensation) and with worse firm performance. Similarly, Fich and White (2003) find that the number of reciprocal interlocks is positively associated with CEO compensation but find no association between these interlocks and various measures of firm performance (see also Fich 2000; Fich and White 2005). However, Devos, Prevost, and Puthenpurackal (2009) find that the presence of interlocked directors is associated with lower firm performance and lower pay-for-performance sensitivity. Moreover, several papers find evidence supporting efficient contracting as well as finding that CEOs are paid for the valuable information and resources their network connections provide (Horton, Millo, and Serafeim 2012; Engelberg, Gao, and Parsons 2013; Larcker, So, and Wang 2013). Finally, Renneboog and Zhao (2011) find mixed results providing support for both views.

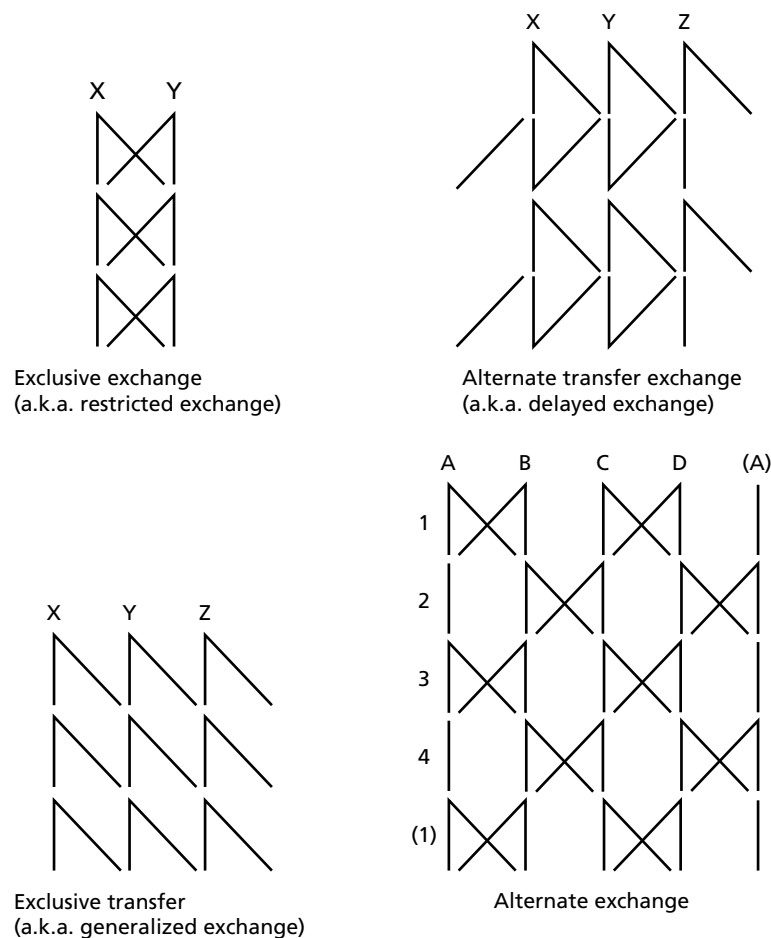
Similarly, research focusing on the CEOs' connections indicates that these ties can either provide the CEO with significant managerial influence and power (Bebchuk, Fried, and Walker 2002) or alternatively, provide informational and resource benefits to the firms for which the CEO is rewarded. A number of papers find evidence consistent with the former. Hwang and Kim (2009) find that socially dependent boards – i.e., boards where the directors have social ties to the CEO – offer higher pay levels to their CEOs. Brown et al. (2012) examine all CEO ties, social and professional, created by CEOs during their life and find similar results to Hwang and Kim (2009). Conversely, prior research also finds evidence of CEO networks providing valuable resources to the firm. Engelberg, Gao, and Parsons (2013) find that a CEO's connections outside of the firm – e.g., past professional, alumni, and social ties – are valuable to the firm in terms of the information they bring and hence, CEOs are paid for such valuable and portable ties. Horton, Millo, and Serafeim (2012) find that the centrality of the CEO and other directors is positively associated with their compensation and future firm performance.

We believe that this inconclusive and at times contradictory evidence regarding the forces that drive corporate remuneration is due to the fact that the research examines observations which cannot explain the root causes of the phenomenon. In essence, the current literature finds that higher centrality in the interlocking network is associated with higher pay and that homogeneous boards pay more. While these observations are correct, we suggest that they are indicative of deeper social processes that motivate executive remuneration. We suggest that remuneration levels should be understood not merely as reflections of pay for performance or rent extraction, but more as continuous attempts to establish and maintain solidarity – the creation and reinforcement of binding social ties. To develop this argument, below we will review social anthropology and social exchange theories which examine the dynamics of social exchange. We utilize insights from these theories to uncover a form of reciprocity that may be at work in corporate interlocks.

## From to kinship to inter-board solidarity

In *The Gift*, Mauss (2000) highlights that in numerous traditional societies, inter-group social exchanges are governed by three rules: giving, receiving, and reciprocating. Drawing on Mauss's gift-giving approach, Lévi-Strauss (1969) developed a theory of elementary rules of kinship – the positive rules governing the exchange of women between the masculine lineages of a tribe – as a way of both banning incest and organizing solidarity through exchange between different lineages. Lévi-Strauss identifies two main forms of exchange: restricted exchange, which derives from the preferential union with a bilateral cross-cousin and corresponds to a situation where two masculine lineages exchange women at each generation; and generalized exchange, which derives from the preferential marriage with a matrilateral cross-cousin, where women are exchanged indirectly. In such cases, the lineage from which one receives a woman is not the same as the one to which one gives a woman. Although not discussed extensively, the union

Figure 1 Four elementary forms of kinship according to Héran (2009)



Note: Héran represents males with a vertical bar |, females with an oblique bar \, marriage with the lower junction  $\searrow$ , and a brother and a sister with the upper junction  $\swarrow$ . He also uses a single bar for representing same-sex siblings and same-sex parallel cousins.

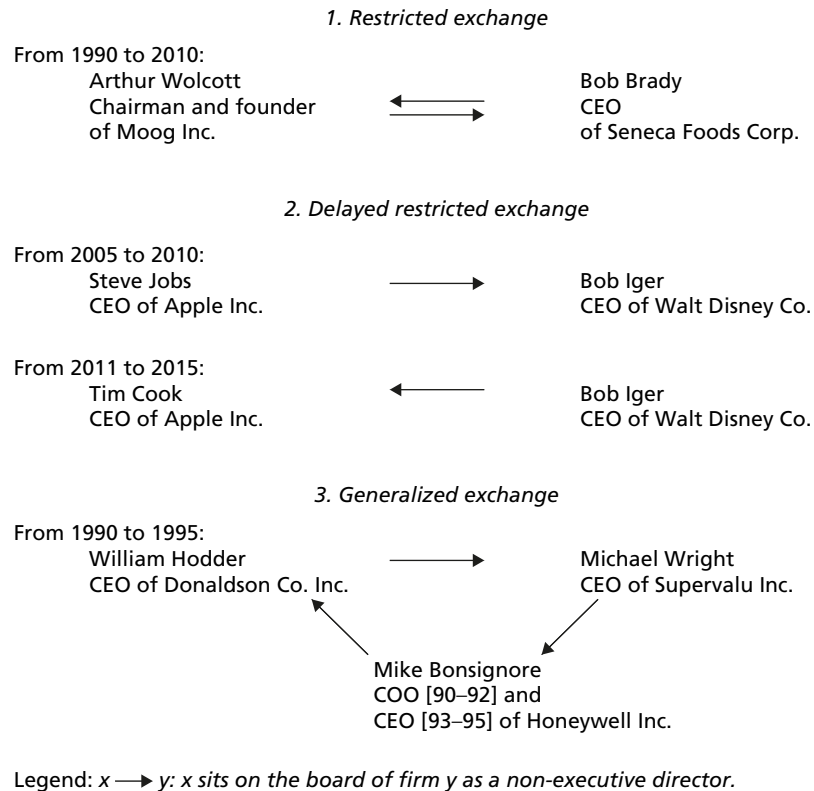
with a patrilineal cross-cousin also exists (Lane 1962) and corresponds to a delayed exchange. A lineage reciprocates for the woman received by giving a woman at the following generation. Summing up 50 years of anthropological literature on kinship, Héran (2009) characterizes four main types of marriage, for which he provides illuminating graphs (Figure 1). He puts forward four types of unions: exclusive exchange (“restricted exchange” in Lévi-Strauss’s terminology), exclusive transfer (“generalized exchange”), alternate transfer (that is, a delayed “restricted exchange”), and alternate exchange (corresponding to the preferential marriage with a quadrilateral cross cousin, which can be viewed as another form of “restricted exchange”).

Recruiting directors of a firm to the board of another firm is different from forming kinship relations, but both activities are aiming at – or at least unintentionally contribute to – strengthened affinities between the two groups. In the case of interlocking directors, expertise, information, and social capital are frequently shared or exchanged through the interlock. Indeed, executives and firms do foster social exchanges through board membership, and CEOs hold most of the power in appointing outside directors (Bebchuk and Fried 2004). It should be noted that this exchange is not simply one of control, but also involves attendance fees and reputation. Moreover, when a CEO invites another CEO to join their board, this invitation might sometimes come as a result of reciprocal exchange.

We define *restricted exchange* (Figure 2) as a situation in which two executive board members from two firms simultaneously sit on each other’s boards as non-executive directors. It is probably the most obvious form of reciprocity among executives (Hallock 1997). However, this type of interlock has garnered academic attention and regulatory criticism, as it raises significant concerns as to whether a director charged with overseeing an executive can be truly independent. Certainly, this type of pattern provides an opportunity for a tit-for-tat exchange. Specialists in exchange theory distinguish between two forms of restricted exchange: *direct negotiated exchange*, where actors negotiate on the terms of an agreement, and *direct reciprocal exchange*, where actors perform successive acts in favor of one another without agreeing on those acts, and with no insurance of reciprocity (Molm, Collet, and Schaefer 2007). It is not possible to argue that all such restricted exchange structures systematically correspond to *direct negotiated exchange*. In some cases, CEOs may deliberately agree to push each others pay up in an “I raise your pay, you raise my pay” bargain. Many of those exchanges, however, may be more subtle than simple tit-for-tat bargaining. Without any explicit agreement, executives involved in restricted exchange may be subconsciously more generous when it comes to determining the pay of the executives they monitor. This is consistent with the findings from natural experiments which indicate the role of strong ties between members of the committee and applicants in academic recruitment (Godechot 2016).

*Delayed restricted exchange* (Figure 2) is a situation where an executive director of firm  $x$  sits on the board of firm  $y$  and invites an executive of firm  $y$  to join the board of a firm  $x$  after the executive’s own board membership in firm  $y$  has ended. *Delayed*

Figure 2 Three examples of reciprocal ties among US CEOs



*exchange* is a less visible way for CEOs to reciprocate and therefore receives less attention than the more obvious *restricted exchange* discussed above. Delayed restricted exchange corresponds more clearly to *direct reciprocal exchange* (Molm, Takahashi, and Peterson 2000; Molm, Collet, and Schaefer 2007). Relative to simultaneous restricted exchange, delayed restricted exchange may seem more insecure, precisely because of this delay. However, in his account of Mauss's gift-giving theory, Pierre Bourdieu underlines precisely the importance of the delay (Bourdieu 1990). Without delay, gifts and counter-gifts are like barter or commercial exchange. Even worse, a simultaneous counter-gift equivalent in kind to the initial gift could be considered an offense (i.e., a non-acceptance of the gift). Finally, compared to *direct negotiated exchange*, *direct reciprocal exchange* gives less salience to conflict (Molm, Collet, and Schaefer 2007). Therefore, the delay grants some symbolic meaning and some solemnity to the social exchange. It probably operates through a mechanism of mutual indulgence rather than tit-for-tat agreement.

Finally *generalized exchange* is a situation where an executive director of firm  $x$  sits as a non-executive board member of firm  $y$ , which has one executive board member sitting on the board of firm  $z$ , which has one executive board member sitting on the board of firm  $x$ . This tie ("three or more cycle" in graph theory) is seldom recognized by regulators or academics and indeed is never discussed in relation to CEOs. However,

Table 1 Description of the boards

Years	No. of firms	No. of board members	No. of executive board members	No. of executives (Exucomp)	No. of firms whose NED are ED elsewhere	No. of firms whose ED are NED elsewhere	2-cycles	3-cycles	4-cycles	No of firms in: >4-cycles	Delayed 2-cycles	Strictly delayed 2-cycles
1990	2,167	6,051	2,450	.	432	375	40	3	3	0	0	0
1991	2,253	6,617	2,603	.	478	413	35	5	0	4	3	0
1992	2,329	7,279	2,779	8,045	555	466	47	5	3	4	5	1
1993	2,468	8,191	3,023	9,821	637	524	42	5	4	11	7	1
1994	2,566	9,070	3,216	10,689	688	579	49	5	2	2	11	3
1995	2,632	9,959	3,392	11,142	704	605	59	9	0	10	15	3
1996	2,714	10,902	3,547	11,686	769	640	68	8	0	0	20	6
1997	2,744	11,915	3,698	12,056	812	688	69	12	0	0	26	9
1998	2,769	12,871	3,831	12,649	821	711	76	8	0	0	34	17
1999	2,787	13,733	3,903	12,204	816	707	75	4	0	1	30	15
2000	2,769	14,132	3,799	11,540	792	701	64	11	3	7	31	14
2001	2,751	14,552	3,782	11,384	789	692	57	6	0	12	41	21
2002	2,747	14,845	3,726	11,559	773	685	42	3	0	15	45	18
2003	2,727	15,123	3,530	11,816	720	680	33	8	0	2	49	21
2004	2,701	15,292	3,408	10,903	708	685	38	8	0	4	47	19
2005	2,662	15,274	3,262	9,388	664	672	22	8	0	5	39	12
2006	2,623	15,216	3,130	10,965	613	647	18	10	0	0	35	12
2007	2,571	14,919	2,977	12,561	592	618	12	12	1	0	31	10
2008	2,548	14,784	2,859	12,023	589	599	10	6	0	0	26	10
2009	2,540	14,709	2,779	11,460	546	571	10	6	0	0	22	8
2010	2,524	14,654	2,728	11,088	543	582	12	6	0	0	20	6
2011	2,504	14,508	2,668	10,834	547	580	12	3	0	0	22	8
2012	2,479	14,420	2,585	10,602	532	578	12	3	0	0	20	8
2013	2,470	14,385	2,544	10,369	517	556	6	0	0	0	21	9
2014	2,464	14,397	2,513	9,977	515	557	4	0	0	0	17	6
2015	2,455	14,378	2,470	8,872	505	539	2	0	0	0	15	4
All	66,964	332,176	81,202	263,633	16,657	15,650	914	154	16	77	632	241
Distinct indiv. or firms	3,395	31,852	10,087	45,288	1,993	1,828	198	46	13	54	125	45

Note: Strictly delayed 2-cycles exclude delayed 2-cycles which were former 2-cycles. We will use this definition going forward.

because of its importance in kinship theory, generalized exchange has generated debate as to its likelihood and its efficacy (Lévi-Strauss 1969; Homans and Schneider 1955; Bearman 1997; Takahashi 2000; Molm, Collet, and Schaefer 2007). Lévi-Strauss (1969) considers generalized exchange to be a way of creating solidarity and as a device for building a society. On the contrary, Homans and Schneider (1955) doubt that generalized exchange could exist without meeting the direct interest of each actor involved in the exchange. Controlled experiments have shown that generalized exchange actually produces more feelings of solidarity than restricted exchange (Molm, Collet, and Schaefer 2007), although the emergence of generalized exchange remains puzzling (Takahashi 2000). Why set up a gift-giving chain when there is such a risk of free-riding, chain interruption, and the possibility of not receiving any gift in return? Most authors derive such structures from norms and from forms of altruism. Although Takahashi (2000) tries within multiple agent simulations to produce a rational emergence of generalized exchange, it relies in the end on the random appearance of a “giving gene” in a subpart of his population. Although, de facto, we find classical examples of generalized exchange for kinship (Lévi-Strauss 1969; Bearman 1997) or for Kula exchange (Malinowski 1922), most studies on the dynamics of networks in contemporary society do not find a tendency for 3-or-more-cycles (Lazega, Lemerrier, and Mounier 2006; Snijders, van de Bunt, and Steglich 2010). Therefore, we do not expect that CEOs will be very active in establishing 3- and 4-cycles. Nevertheless, if a 3-cycle randomly appears, it can still produce solidarity among the executives involved.

### A natural experiment in reciprocal exchange among boards

Following several corporate scandals in 2001 and 2002, US institutions favored a redefinition of director and board independence. The Sarbanes-Oxley Act (2002) places a stronger emphasis on board independence, especially within audit committees. Both the NYSE and the NASDAQ published new rules validated by the SEC in November 2003 and asked listed firms to apply them in 2004. These new rules added a supplementary recommendation to the Sarbanes-Oxley Act regarding board independence, especially within the compensation committees. Hence, in section 303A.02 of its *Listed Company Manual*, the NYSE requires that all members of the board’s compensation, audit, and nomination committees be fully independent. A board qualifies a director to be fully independent if the director “has no material relationship with the listed company.” This prevents the source of a director’s compensation from being dependent on the management of the listed firm. As a consequence, a director is not independent if “the director or an immediate family member is, or has been within the last three years, employed as an executive officer of another company where any of the listed company’s present executive officers at the same time serves or served on that company’s compensation committee.”<sup>1</sup> This rule does not ban all forms of restricted

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1 Cf. NYSE *Listed Company Manual*, Section 303A.02

Figure 3 1992 network between executive directors (control tie)

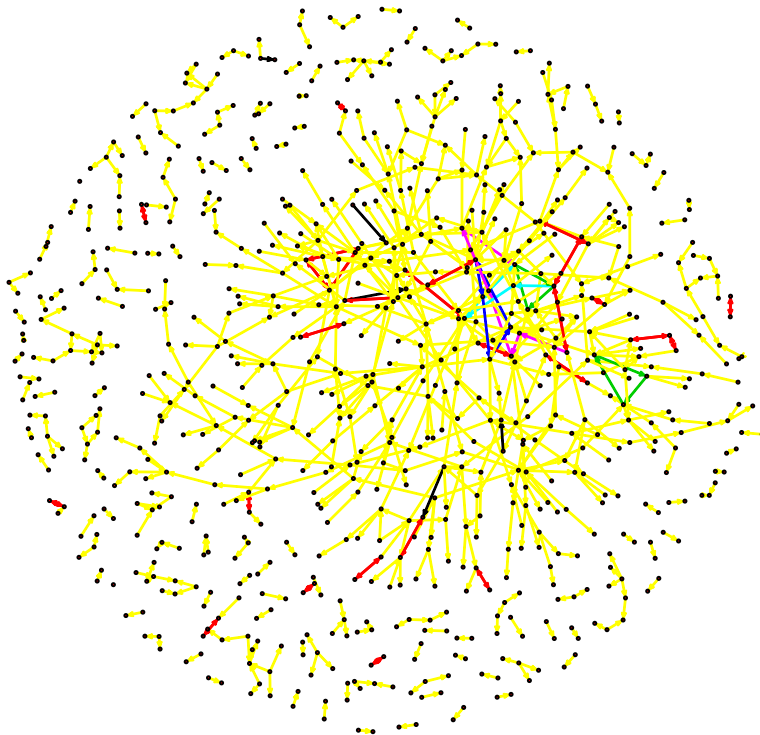
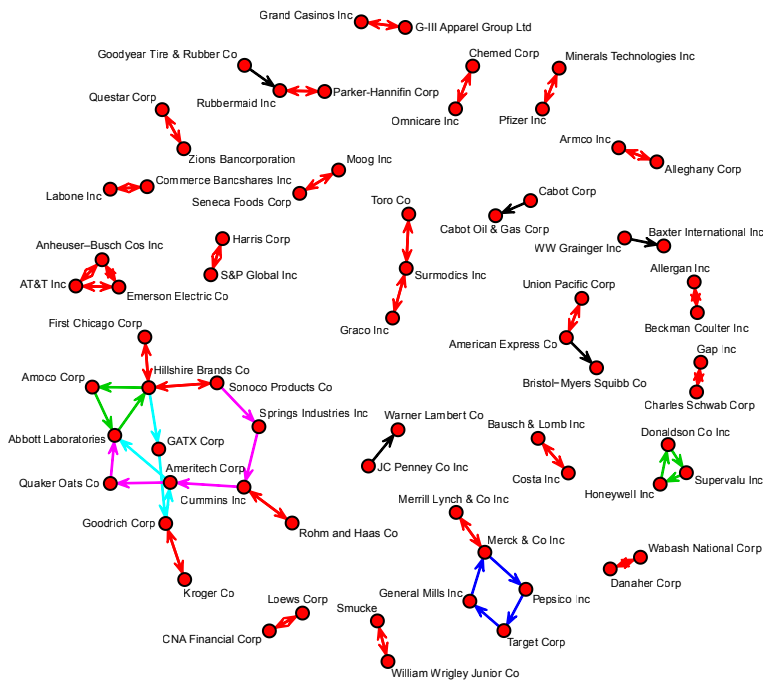


Figure 4 1992 cycles between executive directors (control tie)





exchange, but forbids two executive directors from two different firms being on each other's compensation committees. The NASDAQ set up similar rules but only requires a majority of compensation, audit, and nomination committee members to be fully independent.

These codes can therefore serve as a natural experiment for the social exchange mechanism. The codes target mainly restricted exchange – and to some extent delayed exchange (at least the short delays) – within compensation committees. However, longer delayed exchange and generalized exchange are not recognized and thus not covered.

Listed firms may still implement restricted and delayed exchange. However, since directors in such reciprocity cycles are excluded from compensation committees, they are less likely to directly influence the precise setting up of executive pay. This should therefore weaken their effect on executive pay. They could nevertheless still have an indirect influence through their informal advice to the compensation committee or when they vote at board level on the committee's proposals. This is the case especially if restricted exchange corresponds to a pay-increasing agreement. Or alternatively, if the reciprocity structure contributes to an unconscious bias, its official condemnation might lead boards to become conscious of the bias and to show even stronger restraint in pay while still maintaining this type of structure.

### 3 Data, modeling equations, and other variables

#### Data

Our sample is derived from multiple data sources. We obtained data from *Boardex* on US boards of directors for the period from 1990 to 2015 in order to analyze the structure of social exchange between boards. We selected quoted firms and private firms and dropped all other forms of organization (i.e., universities, charities, clubs, government, etc.). After this restriction, the initial sample contained 230,431 board members from 384,645 unique firms, resulting in 1,091,118 *board members*  $\times$  *firm* observations.

We obtained executive pay data from the *Exucomp* database. This database provides compensation data between 1992 and 2015 for 45,649 executives in 3,557 unique firms, resulting in 263,637 *executives*  $\times$  *firm*  $\times$  *year* observations. One fourth of this information (77,691) contains data on executive board members; the remaining data concerns top executives who do not sit on boards.

Figure 5 2000 network between executive directors (control tie)

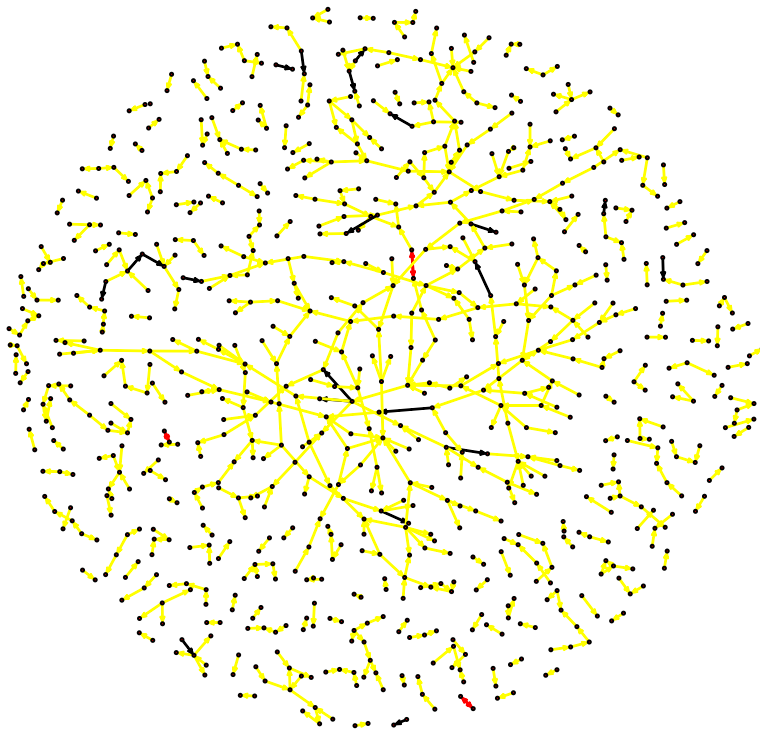
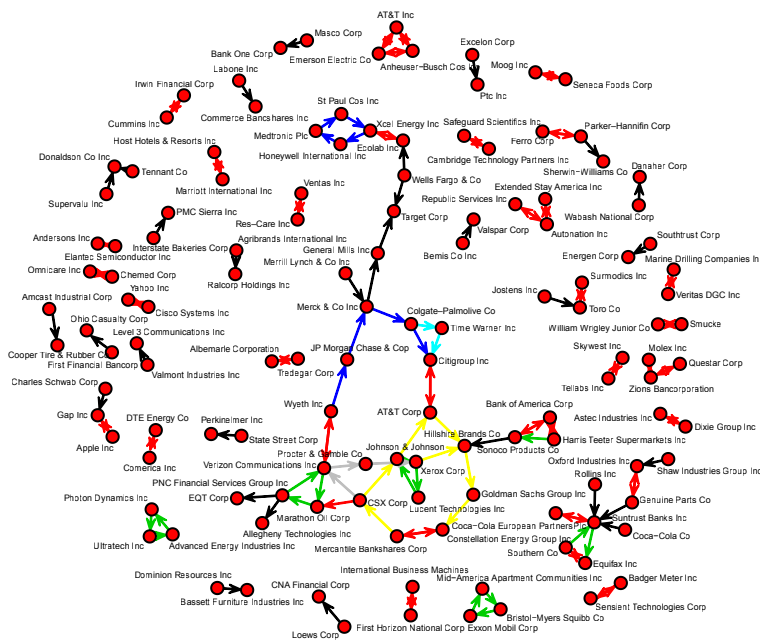


Figure 6 2000 cycles between executive directors (control tie)



We obtained firm-specific data from *Compustat* for the period from 1990 to 2016 to enable us to construct several control variables. For example, to control for a firm's revenue, we were able to obtain information for 30,413 firms, resulting in 329,789 *firm*  $\times$  *year* observations.

After merging these three datasets, our final sample contained 3,395 unique firms, with 31,852 individual board members and pay for 45,288 executives. Between 1990 and 2015, each year in our final database contained between 2,000 and 2,700 unique firms, 6,000 to 14,000 board members, and 8,000 to 12,000 executives (Table 1).

### From board composition to executive cycles

Our network approach differs from prior interlock studies, which generally approximate the link between the numbers of contemporaneously interlocking CEOs. We concentrate on the precise intertwining of social exchange and corporate control. Therefore we do not consider, for example, that two executives sitting together as non-executive board members constitute a significant link of control, so these ties are ignored. Our network arc of executive control reflects the fact that an executive from one firm sits on the board of another firm as a non-executive board member and therefore controls the firm and its executive. To capture social exchange of control between executives, we employ the classical  $k$ -cycle measure from network literature.<sup>2</sup> Therefore, we use 2-cycles ( $x \rightarrow y \rightarrow x$ ) to measure restricted exchange, and 3-cycles ( $x \rightarrow y \rightarrow z \rightarrow x$ ) and 4-cycles ( $x \rightarrow y \rightarrow z \rightarrow w \rightarrow x$ ) are used to measure generalized exchange. We ignore any  $k$ -cycle above 4, as these are both rare and unstable, and we suspect that these cycles are the random product of network connectivity and consequently do not produce any meaningful social effects. Finally, delayed exchange corresponds to firms which have among their non-executive board members an executive from a firm for which they had an executive on the board in the previous five years.

Figure 3 provides an example of this control network for the first year of our period: 1992. Most links are non-reciprocal and do not belong to any sort of cycle. Within this graph, we isolate, using different colors, the links that specifically belong to cycles or delayed 2-cycles. Approximately 15% of the control links between executives from different firms imply some form of cyclicity that could attenuate the control purpose. Figure 4 further isolates those cycles between firms. The majority are in a 2-cycle (47 firms), while five firms are in a 3-cycle, three firms in a 4-cycle, four firms in a 5-and-above-cycle, and five firms in delayed 2-cycles. Figures 5 to 8 illustrate the sense of the evolution in cycling in the control network. In 2000, for instance, cycling is intense, and 4% of all firms and 14% of firms involved in the control network belong to at least one cycle. By contrast, in 2013, as shown by Figures 7 and 8, cycling ties largely vanish, with the majority of firms engaging in delayed exchange.

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2 In network literature, a  $k$ -cycle is a directed path of  $k$  degrees returning to its starting point.

Figure 7 2013 control network between executive directors (control tie)

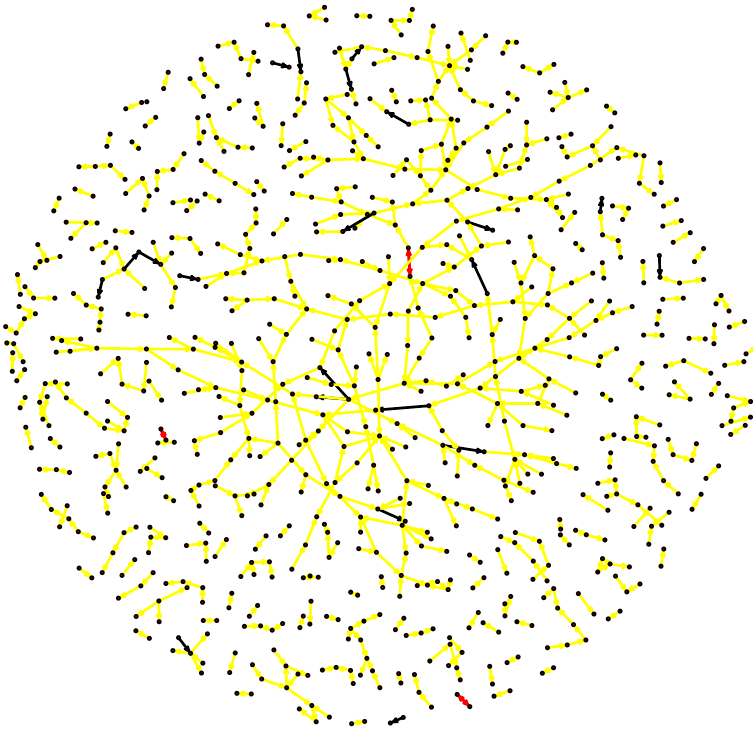


Figure 8 2013 cycles between executive directors (control tie)

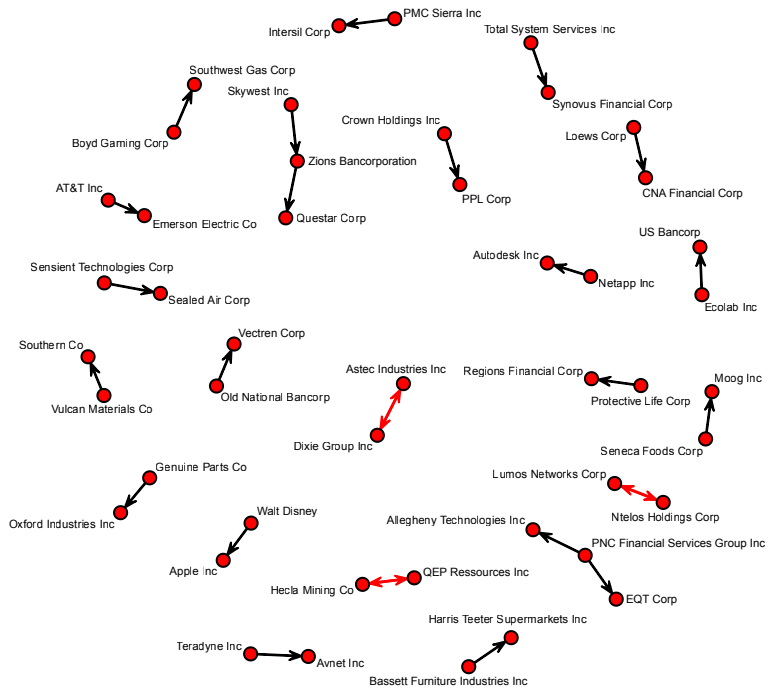
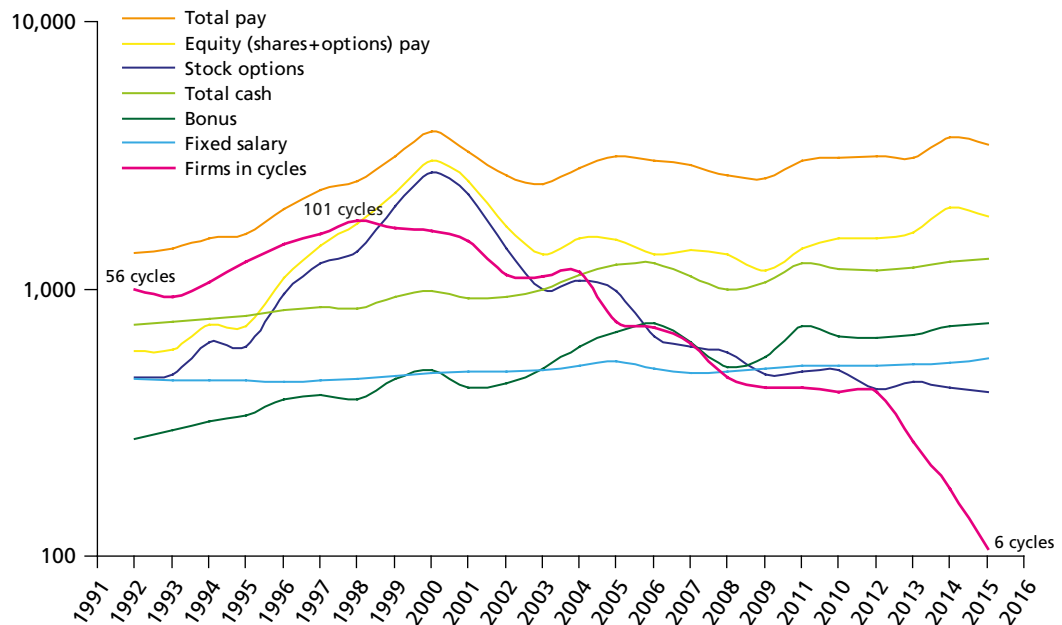


Figure 9 Executive pay and cycles



Note: Compensation variables are expressed in thousands of 2015 dollars (log-scale). We superimposed the number of firms engaged in at least one cycle (2-cycles, 3-cycles, 4-cycles and strictly delayed exchange cycles – we excluded  $k$ -cycles where  $k > 4$ ). For comparison purposes, we set the starting value (56 firms in cycles) of this series to 1,000 in 1992.

Figure 9 and the right-hand side of Table 1 support these initial observations. Cycling in the control network increases in the 1990s, reaching a peak at the end of that decade. In the 2000s it declines substantially, especially after the mid-2000s. There are several reasons for such a decline. First, the corporate governance codes adopted a stricter notion of director independence for corporate boards and discouraged *restricted exchange* and other related forms of dependence between executive and non-executive directors. Second, firms tended to appoint fewer of their own executives onto their boards and generally to have only one executive on the board, commonly the CEO. COO or CFOs are generally not appointed anymore, which decreases the probability of such cyclical ties. Finally, the decreasing density of interlocks and the fracturing of corporate America also contributed to a decline in the likelihood of cyclical ties (Mizruchi 2013; Chu and Davis 2016). We will check further whether this decline in cycling is due to a lower propensity to cycle or to a decline in cycling opportunities.

Finally, Figure 9 also highlights the fact that in the early 1990s, the increase in cycling was in line with increases in executive pay. However, after 2000, executive pay declined only moderately during the dot-com crisis, especially in relation to option-based compensation. It stabilized at higher levels after 2003 and then appears to follow the business cycle (Kaplan 2013), unlike cycling, which declines substantially after 2005.

## Modeling equations

### *Network dynamics*

In order to estimate the probability of cycling, we employ an elementary dyadic logistic regression. We model the probability that a firm controls another firm through the presence of at least one executive of the former firm on the board of the latter firm. The equation is as follows:

$$p(\text{firm } x \text{ control firm } y \text{ executives}) = \text{past\_controlling\_tie}_{t-1} + \text{cycling\_opportunities}_{a,t-1} + \text{activity}_{a,t-1} + \text{popularity}_{b,t-1} + \text{year}_t + \text{error}_{ijt} \quad (1)$$

The 26-year longitudinal dimension of our data enables us to introduce a lagged structure of the network as a predictor of link formation or maintenance at time  $t$ . We therefore avoid the traditional endogeneity problem of synchronously explaining the network structure by assuming the lagged network is exogenous. While this assumption could be questionable, the length of our period enables us to limit the bias by including lag-dependent variables. Logistic regressions, used similarly in previous studies (Rider 2012; Bous-sard, Godechot, and Woloszko 2017), offer a great deal of flexibility, unlike SAOM (a.k.a. SIENA) and TERGM models (Snijders, van de Bunt, and Steglich 2010; Cranmer and Desmarais 2011), while also providing the advantage of handling much larger datasets.

### *Impact of cycles on pay*

To determine the impact of control cycles on pay, we estimate executives' wage equations with first-difference panel regressions. First-difference models offer flexibility for estimating both short-term effects and longer-term effects of embeddedness in the reciprocity cycle. They also enable us to differentiate between entering and exiting a reciprocity cycle. *Firm*  $\times$  *executives* first-difference regressions control for time-invariant characteristics of either the firm, the executive, or their match. We therefore measure the impact of entering or exiting a reciprocity cycle on the evolution of executive wages. We also control for a set of firm and individual time-varying variables described in detail below. Lastly, we include yearly fixed effects to control for common shocks in the evolution of executive pay.

Our main equation is the following:

$$\Delta_{[t-k,t]} \ln(\text{wage}_{if} + 1) = \Delta_{[t-k,t]} \text{firm\_in\_a\_cycle}_f + \Delta_{[t-k,t]} \text{controls}_{if} + \text{year}_t + \text{error}_{ift} \quad (2)$$

Since the time period is substantial ( $T=24$ ), the models' residuals may be serially correlated. In such cases, first-difference models are generally viewed as more efficient than fixed effect models. However, if residual serial correlation does not follow a random

walk, first-difference regressions are still biased. In order to address the serial correlation issue, and in order to check whether our results are due to reverse causality, we also follow Anderson-Hsiao's instrumental variable technique (Anderson and Hsiao 1981). We introduce the lag of the first-difference of the dependent variable, instrumented with the past level of the lagged dependent variable.

$$\begin{aligned} \Delta_{[t-k,t]} \ln(wage_{if} + 1) = & [\Delta_{[t-2k,t-k]} \ln(wage_{if} + 1) | \ln(wage_{if,t-2k} + 1)] + \\ & \Delta_{[t-k,t]} firm\_in\_a\_cycle_f + \Delta_{[t-k,t]} controls_{if} + year_t + error_{ift} \end{aligned} \quad (3)$$

While it is common to use Arellano-Bond GMM or Bond-Blundell system-GMM estimators, which are more efficient on short panels, Anderson-Hsiao's IV estimator works well on long panels with remarkably small biases and is both simpler and easier to implement on large datasets (Judson and Owen 1999).

#### *Impact of cycles on performance*

Finally, to ascertain whether these forms of reciprocity reflect rent extraction, we investigate whether they have some impact on indicators of the firm's operating performance post one ( $t+1$ ) or two years ( $t+2$ ). In order to capture time invariant unobservable heterogeneity, we continue to use a first-difference equation (Equation 4).

$$\Delta_{[t+k-1,t+k]} firm\_result_f = \Delta_{[t-1,t]} firm\_in\_a\_cycle_f + \Delta_{[t-1,t]} controls_f + year_t + error_{ft} \quad (4)$$

#### Variables

We apply Equations 2 and 3 to seven dependent executive pay variables extracted from Exucomp: fixed salary, bonus, bonus to fixed salary ratio, total cash, estimated present value of stock options, total equity-related pay, and total compensation. Table A1 provides the descriptive statistics on all variables used to estimate equations 2 to 3.<sup>3</sup> In order to estimate classical multiplicative models for all continuous variables, we use the natural logarithm, to which we add one in order to handle null compensations (except for the bonus to fixed salary ratio). We winsorize the bonus to fixed salary ratio at the top 1 % level.

3 In EXUCOMP, we used SALARY for fixed salary, BONUS + NONEQ\_INCENT for bonuses, SALARY + BONUS + NONEQ\_INCENT for total cash. We used OPTION\_AWARDS or, if the latter is missing, OPTION\_AWARDS\_BLK\_VALUE or, if the latter is missing, OPTION\_AWARDS\_RPT\_VALUE for options. We sum our option pay variable with STOCK\_AWARDS or, if the latter is missing, with RSTKGRNT to calculate equity pay. Finally, total pay is given by TOTAL\_SEC, or, if the latter is missing, by TDC1, or if the latter is missing by TDC2.

In equations 2, 3, and 4 we introduce a number of executive, firm, and board controls. To control for individual executive heterogeneity, we include two executive characteristics available in Boardex: specifically, whether the executive is a CEO and whether the executive is a board member (while non-board member executives stand as the reference category). The number of executives described in the firm provides an approximation of the hierarchical position of executives in the firm: firms which describe the pay of more executives will probably describe executives lower in the hierarchy. While this last proxy is not very precise, the director-firm first-difference models also control for all time-invariant unobserved individual characteristics.

To control for firm characteristics, we include firm size measured by both total assets and shareholders' equity, and firm performance using sales and operating income, to which we apply a quasi-log transformation following the formula:  $sign(x) \times \ln(|x|+1)$ . We also include a dummy variable to capture negative operating income, a variable to control for one-year increase in operating income (difference in quasi-log), as well as a 3-year coefficient of variation of operating income to capture volatility (winsorized at  $p = 0.01$  and  $p = 0.99$ ) and return on equity (ratio of operating income to equity winsorized at  $p = 0.01$  and  $p = 0.99$ ). Finally, we include a dummy variable to control for any differences between private and public firms.

We control for a number of board and network characteristics. Specifically, we control for the size of the board, which has been found to be a positive predictor of executive pay. We also proxy the position of the firm in the control network with two dummy variables which capture the network "popularity" and "activity." We therefore control for the fact that at least one non-executive director also serves as an executive director in another firm (hence  $firm w \rightarrow firm x$ , where " $\rightarrow$ " stands for control), and for the fact that one of the firm's executive directors is a non-executive director elsewhere (hence  $firm x \rightarrow firm z$ ). Controlling for these two types of links is important when measuring the impact of cycles, as we need to make sure that cycles (hence  $firm y \rightarrow firm x \rightarrow firm y$ ) really capture a reciprocal social exchange and not the combination of incoming and outgoing control ties.

Finally, our variables of interest (the cyclical cycles described previously) are captured using three dummy variables, each taking the value of one if the cycle has: 1) at least one 2-cycle connection with another firm; 2) at least one delayed 2-cycle with another firm;<sup>4</sup> and 3) at least one 3-cycle or one 4-cycle connection with another firm – and zero otherwise.

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4 More precisely, a delayed 2-cycle corresponds to a situation where a given control tie ( $firm y \rightarrow firm x$ ) was preceded by an asymmetrical reverse control tie ( $firm x \rightarrow firm y$ ) during at least one of the five previous years (or was already a delayed 2-cycle in the preceding year). We nevertheless exclude cases where a given 2-cycle turns into a delayed one due to the severance of the tie, to avoid capturing the effect of the severance of the 2-cycle.



Table 2 Probability for firm  $y$  to control firm  $x$ 

	Desc. Mean	First order link	Model 1	Model 2	Model 3	Model 4	Model 5
Past controlling tie in $t-1$	0.0133 %	81.03 %	11.343*** (0.031)				11.130*** (0.039)
Past reversed controlling tie in $t-1$ (Restricted exchange opportunity)	0.0133 %	4.07 %	1.248*** (0.135)	4.811*** (0.039)	4.500*** (0.111)	0.326*** (0.095)	1.508*** (0.165)
Past reversed tie in $[t-5, t-2]$ & no tie in $t-1$ (Delayed exchange opportunity)	0.0082 %	0.34 %	4.618*** (0.151)	2.082*** (0.156)	4.269*** (0.153)		4.875*** (0.182)
Past reversed 2 or 3 path in $t-1$ (Generalized exchange opportunity)	0.0193 %	0.61 %	0.711*** (0.228)	2.198*** (0.078)	2.220*** (0.218)	0.139 (0.187)	0.484* (0.277)
Past firm $y$ controlling activity in $t-1$	$m=0.35$	$r=0.021$	0.278*** (0.012)	0.812*** (0.004)	0.410*** (0.012)	0.062*** (0.016)	0.261*** (0.014)
Past firm $x$ controlling popularity in $t-1$	$m=0.35$	$r=0.021$	0.120*** (0.011)	0.697*** (0.003)	0.372*** (0.011)	-0.154*** (0.013)	0.158*** (0.012)
(Year $\geq 2004$ ) $\times$ Past tie in $t-1$	0.0121 %	80.2 %					0.491*** (0.064)
(Year $\geq 2004$ ) $\times$ Past reversed tie in $t-1$ (Restricted exchange opportunity)	0.0121 %	1.78 %					-0.734** (0.285)
(Year $\geq 2004$ ) $\times$ Past reversed tie in $[t-5, t-2]$ & no tie in $t-1$ (Delayed exchange opportunity)	0.0096 %	0.19 %					-0.652** (0.325)
(Year $\geq 2004$ ) $\times$ Past reversed 2- or 3-path in $t-1$ (Generalized exchange opportunity)	0.0136 %	0.72 %					0.621 (0.493)
(Year $\geq 2004$ ) $\times$ Past firm $y$ controlling activity in $t-1$	$m=0.31$	$r=0.021$					0.045* (0.025)
(Year $\geq 2004$ ) $\times$ Past firm $x$ controlling popularity in $t-1$	$m=0.31$	$r=0.019$					-0.118*** (0.026)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Field	All	All	All	All	lag(tie)=0	lag(tie)=1	All
No. of obs. (dyads)	163,313,436	163,313,436	163,313,436	163,313,436	163,291,665	2,1771	163,313,436

Note: All models are logistic regressions. Standard errors in parentheses. \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

In order to estimate equation (4), we use  $t+1$  and  $t+2$  measures of the firm's return (assets, equity, income, sales, ROE) as dependent variables and  $t$  network measures as independent variables, and  $t$  performance variables as control variables.

## 4 Results

### Tie dynamics

Table 1 reports the description of the sample and the frequency of the cyclical cycles. Based on the frequencies reported in columns 8 to 13, it could initially suggest that these cyclical ties are very scarce and therefore potentially not very meaningful. They could simply be an artifact of a random consequence of network dynamics, or even a situation that is deliberately avoided by corporate actors aiming to achieve sound corporate governance.

In order to address this issue, we turn the matrix of control ties between non-isolated firms ( $\approx 2500 \times 2500$  firms) for each year into a dyadic database (Table 2). This generates a database of 163 million dyads. In order to manage it and run the models, we use sparse matrix tools and aggregate identical lines and estimated weighted descriptive statistics and regressions on a reduced matrix of 137,000 lines.

This dyadic database enables us to investigate the occurrence of a control tie between two firms. In Column 1, we find that the average probability of occurrence of a control tie between a given firm  $y$  and a given firm  $x$  is approximately 0.014%. When the tie existed in  $t-1$ , the probability increases to 81% indicating, unsurprisingly, a strong persistence of ties. Focusing on whether a firm will cycle in  $t$  when it had an opportunity to do so; the existence of a reverse control tie in  $t-1$  increases the probability of the formation of control tie to 4%. Moreover, a former reverse control tie, even when it was severed, still increases the probability of occurrence of a control tie to 0.3%. The effect of inverted 2- or 3-paths, which offer an opportunity for firms to engage in generalized exchange, also increases the probability of occurrence of a tie to 0.6%.

Column 3 reports the results of our first estimation of Equation 1. We find positive and significant ( $p < 0.001$ ) coefficients on all three cyclical ties. This suggests that firms do indeed favor cycling ties in board composition. The opportunities for restricted exchange, delayed exchange, and generalized exchange multiply the odds ratio of making a tie, respectively, by 3.6 (i.e.,  $\exp[1.3]$ ), 90 (i.e.,  $\exp[4.6]$ ) and 2 (i.e.,  $\exp[0.7]$ ). So although these cycles are rare – mainly because opportunities for creating such ties are rare – we find that when this opportunity does occur, firms use these ties more often than would be expected in a random distribution.

To address the concern of a bias being introduced by the presence of the lag dependent variable, especially when it approaches unit root, we estimate our model without the main lag dependent variables (Model 2) and further estimate the model conditionally to the lag dyadic tie: tie creation (Model 3) – when the tie did not exist in  $t-1$  – and tie maintenance (Model 4) – when the tie already existed in  $t-1$ . We find that the results are qualitatively similar. The three cycling opportunities contribute to the tie, especially to tie creation. Past reciprocity contributes to tie maintenance, while past generalized exchange does not have a significant effect on the latter (delayed exchange opportunity structure presupposes the severance of a lagged tie and cannot be estimated).

In order to estimate the impact of the new requirements for board independence under the governance codes described earlier, we compare two periods: pre-requirements (1992–2003) and post-requirements (2004–2015) in Model 5.

The results indicate that after 2003, there is a strong decline in the tendency to achieve restricted exchange and a moderate decline in the achievement of delayed restricted exchange. Despite its decline compared to the pre-2004 period, tendency to restricted exchange remains positive and significant during the last period (when summing main and interaction effects).

Conversely, the tendency to achieve generalized exchange increases: the interaction effect is not significant, but the sum of the main effect and the 2004–2015 effect is significant. The decline in generalized exchange that we observe in the descriptives reported in Table 2 is therefore mainly due to the declining density of the networks. Executives have fewer occasions to achieve such forms, although they are more inclined to do so.

Our results contrast sharply with those of Withers, Kim and Howard (2018), who find an increase in reciprocity in the period 2004–2006 immediately following the Sarbanes-Oxley Act (2002). Part of the difference might be due to the size of their sample, which is much smaller than ours, and the methodology – the sophisticated Stochastic Actor-Oriented Model of network change (with the Siena software) versus very simple logistic regressions. However, we postulate that Withers, Kim, and Howard (2018) may have overlooked the time necessary for firms to adapt to the new recommendations concerning board governance.<sup>5</sup>

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5 Hence, when we restrict Model 5 to 1998–2006, we do find a positive but non-significant parameter on restricted exchange after 2003.

## Reciprocities and executive pay

Table 3 reports the descriptive statistics on the compensation of executives and the position in reciprocity cycles. This forms our first approach to investigating the relationship between structural forms of reciprocity and pay. Panel A clearly shows that executives in firms embedded in cycles enjoy higher pay. For instance, firms engaging in *restricted exchange* pay on average +18 % in fixed salary, +19 % in bonuses, +19 % in total cash, +117 % in stock options, +60 % in equity pay and +38 % total compensation than firms that do not count any reciprocal ties within their board. The impact of delayed exchange – or even more, of generalized exchange – appears even stronger.

However, those firms that resort to such reciprocity ties might also have some specific characteristics in terms of size, sector, or executive skills that could also explain the pay gap. Panel B alleviates some of this concern by following the average evolution in pay for each firm's executives in the two years following the apparition of a reciprocity link within the board of directors. In the first year, restricted exchange, delayed exchange, and generalized exchange increase bonuses by, respectively, 6 %, 76 %, and 26 %; total cash by 9 %, 8 %, and 0 %; and total compensation by 10 %, -4 %, and 14 %. The two-year impact is even stronger, with respectively +12 %, +13 %, and +12 % of total cash. Although these are only univariate results, this simple first-difference table imposes a highly demanding structure to the comparison, as it controls for time-invariant individual, firm, and *individual* × *firm* heterogeneities.

To control for time-varying firm and individual heterogeneity we run Equation 2, the first-difference regression, which controls for the change in the hierarchical position of the executive, the change in the size of the firm and its operating performance, and the change in the position within the interlock network. Table 4 presents the estimates of Equation 2. In order to capture the effect of cycles that are both simultaneous and delayed, we introduce both changes in cycling and lagged changes in cycling as independent measures.

The change in restricted exchange has a modest simultaneous effect, producing, in the year of change, a 5-point increase in the bonus to fixed salary ratio (Column 3), a 3-point increase in total cash (Column 4), and a 17-point increase in option payment (Column 5). The impact of lagged changes is not significantly associated with pay.

Delayed exchange has significant impact on pay in time  $t$ , with a significant increase in bonuses (+40 % =  $\exp[0.33]$ ) during the first year, and another 4 % in total cash during the second year. However, delayed exchange does not seem to significantly impact any other component of pay in this specification.

Generalized exchange produces a positive association on pay, mainly within a one-year delay. The coefficient on generalized exchange in Column 2 indicates a positive effect of 29 % ( $\exp[0.25]$ ) reciprocity on bonus in the first year, which increases by an

Table 3 Compensation and reciprocity cycles

Type of executives	No. of obs.	Salary	Bonus	Total cash	Option comp.	Equity comp.	Total comp.
All executives	263,633	491 (0.7)	525 (2.6)	1,016 (2.9)	925 (9.5)	1,523 (14.1)	2,706 (14.4)
In firms in a restricted exchange link	4,524	574 (7.1)	624 (26.6)	1,198 (30.7)	1,953 (247.9)	2,412 (253.9)	3,700 (228.1)
In firms in a delayed exchange link	1,299	548 (8.3)	635 (24.5)	1,184 (30.4)	1,000 (66.9)	2,416 (372.7)	3,888 (352.5)
In firms in a generalized exchange link	976	712 (13.4)	1,030 (55.6)	1,742 (64.1)	2,329 (286.9)	3,342 (306.5)	5,346 (305.3)
In firms outside any exchange links	238,530	488 (0.7)	525 (2.7)	1,012 (3.1)	901 (9.1)	1,507 (14.5)	2,684 (14.8)

Note: Mean in 2015 constant thousands \$ and standard error in parentheses.

Panel B. Individual increase in compensation of US executives when entering reciprocity cycles									
<i>One-year increase</i>	No. of obs.	Salary	Bonus	Total cash	Option comp.	Equity comp.	Total comp.		
All executives	211,449	0.076 (0.001)	-0.033 (0.005)	0.069 (0.001)	-0.11 (0.007)	0.18 (0.008)	0.18 (0.002)		
In firms entering a restricted exchange link	703	0.113 (0.016)	+4%* (0.085)	0.155 (0.02)	+9%*** (0.123)	0.49 (0.137)	0.212 (0.027)	+30%*	+10%***
In firms entering a delayed exchange link	228	0.073 (0.018)	-0% (0.131)	0.149 (0.027)	+8%*** (0.178)	0.25 (0.237)	0.074 (0.05)	+6%	-4%
In firms entering a generalized exchange link	287	0.068 (0.012)	-1% (0.114)	0.068 (0.023)	+0% (0.232)	0.23 (0.217)	0.252 (0.046)	+4%	+14%***
In firms remaining outside any exchange links	186,078	0.075 (0.001)	ref	0.068 (0.001)	ref	0.19 (0.008)	0.113 (0.002)	ref	ref
<i>Two-year increase when entering a reciprocity cycle in t-2</i>									
All executives	166,810	0.121 (0.001)	0.0172 (0.006)	0.127 (0.002)	-0.1061 (0.008)	0.184 (0.008)	0.225 (0.002)		
In firms entering a restricted exchange link	417	0.199 (0.027)	+8%*** (0.103)	0.242 (0.032)	+12%*** (0.186)	0.619 (0.197)	0.342 (0.054)	+54%***	+12%**
In firms entering a delayed exchange link	147	0.116 (0.024)	-0% (0.184)	0.257 (0.034)	+13%*** (0.296)	-0.184 (0.273)	0.137 (0.058)	-43%	-8%
In firms entering a generalized exchange link	122	0.131 (0.024)	+1% (0.214)	0.24 (0.037)	+12%*** (0.308)	0.71 (0.338)	0.373 (0.059)	+22%	+16%**
In firms remaining outside any exchange links	148,426	0.119 (0.001)	ref	0.125 (0.002)	ref	0.183 (0.008)	0.218 (0.002)	ref	ref

Note: Mean difference in log of 2015 constant \$ compensation and standard error in parentheses. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ . (Student t-test).

additional +27 % in the second year. Effects on bonus to fixed salary ratio, on total cash, or on equity payment are significant in the second year. This result is consistent with the findings reported in the social exchange literature, which generalized that exchange needs more time to produce an effect.

Table A2 presents the results of Equation 3, with the inclusion of the Anderson-Hsiao IV estimates, which control for serial correlations and reverse causality. Overall, the results indicate that the coefficients are slightly attenuated and, given that the Anderson-Hsiao method inflates the standard errors, their significance is reduced. Due to the increase in standard errors, the results do not confirm the simultaneous significant impact of restricted exchange but continue to confirm impact of delayed exchange and generalized exchange on bonuses.

One way of summarizing the intertwining of changes and lagged changes in cycling is to measure differences over a longer time period. Table A3 provides results for 1-year (without controlling for lagged changes in cycling), 2-year, and 3-year first-difference models. Overall, it produces results which are consistent with the results reported in Table 4. It indicates that measured over a longer period, changes in cycling produce generally larger and more robust effects. The use of the two-year difference model allows us to better summarize the joint effect of differences<sup>6</sup> and lagged differences in cycling structures.

We use this model in Table 5 to measure the asymmetry between entering a reciprocity cycle and exiting from it. Table 5 and Table A4 (for Anderson-Hsiao IV estimates) show that entering a reciprocity cycle produces both positive and significant effects of the three cycling structures. If entering and exiting a cycle had a symmetrical effect on pay, we would expect to find negative coefficients of a similar magnitude for exiting. This is generally not the case here. We find that the magnitude is lower, the coefficient is less significant, and sometimes the coefficients are even positive (especially for delayed exchange). Overall, this tends to suggest that entering these cycles provides benefits to executives, although leaving them is not that harmful.

We also examine whether the increased pressure for sound corporate governance following the Sarbanes-Oxley Act (2002) and its implementation by the NYSE and the NASDAQ in 2003, and the correlative decline in interlock cyclicity shown by Table 2, also reduces the effect of reciprocity on executive pay. Here, this exogenous shock in corporate rules serves as a natural experiment on the efficacy of reciprocal ties on pay. As explained previously, it allows us to compare a first period where those restricted and delayed exchanges are not constrained with a period where they are constrained. Two mechanisms could be at play here. The new rules did not formally ban board cycles –

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6 In order to capture two-year changes in our cycling structures, we also imposed the one-year change to be equal to zero. Therefore, the firms enter or exit a reciprocity cycle between  $t-2$  and  $t-1$ , and not between  $t-1$  and  $t$ .

Table 4 The effect of reciprocity on CEO pay. Results from two-year first-difference OLS regressions (within *firm* × *individual* units)

	Fixed salary $\Delta \ln(w+1)$	Bonus $\Delta \ln(w+1)$	Bonus/ Salary $\Delta(w)$	Total cash $\Delta \ln(w+1)$	Stock options $\Delta \ln(w+1)$	Equity pay $\Delta \ln(w+1)$	Total pay $\Delta \ln(w+1)$
$\Delta$ CEO	0.480*** (0.013)	0.941*** (0.046)	0.102*** (0.019)	0.550*** (0.015)	1.192*** (0.070)	1.858*** (0.076)	0.479*** (0.018)
$\Delta$ Other executive board member	0.102*** (0.009)	0.243*** (0.035)	0.050*** (0.014)	0.125*** (0.011)	0.729*** (0.059)	0.714*** (0.063)	0.268*** (0.014)
$\Delta$ Number of top executives in the firm	-0.010*** (0.001)	-0.059*** (0.006)	-0.016*** (0.002)	-0.018*** (0.002)	-0.023*** (0.008)	-0.091*** (0.009)	0.003* (0.002)
$\Delta$ Assets [ $\ln(x+1)$ ]	0.023*** (0.006)	0.216*** (0.034)	0.081*** (0.014)	0.068*** (0.009)	0.259*** (0.041)	0.626*** (0.046)	0.181*** (0.012)
$\Delta$ Equity $\text{sgn}(x)\ln( x +1)$	-0.000 (0.001)	0.000 (0.006)	0.002 (0.002)	-0.001 (0.002)	0.048*** (0.007)	0.046*** (0.009)	0.011*** (0.002)
$\Delta$ Sales $\text{sgn}(x)\ln( x +1)$	0.027*** (0.005)	0.254*** (0.044)	0.118*** (0.018)	0.080*** (0.011)	0.081** (0.032)	0.204*** (0.041)	0.060*** (0.010)
$\Delta$ Operating income $\text{sgn}(x)\ln( x +1)$	0.002** (0.001)	0.145*** (0.006)	0.060*** (0.002)	0.030*** (0.001)	0.023*** (0.007)	0.048*** (0.008)	0.020*** (0.002)
$\Delta$ Operating income $\leq 0$	0.009 (0.007)	0.296*** (0.047)	0.325*** (0.015)	0.137*** (0.010)	-0.003 (0.056)	0.118** (0.055)	0.065*** (0.013)
$\Delta$ Increase in operating income since $t-1$	0.000 (0.000)	0.014*** (0.002)	0.005*** (0.001)	0.003*** (0.000)	-0.017*** (0.003)	-0.027*** (0.003)	-0.002*** (0.001)
$\Delta$ 3-year-coefficient of variation of operating income	-0.000 (0.000)	-0.002 (0.002)	-0.003*** (0.001)	-0.001*** (0.000)	0.001 (0.003)	-0.005* (0.003)	-0.002*** (0.001)
$\Delta$ ROE	0.001 (0.004)	0.124*** (0.019)	0.030*** (0.006)	0.020*** (0.004)	-0.011 (0.024)	0.030 (0.025)	0.016*** (0.006)
$\Delta$ Private firm	0.010* (0.005)	0.048 (0.031)	0.001 (0.015)	0.013 (0.008)	0.004 (0.040)	-0.054 (0.040)	0.012 (0.009)
$\Delta$ Board size	0.001 (0.001)	0.005 (0.005)	0.004* (0.002)	0.001 (0.001)	0.014* (0.007)	0.012 (0.008)	-0.000 (0.002)
$\Delta$ At least one NED is ED elsewhere	-0.000 (0.003)	0.005 (0.018)	0.009 (0.007)	0.003 (0.005)	-0.021 (0.027)	-0.025 (0.027)	0.001 (0.006)
$\Delta$ At least one ED is NED elsewhere	0.010** (0.004)	0.068*** (0.020)	0.016** (0.007)	0.017*** (0.005)	0.078*** (0.027)	0.170*** (0.029)	0.017*** (0.006)
$\Delta$ Restricted exchange	-0.002 (0.013)	0.023 (0.059)	<b>0.050**</b> <b>(0.023)</b>	<b>0.027*</b> <b>(0.015)</b>	<b>0.169**</b> <b>(0.086)</b>	0.108 (0.106)	0.010 (0.022)
$\Delta$ Delayed exchange	0.002 (0.011)	<b>0.329***</b> <b>(0.118)</b>	-0.004 (0.040)	0.023 (0.020)	0.072 (0.159)	-0.187 (0.152)	-0.004 (0.035)
$\Delta$ Generalized exchange	-0.015 (0.011)	<b>0.253***</b> <b>(0.091)</b>	0.019 (0.038)	-0.003 (0.018)	-0.025 (0.144)	0.050 (0.162)	0.011 (0.035)
$\Delta$ Lagged restricted exchange	0.005 (0.010)	-0.043 (0.058)	-0.013 (0.018)	0.000 (0.014)	-0.127 (0.085)	0.108 (0.098)	-0.003 (0.021)
$\Delta$ Lagged delayed exchange	-0.005 (0.011)	-0.035 (0.093)	-0.014 (0.032)	0.002 (0.017)	-0.196 (0.148)	-0.205 (0.135)	-0.051 (0.035)
$\Delta$ Lagged generalized exchange	0.002 (0.016)	<b>0.238**</b> <b>(0.113)</b>	<b>0.122***</b> <b>(0.044)</b>	<b>0.055**</b> <b>(0.022)</b>	0.112 (0.126)	<b>0.346**</b> <b>(0.154)</b>	<b>0.059**</b> <b>(0.029)</b>
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	190,313	190,290	189,579	190,310	167,542	134,152	190,242
R <sup>2</sup>	0.043	0.071	0.048	0.073	0.011	0.024	0.034

Note: All models are 1-year first-differences OLS panel regression. OLS estimates. Robust clustered standard errors at the *firm* × *executive* level. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .



Table 5 The asymmetrical effects of entering or exiting a reciprocity cycle

	Fixed salary $\Delta \ln(w+1)$	Bonus $\Delta \ln(w+1)$	Bonus/ Fix. $\Delta(w)$	Total cash $\Delta \ln(w+1)$	Stock options $\Delta \ln(w+1)$	Equity pay $\Delta \ln(w+1)$	Total pay $\Delta \ln(w+1)$
Entering restricted exchange	<b>0.045*</b> (0.027)	<b>0.198*</b> (0.104)	0.048 (0.048)	<b>0.070**</b> (0.032)	0.108 (0.183)	0.242 (0.197)	0.010 (0.055)
Entering delayed exchange	-0.019 (0.023)	<b>0.643***</b> (0.175)	<b>0.146*</b> (0.079)	<b>0.092***</b> (0.034)	-0.428 (0.281)	-0.281 (0.267)	-0.089 (0.058)
Entering generalized exchange	-0.008 (0.024)	<b>0.366*</b> (0.206)	<b>0.255***</b> (0.095)	<b>0.085**</b> (0.036)	0.128 (0.312)	0.470 (0.334)	0.122** (0.059)
Exiting restricted exchange	0.007 (0.021)	0.048 (0.099)	<b>-0.082**</b> (0.037)	-0.038 (0.030)	0.018 (0.127)	-0.071 (0.127)	-0.022 (0.032)
Exiting delayed exchange	-0.020 (0.020)	<b>0.535***</b> (0.165)	<b>0.283***</b> (0.077)	<b>0.091**</b> (0.036)	-0.436 (0.269)	0.100 (0.153)	0.055 (0.042)
Exiting generalized exchange	0.010 (0.022)	<b>-0.541***</b> (0.157)	-0.087 (0.075)	-0.052 (0.037)	-0.226 (0.207)	-0.103 (0.183)	0.016 (0.059)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	151,185	151,164	150,581	151,182	132,740	132,668	151,129
R <sup>2</sup>	0.047	0.106	0.071	0.092	0.025	0.023	0.064

Note: We limit changes in cycling to those occurring between  $t-2$  and  $t-1$ . All models are 2-year first-differences OLS panel regression. Robust clustered standard errors at the  $firm \times executive$  level. Control variables are the same as in Table 4. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

even the most obvious one, restricted exchange – but banned “interlocks” (what we call restricted exchange) from a board’s compensation committee. Interlocked directors can remain on the board and continue to potentially influence executive pay through their indirect influence and their votes on proposals by the compensation committee. The primary effect of the new regulation banning interlocks from compensation committees should, at a minimum, decrease the effect of restricted exchange.

Could the effect remain positive? On the one hand, the criticisms addressed to *restricted exchange* could lead firms using it for other business reasons to become conscious that it also leads to some partiality in board monitoring. This process of conscientization could lead to the use of strategies to diminish the bias through increased restraint in pay. This additional phenomenon could lead to a negative effect of restricted exchange after 2003.

On the other hand, when these forms of endogamy are criticized, they may be abandoned by the firms that wish to abide by the principles of sound corporate governance and remain in those firms that are run by more opportunistic executives who prefer weak corporate governance. This selection effect could drive up the positive effect of cyclicity on CEO pay and lead to its maintenance.

The new regulation and its interpretation led to targeting restricted exchange and short-term delayed exchange; it did not acknowledge or discuss long-term delayed exchange or generalized exchange. Consequently, we should not observe a decrease in the impact of generalized exchange.

Table 6 and Table A5 (for Anderson-Hsiao IV estimates) show striking results for restricted and delayed exchange. Before 2004, restricted exchange between executives produces consistent pay premiums for all types of pay: restricted exchange increases bonuses +20% ( $\exp[0.18]$ ), bonus to fixed salary ratio by 9 percentage points, total cash by +6%, options by +23%, and equity pay by +33%. Similarly, delayed exchange increases bonus to fixed salary ratio by 15 percentage points and total cash by +7%. This is consistent and confirms Hallock's (1997; 1999) findings for the pre-2004 period. Moreover, our controls for matched firm-executive fixed effects provide much stronger proof of the impact of restricted exchange during this period.

Conversely, after 2004, the restricted exchange effect declines by a magnitude of -40 to -50% for bonuses, stock options and equity pay, of -12% for total pay. The decline is even more pronounced than the pre-2004 benefit. A similar result is found for delayed exchange, which was also partially targeted by the 2003 reform. Therefore, after 2004, having a restricted exchange tie in the board also leads to compensation that is significantly lower (for bonuses, options, and total pay) than for executives outside any reciprocity tie.<sup>7</sup> This phenomenon is consistent with a process where boards acknowledge their own bias. When they maintain an interlock, boards and executives appear to overreact to this source of positive bias by setting executive pay at a level below other firms.

The opposite is true for *generalized exchange*, which remains the same or even increases after 2004, especially for bonuses and total cash. We also find a significant decline for options after 2004; however, this finding must be considered with caution due to the definition during this period and to the limited number of outliers.

Currently, under current corporate governance codes, generalized exchange is ignored and hence unlikely to be monitored. Consequently, it is not surprising that it continues to have a positive impact on pay during the second period. However, without any change in corporate norms, the declining participation of executives on boards, both as non-executive board members and as executive directors, considerably diminishes the opportunity for such cycles to be created. At the end of the period, generalized exchange no longer impacts pay, simply because this type of tie disappeared.

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7 Results will be sent on request.

Table 6 The effect of reciprocity before and after the implementation of Sarbanes-Oxley. Results from two-year first-difference OLS regressions (within *firm* × *individual* units)

	Fixed salary $\Delta \ln(w+1)$	Bonus $\Delta \ln(w+1)$	Bonus/ Fix. $\Delta(w)$	Total cash $\Delta \ln(w+1)$	Stock options $\Delta \ln(w+1)$	Equity pay $\Delta \ln(w+1)$	Total pay $\Delta \ln(w+1)$
$\Delta$ Restricted exchange	0.002 (0.021)	<b>0.183**</b> ( <b>0.081</b> )	<b>0.083**</b> ( <b>0.034</b> )	<b>0.060**</b> ( <b>0.027</b> )	<b>0.210*</b> ( <b>0.125</b> )	<b>0.288**</b> ( <b>0.130</b> )	0.047 (0.034)
$\Delta$ Delayed exchange	-0.016 (0.021)	0.195 (0.135)	<b>0.146**</b> ( <b>0.064</b> )	<b>0.065**</b> ( <b>0.027</b> )	-0.259 (0.326)	-0.312 (0.260)	-0.066 (0.055)
$\Delta$ Generalized exchange	-0.042* (0.024)	<b>0.428**</b> ( <b>0.178</b> )	0.118 (0.073)	0.015 (0.035)	<b>0.505*</b> ( <b>0.262</b> )	0.355 (0.243)	0.031 (0.062)
(Year > 2004) × $\Delta$ Restricted exchange	0.041 (0.032)	<b>-0.557***</b> ( <b>0.194</b> )	-0.060 (0.073)	-0.041 (0.045)	<b>-0.639***</b> ( <b>0.213</b> )	<b>-0.553***</b> ( <b>0.212</b> )	<b>-0.127**</b> ( <b>0.050</b> )
(Year > 2004) × $\Delta$ Delayed restricted exchange	0.034 (0.030)	-0.313 (0.254)	<b>-0.459***</b> ( <b>0.113</b> )	<b>-0.140***</b> ( <b>0.051</b> )	0.565 (0.392)	0.246 (0.300)	-0.015 (0.070)
(Year > 2004) × $\Delta$ Generalized exchange	<b>0.092***</b> ( <b>0.032</b> )	0.117 (0.243)	0.068 (0.119)	<b>0.129**</b> ( <b>0.055</b> )	<b>-0.724**</b> ( <b>0.329</b> )	-0.314 (0.319)	-0.006 (0.083)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	151,185	151,164	150,581	151,182	132,740	132,668	151,129
R <sup>2</sup>	0.047	0.106	0.071	0.092	0.025	0.023	0.064

Note: We limit changes in cycling to those occurring between  $t-2$  and  $t-1$ . Therefore, the first changes in cycling during the second period occur between 2003 and 2004. All models are 2-year FD OLS panel regression. Robust clustered standard errors at the *firm* × *executive* level. Control variables are the same as in Table 4. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

### Are these networks effects rent extraction?

One could argue that cycles in board networks are linked to industrial strategies, such as building alliances between firms, exchanging information and testing the first steps of future mergers. Consequently, they could be tied to higher pay not because board members within reciprocity cycles are more generous when it comes to the evaluation of the executives they monitor, but because these executives are engaged through this type of tie in an industrial strategy that is profitable for their firm.

In our prior models, we controlled for firm performance (see Tables 4 to 6) and the results indicated that the network effects continue to be associated with higher pay. However, the impact of the network on a firm's performance may take time to materialize. We therefore investigate the impact of our three forms of *reciprocity exchange* on a firm's performance in time  $t+1$  and  $t+2$ . Firm performance is measured using a number of performance indicators: assets, equity, sales, income, and return on equity (ROE).

Table 7 reports the results of this additional analysis using first-difference models. The results provide very little evidence of improvements in firm performance over the following 2-year period. Reciprocity exchange is not significantly and positively associated with any of our measures of a firm's performance, except for a small significant positive effect of delayed exchange on sales and ROE in  $t+1$ , which vanish in

Table 7 Effect of social exchange on future results. First differences models

	$\Delta_{[t,t+1]}$ Assets	$\Delta_{[t,t+1]}$ Equity	$\Delta_{[t,t+1]}$ Sales	$\Delta_{[t,t+1]}$ Income	$\Delta_{[t,t+1]}$ ROE	$\Delta_{[t+1,t+2]}$ Assets	$\Delta_{[t+1,t+2]}$ Equity	$\Delta_{[t+1,t+2]}$ Sales	$\Delta_{[t+1,t+2]}$ Income	$\Delta_{[t+1,t+2]}$ ROE
$\Delta_{[t-1,t]}$ Assets $\log(x+1)$	0.112** (0.054)	0.112** (0.054)	0.354*** (0.013)	-0.821*** (0.092)	-0.165*** (0.018)	0.005 (0.039)	0.142*** (0.013)	0.142*** (0.013)	-0.162* (0.083)	-0.042*** (0.015)
$\Delta_{[t-1,t]}$ Equity $\text{sgn}(x) \times \log( x +1)$	0.014*** (0.002)	0.014*** (0.002)	-0.009** (0.005)	-0.261*** (0.025)	0.015** (0.006)	0.008*** (0.001)	0.002 (0.001)	0.002 (0.001)	-0.059** (0.024)	0.002 (0.005)
$\Delta_{[t-1,t]}$ Sales $\text{sgn}(x) \times \log( x +1)$	0.157*** (0.035)	0.160** (0.075)	0.157*** (0.035)	-0.013 (0.084)	0.020 (0.017)	0.090*** (0.022)	0.038 (0.030)	0.038 (0.030)	-0.426*** (0.057)	-0.014 (0.015)
$\Delta_{[t-1,t]}$ Income $\text{sgn}(x) \times \log( x +1)$	0.003*** (0.000)	0.011** (0.005)	0.002*** (0.001)	0.002*** (0.001)	-0.014*** (0.001)	0.002*** (0.000)	0.011*** (0.004)	-0.002 (0.001)	-0.004*** (0.001)	-0.004*** (0.001)
$\Delta_{[t-1,t]}$ ROE	0.012** (0.005)	0.230*** (0.068)	-0.002 (0.011)	-0.750*** (0.077)	-0.021 (0.055)	0.005 (0.005)	-0.021 (0.055)	-0.007 (0.008)	-0.270*** (0.062)	-0.003 (0.012)
$\Delta_{[t-1,t]}$ Private firm	-0.023*** (0.008)	0.003 (0.042)	-0.024 (0.017)	-0.076 (0.103)	-0.003 (0.011)	-0.017** (0.008)	-0.059 (0.055)	-0.037** (0.018)	0.028 (0.110)	-0.003 (0.012)
$\Delta_{[t-1,t]}$ Board size	0.001 (0.002)	0.007 (0.007)	0.002 (0.001)	0.042** (0.017)	0.003 (0.002)	0.002 (0.001)	0.010 (0.007)	0.001 (0.001)	0.002 (0.018)	0.001 (0.002)
$\Delta_{[t-1,t]}$ At least one NED is ED elsewhere	0.004 (0.005)	0.006 (0.025)	-0.005 (0.006)	0.083 (0.064)	0.003 (0.008)	0.001 (0.004)	-0.014 (0.030)	-0.001 (0.006)	0.021 (0.063)	0.011 (0.008)
$\Delta_{[t-1,t]}$ At least one ED is NED elsewhere	0.014*** (0.004)	-0.001 (0.032)	0.003 (0.005)	-0.028 (0.071)	0.007 (0.008)	0.007 (0.004)	0.030 (0.031)	0.000 (0.007)	-0.121* (0.070)	-0.003 (0.008)
$\Delta_{[t-1,t]}$ Restricted exchange	0.005 (0.012)	-0.049 (0.080)	-0.002 (0.012)	0.162 (0.201)	0.019 (0.021)	0.005 (0.010)	0.024 (0.085)	-0.012 (0.010)	0.293 (0.249)	-0.014 (0.022)
$\Delta_{[t-1,t]}$ Delayed exchange	0.005 (0.019)	-0.129 (0.142)	0.027* (0.014)	-0.092 (0.307)	0.109*** (0.041)	0.020 (0.021)	-0.268* (0.137)	0.035 (0.021)	-0.454 (0.334)	-0.077* (0.046)
$\Delta_{[t-1,t]}$ Generalized exchange	-0.000 (0.012)	0.104 (0.141)	-0.018 (0.014)	-1.135** (0.475)	-0.090* (0.047)	0.004 (0.012)	-0.173 (0.148)	-0.000 (0.015)	0.065 (0.358)	0.075 (0.047)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	38,265	38,264	38,256	38,253	38,252	37,437	37,436	37,422	37,422	37,421
R <sup>2</sup>	0.087	0.018	0.110	0.053	0.027	0.051	0.009	0.041	0.033	0.009

Note: All models are 1-year FD OLS panel regression. Robust clustered standard errors at the firm level. \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

$t+2$ . We also find a negative and significant impact of generalized exchange on income and ROE. Overall, the picture suggests that there is no link between forms of exchange and forward measures of a firm's performance. This therefore leads us to interpret the impact of reciprocal exchange on executive pay as being one of rent extraction, rather than an efficient market price for performance.

## 5 Discussion: A tip of the iceberg phenomenon

This article finds that firms engaged in several forms of board reciprocities – *restricted*, *delayed*, and *generalized exchange* – which undermine non-executive directors' independence and grant their executives higher pay, especially bonus payments and total cash. Our study makes several contributions. First, by specifically focusing on a form of social exchange whereby the actors are structurally tied to one another and have a common interest in improving each other's pay, we add to the compensation literature and provide strong evidence of rent extraction. Second, our results, which capture time-varying solidarity within firm boards, are consistent with the findings of previous studies that find a positive impact of homophilic ties on pay (Kramarz and Thesmar 2013; Kim, Kogut, and Yang 2015) and provide evidence that our results are therefore less likely to capture a reflection problem (Manski 1993; Mouw 2006). Third, we extend previous studies showing the positive impact on pay of *restricted exchange* (Hallock 1997) in two ways. Firstly, we provide a stronger model of the impact of cross-directorship by taking into account the firm and individual constant unobserved heterogeneity; and secondly, we identify additional forms of reciprocity. Lastly, we also contribute to social exchange theory. We show that mutual benefits for actors come not only from classical restricted exchanges, but also from being engaged in delayed exchange and generalized exchange. These two exchange structures could be considered less efficient given the opportunity to free ride and to not reciprocate.

The evolution of the norms defining board independence after 2004 serves as a natural experiment supporting the positive association of at least two of the cycling structures, *restricted* and *delayed exchange*, on pay. New codes of governance targeted these forms of social exchange for being incompatible with full independence and excluded them from compensation committees. Following this new regulation, the pre-2004 premium of these types of exchange on bonuses and equity pay disappeared, and even reverted to a negative premium in executives' pay. Conversely, *generalized exchange*, which was not targeted by corporate governance codes, remained effective.

Although the marginal effect of these reciprocity structures is substantial, the overall effect on executive pay and its evolution remains limited because these structures are rare. Indeed, with the fragmentation of corporate networks (Mizruchi 2013; Chu and Davis 2016), they are almost non-existent after 2013. Had such reciprocal ties not existed,

the levels and changes in CEO pay would not have been very different. For instance, counterfactually suppressing the pre-2004 twenty-percent premium on bonuses for restricted exchange would have diminished global bonus amounts by only one percent during this period. However, because we focus on very rare ties and structures, we argue that our findings only reveal the tip of the iceberg of the phenomenon.

Executives are tied to one another via multiple sorts of ties, but we focus only on the most visible and the most traceable forms. By doing so, we believe we underestimate the multiplex and therefore complex types of exchange in the corporate world. Bourdieu's analysis for French academia may also hold true for US executives:

[T]he circulation of services rendered can only be perceived at the level of a group of institutions, and it is rare that they take the visible form of a direct and immediate exchange ... the longer, the more complicated and the more indecipherable for uninitiated is the cycle of exchange. (Bourdieu 1988, 86)

Thus, a future challenge for social network analysts is to estimate the true size of the iceberg based on the size of its tip.

## Appendix

Table A1 Descriptive statistics

	Mean	Std. Error	Min.	Q1	Median	Q3	Max.	No. of obs.
Fixed salary $[\ln(x+1)]$	5.995	0.0014	0.000	5.660	6.005	6.40	9.3	263,627
Bonus $[\ln(x+1)]$	4.754	0.0046	-0.001	4.177	5.402	6.29	12.0	263,610
(Bonus/Fixed salary)*	0.848	0.0021	0.000	0.228	0.585	1.05	7.0	262,612
Total cash $[\ln(x+1)]$	6.512	0.0018	0.000	5.991	6.475	7.03	12.0	263,624
Stock options $[\ln(x+1)]$	3.969	0.0065	0.000	0.000	5.095	6.52	13.6	239,511
Equity pay (stock options + shares) $\ln(x+1)$	5.316	0.0058	0.000	4.532	6.131	7.22	14.5	239,400
Total pay $[\ln(x+1)]$	7.214	0.0022	0.000	6.461	7.151	7.91	14.5	263,556
CEO	0.158	0.0007	0.000	0.000	0.000	0.00	1.0	263,633
Other executive board member	0.141	0.0007	0.000	0.000	0.000	0.00	1.0	263,633
Number of top executives in the firm	6.105	0.0029	1.000	5.000	6.000	7.00	18.0	263,633
Assets $[\ln(x+1)]$	7.767	0.0035	0.001	6.487	7.643	8.92	15.1	262,297
Equity $sgn(x)\ln( x +1)$	6.435	0.0050	-11.460	5.640	6.606	7.70	12.5	262,291
Sales $sgn(x)\ln( x +1)$	7.381	0.0032	-8.485	6.304	7.317	8.45	13.1	261,870
Operating income $sgn(x)\ln( x +1)$	3.218	0.0074	-11.602	2.765	4.261	5.56	11.4	262,199
Operating income $\leq 0$	0.175	0.0007	0.000	0.000	0.000	0.00	1.0	262,209
Increase in operating income since $t-1$	-0.024	0.0068	-20.468	-0.271	0.098	0.43	20.4	260,701
3-year-coefficient of variation of operating income‡	0.163	0.0045	-12.062	0.063	0.190	0.46	11.5	257,399
ROE (Operating income/Equity)‡	0.080	0.0007	-2.063	0.043	0.110	0.17	1.6	262,191
Private firm	0.295	0.0009	0.000	0.000	0.000	1.00	1.0	263,633
Board size	7.894	0.0065	1.000	6.000	8.000	10.00	31.0	245,257
At least one NED is ED elsewhere	0.328	0.0009	0.000	0.000	0.000	1.00	1.0	245,257
At least one ED is NED elsewhere	0.320	0.0009	0.000	0.000	0.000	1.00	1.0	245,257
Restricted exchange	0.018	0.0003	0.000	0.000	0.000	0.00	1.0	245,257
Delayed exchange	0.004	0.0001	0.000	0.000	0.000	0.00	1.0	245,257
Generalized exchange	0.005	0.0001	0.000	0.000	0.000	0.00	1.0	245,257

Note: \* Winsorized at  $p=0.99$

‡ Winsorized at  $p=0.01$  and  $p=0.99$

Table A2 Taking into account possible serial correlation with the Anderson-Hsiao instrumental variable technique

	Fixed salary $\Delta \ln(w+1)$	Bonus $\Delta \ln(w+1)$	Bonus/ Fix. $\Delta(w)$	Total cash $\Delta \ln(w+1)$	Stock options $\Delta \ln(w+1)$	Equity pay $\Delta \ln(w+1)$	Total pay $\Delta \ln(w+1)$
$\Delta$ CEO	0.390*** (0.013)	0.912*** (0.057)	0.171*** (0.022)	0.485*** (0.017)	1.397*** (0.083)	1.516*** (0.079)	0.524*** (0.024)
$\Delta$ Other executive board member	0.094*** (0.010)	0.265*** (0.045)	0.062*** (0.017)	0.125*** (0.013)	0.656*** (0.072)	0.611*** (0.067)	0.187*** (0.019)
$\Delta$ Number of top executives in the firm	-0.028*** (0.001)	-0.054*** (0.007)	-0.002 (0.003)	-0.030*** (0.002)	-0.015* (0.009)	-0.053*** (0.009)	-0.001 (0.002)
$\Delta$ Assets $[\ln(x+1)]$	0.040*** (0.006)	0.154*** (0.041)	0.042** (0.017)	0.064*** (0.010)	0.241*** (0.048)	0.264*** (0.047)	0.179*** (0.014)
$\Delta$ Equity $sgn(x)\ln( x +1)$	-0.000 (0.001)	-0.001 (0.007)	0.001 (0.003)	-0.000 (0.002)	0.051*** (0.009)	0.068*** (0.009)	0.012*** (0.002)
$\Delta$ Sales $sgn(x)\ln( x +1)$	0.027*** (0.004)	0.266*** (0.053)	0.123*** (0.022)	0.082*** (0.013)	0.071** (0.035)	0.130*** (0.042)	0.065*** (0.012)
$\Delta$ Operating income $sgn(x)\ln( x +1)$	0.001 (0.001)	0.100*** (0.008)	0.047*** (0.003)	0.022*** (0.002)	0.026*** (0.008)	0.031*** (0.008)	0.024*** (0.002)
$\Delta$ Operating income $\leq 0$	0.005 (0.006)	0.293*** (0.060)	0.356*** (0.019)	0.145*** (0.011)	-0.019 (0.066)	-0.001 (0.061)	0.060*** (0.015)
$\Delta$ Increase in operating income since $t-1$	-0.000 (0.000)	0.052*** (0.003)	0.020*** (0.001)	0.010*** (0.001)	-0.020*** (0.003)	-0.023*** (0.003)	-0.005*** (0.001)
$\Delta$ 3-year-coefficient of variation of operating income	-0.000 (0.000)	0.002 (0.003)	-0.002** (0.001)	-0.001** (0.001)	0.006* (0.003)	0.001 (0.003)	-0.002*** (0.001)
$\Delta$ ROE	-0.004 (0.003)	0.132*** (0.024)	0.039*** (0.008)	0.019*** (0.005)	0.009 (0.028)	0.057** (0.027)	0.022*** (0.007)
$\Delta$ Private firm	0.009* (0.006)	0.061* (0.036)	-0.003 (0.017)	0.012 (0.009)	0.041 (0.045)	-0.047 (0.044)	0.009 (0.011)
$\Delta$ Board size	0.000 (0.001)	-0.003 (0.006)	-0.001 (0.002)	-0.001 (0.001)	0.005 (0.008)	0.015** (0.008)	-0.000 (0.002)
$\Delta$ At least one NED is ED elsewhere	-0.000 (0.003)	0.030 (0.022)	0.018** (0.008)	0.008* (0.005)	-0.000 (0.031)	0.043 (0.028)	0.003 (0.007)
$\Delta$ At least one ED is NED elsewhere	0.008** (0.003)	0.072*** (0.024)	0.009 (0.009)	0.015*** (0.005)	0.082*** (0.031)	0.093*** (0.029)	0.011 (0.007)
$\Delta$ Restricted exchange	-0.008 (0.011)	-0.057 (0.076)	0.035 (0.027)	0.017 (0.017)	0.163 (0.099)	0.066 (0.099)	0.029 (0.024)
$\Delta$ Delayed exchange	-0.008 (0.008)	0.305** (0.154)	0.005 (0.048)	0.013 (0.024)	0.220 (0.190)	-0.165 (0.181)	0.024 (0.043)
$\Delta$ Generalized exchange	-0.016* (0.010)	0.282** (0.114)	0.022 (0.047)	0.002 (0.020)	0.160 (0.160)	0.315** (0.160)	0.081** (0.037)
$\Delta$ Lagged restricted exchange	0.021** (0.009)	-0.014 (0.069)	-0.020 (0.020)	0.015 (0.015)	-0.245** (0.100)	-0.055 (0.085)	0.014 (0.026)
$\Delta$ Lagged delayed exchange	-0.015 (0.009)	-0.045 (0.116)	-0.009 (0.040)	-0.004 (0.020)	-0.160 (0.175)	0.017 (0.180)	-0.053 (0.039)
$\Delta$ Lagged generalized exchange	0.001 (0.011)	0.186 (0.135)	0.123** (0.050)	0.055** (0.023)	0.237 (0.151)	0.125 (0.123)	0.016 (0.026)
$\Delta_{[t-2,t-1]}$ LDV instrumented with $LDV_{t-1}$	0.228*** (0.015)	0.217*** (0.006)	0.558*** (0.021)	0.256*** (0.013)	0.078*** (0.006)	1.025*** (0.006)	0.081*** (0.013)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	152,447	152,418	151,816	152,444	131,375	131,302	118,751

Note: All models are 2-year FD 2SLS panel regression. The last line includes the lag of the 2-year first difference dependent variable instrumented by its past level. Hence, for fixed salary, the FD of the dependent variable is  $\Delta_{[t-2,t]}$  log wage, the lag of the FD of the LDV is  $\Delta_{[t-4,t-2]}$  log wage and its instrument is the level log wage  $e_{t-4}$ . Robust clustered standard errors at the firm  $\times$  executive level. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .



Table A3 From 1-year first differences to 3-year first differences

<i>1-year first differences</i>	Fixed salary $\Delta \ln(w+1)$	Bonus $\Delta \ln(w+1)$	Bonus/ Fix. $\Delta(w)$	Total cash $\Delta \ln(w+1)$	Stock options $\Delta \ln(w+1)$	Equity pay $\Delta \ln(w+1)$	Total pay $\Delta \ln(w+1)$
$\Delta$ Restricted exchange	0.002 (0.013)	0.009 (0.062)	0.043* (0.023)	0.027* (0.015)	0.155* (0.090)	0.110 (0.102)	0.009 (0.023)
$\Delta$ Delayed exchange	0.002 (0.011)	0.331*** (0.123)	-0.002 (0.040)	0.022 (0.020)	0.104 (0.165)	-0.160 (0.151)	0.003 (0.037)
$\Delta$ Generalized exchange	-0.015 (0.011)	0.194** (0.092)	-0.012 (0.038)	-0.017 (0.019)	-0.054 (0.143)	-0.034 (0.150)	-0.004 (0.035)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	191,906	191,883	191,156	191,903	0.012	0.045	0.069**
R <sup>2</sup>	0.043	0.071	0.048	0.072	(0.017)	(0.076)	(0.031)
<i>2-year first differences; change in cycling between t-2 and t-1</i>							
$\Delta$ Restricted exchange	0.012 (0.017)	0.045 (0.076)	0.069** (0.031)	0.050** (0.023)	0.029 (0.102)	0.131 (0.105)	0.016 (0.028)
$\Delta$ Delayed exchange	0.001 (0.015)	0.047 (0.125)	-0.072 (0.055)	-0.000 (0.025)	0.024 (0.197)	-0.188 (0.152)	-0.073** (0.036)
$\Delta$ Generalized exchange	-0.009 (0.017)	0.479*** (0.131)	0.141** (0.063)	0.063** (0.028)	0.200 (0.173)	0.228 (0.165)	0.030 (0.043)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	151,185	151,164	150,581	151,182	132,740	132,668	151,129
R <sup>2</sup>	0.047	0.106	0.071	0.092	0.025	0.023	0.064
<i>3-year first differences; change in cycling between t-3 and t-2</i>							
$\Delta$ Restricted exchange	-0.007 (0.024)	0.051 (0.110)	0.118** (0.052)	0.073* (0.040)	-0.132 (0.128)	-0.128 (0.119)	0.020 (0.043)
$\Delta$ Delayed exchange	0.005 (0.017)	0.322* (0.169)	0.097 (0.060)	0.074*** (0.028)	0.595*** (0.219)	0.349* (0.180)	0.044 (0.039)
$\Delta$ Generalized exchange	0.009 (0.032)	0.437*** (0.142)	0.144* (0.078)	0.078* (0.042)	-0.384* (0.206)	-0.215 (0.179)	-0.017 (0.052)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	117,372	117,356	116,878	117,370	103,279	103,218	117,330
R <sup>2</sup>	0.057	0.115	0.072	0.103	0.041	0.034	0.086

Note: All models are FD panel OLS regression. Robust clustered standard errors at the *firm*  $\times$  *executive* level. Control variables are the same as in Table 4. For 3-year first differences, we focus on changes in cycling that occurred between  $t-3$  and  $t-2$  and we exclude those that occurred between  $t-2$  and  $t$ .

\*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

Table A4 Entering and exiting cycles. Checking Table 5 for serial correlations with the Anderson-Hsiao instrumental variable technique

	Fixed salary $\Delta \ln(w+1)$	Bonus $\Delta \ln(w+1)$	Bonus/ Fix. $\Delta (w)$	Total cash $\Delta \ln(w+1)$	Stock options $\Delta \ln(w+1)$	Equity pay $\Delta \ln(w+1)$	Total pay $\Delta \ln(w+1)$
Entering restricted exchange	0.026 (0.025)	0.269** (0.122)	0.046 (0.059)	0.064* (0.038)	0.100 (0.214)	0.301 (0.222)	0.015 (0.063)
Entering delayed exchange	-0.015 (0.016)	0.652*** (0.223)	0.138 (0.092)	0.100** (0.040)	-0.097 (0.316)	-0.076 (0.305)	-0.084 (0.058)
Entering generalized exchange	-0.041 (0.028)	0.340 (0.270)	0.284** (0.118)	0.063 (0.046)	-0.013 (0.373)	0.446 (0.384)	0.150** (0.064)
Exiting restricted exchange	0.008 (0.022)	0.168 (0.135)	-0.045 (0.048)	-0.036 (0.041)	0.061 (0.155)	0.008 (0.153)	-0.068* (0.035)
Exiting delayed exchange	0.003 (0.018)	0.800*** (0.222)	0.395*** (0.102)	0.165*** (0.046)	-0.539 (0.334)	0.072 (0.179)	0.076 (0.050)
Exiting generalized exchange	0.034** (0.016)	-0.594*** (0.180)	-0.046 (0.085)	-0.026 (0.039)	-0.388 (0.249)	-0.053 (0.208)	-0.042 (0.054)
$\Delta_{[t-4,t-2]}$ LDV instrumented with LDV $_{t-4}$	0.347*** (0.028)	0.270*** (0.009)	0.347*** (0.020)	0.345*** (0.023)	0.158*** (0.008)	0.083*** (0.008)	0.207*** (0.012)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	118,648	118,625	118,128	118,646	102,414	102,351	118,604

Note: We limit changes in cycling to those occurring between  $t-2$  and  $t-1$ . All models are 2-year FD 2SLS panel regression. The last line includes the lag of the 2-year first-difference dependent variable instrumented by its past level. Hence, for fixed salary, the FD of the dependent variable is  $\Delta_{[t-2,t]}\log$  wage, the lag of the FD of the LDV is  $\Delta_{[t-4,t-2]}\log$  wage and its instrument is the level  $\log$  wage $_{t-4}$ . Robust clustered standard errors at the *firm*  $\times$  *executive* level. Control variables are the same as in Table 4. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

Table A5 Period interaction. Checking Table 6 for serial correlations with the Anderson-Hsiao instrumental variable technique

	Fixed salary $\Delta \ln(w+1)$	Bonus $\Delta \ln(w+1)$	Bonus/ Fix. $\Delta(w)$	Total cash $\Delta \ln(w+1)$	Stock options $\Delta \ln(w+1)$	Equity pay $\Delta \ln(w+1)$	Total pay $\Delta \ln(w+1)$
$\Delta$ Restricted exchange	-0.002 (0.019)	0.294*** (0.107)	0.104** (0.047)	0.089** (0.038)	0.279* (0.152)	0.325** (0.153)	0.107*** (0.039)
$\Delta$ Delayed exchange	-0.013 (0.013)	0.238 (0.163)	0.183*** (0.055)	0.084*** (0.027)	0.162 (0.382)	-0.012 (0.288)	-0.033 (0.059)
$\Delta$ Generalized exchange	-0.054*** (0.019)	0.460** (0.216)	0.064 (0.089)	-0.002 (0.039)	0.612* (0.330)	0.373 (0.296)	0.144** (0.064)
(Year > 2004) $\times$ $\Delta$ Restricted exchange	0.027 (0.030)	-1.066*** (0.240)	-0.219*** (0.076)	-0.156*** (0.056)	-0.909*** (0.249)	-0.722*** (0.246)	-0.224*** (0.060)
(Year > 2004) $\times$ $\Delta$ Delayed restricted exchange	0.009 (0.024)	-0.695** (0.332)	-0.671*** (0.139)	-0.254*** (0.064)	0.147 (0.462)	-0.121 (0.346)	-0.097 (0.076)
(Year > 2004) $\times$ $\Delta$ Generalized exchange	0.048 (0.029)	0.083 (0.286)	0.151 (0.139)	0.096* (0.058)	-0.802** (0.402)	-0.426 (0.365)	-0.177** (0.076)
$\Delta_{[t-4,t-2]}$ LDV instrumented with LDV $_{t-4}$	0.347*** (0.028)	0.270*** (0.009)	0.347*** (0.020)	0.345*** (0.023)	0.158*** (0.008)	0.083*** (0.008)	0.207*** (0.012)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	118,648	118,625	118,128	118,646	102,414	102,351	118,604

Note: We limit changes in cycling to those occurring between  $t-2$  and  $t-1$ . Therefore, the first changes in cycling during the second period occur between 2003 and 2004. All models are 2-year FD 2SLS panel regression. The last line includes the lag of the 2-year first-difference dependent variable instrumented by its past level. Hence, for fixed salary, the FD of the dependent variable is  $\Delta_{[t-2,t]}$  log wage, the lag of the FD of the LDV is  $\Delta_{[t-4,t-2]}$  log wage and its instrument is the level log wage $_{t-4}$ . Robust clustered standard errors at the firm  $\times$  executive level. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

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