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Two Essays in Corporate Finance: The Effects of Ownership and Governance on a Firm's Innovation and Capital Structure Decisions

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This dissertation is dedicated to those who uncondionally and continuously support, help and love me in my life.

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Abstract

In the first chapter, we assess the effect of changes of government ownership on corporate innovation activities. Across 58 non-US countries, treatment firms' innovation, both in quantity and quality, decrease after a governmental acquisition by using a difference-in-difference regressions and propensity score matching. We show that there is conflict of interest between major shareholders and minor shareholders. The corporate innovation efficiency also decline after the government acquisition. We find that this negative relationship is more severe for the group with higher government ownership of banks, better creditor rights and worse stock market development.

For second chapter, if the optimal capital structure exists, an overleveraged firm is expected to move towards the target structure by taking actions that would lower the leverage. Many previous studies, however, show that leverage-decreasing transactions, including offering stocks in exchange of bonds, are meted out with negative market reactions, suggesting deficiencies of the trade-off theory in explaining this phenomenon. In this paper we hypothesize and show that the negative market reactions might be attributed to incorrect rebalancing by poorly-governed firms in the under-leverage domain, who instead of increasing leverage are purposely engaged in leverage-reducing activities.

Keywords: Government Ownership; Government Acquisition; Corporate Innovation; Innovation Efficiency; Capital Structure; Exchange Offer; Equity-for-Debt; Speed of Adjustment; Peking Order Theory; Trade-off Theory; Corporate Governance;

Chapter 1

Government Ownership and Corporate Innovation: International Evidence

1. Introduction

The effects of various ownership structures on firm performance and manager behaviors have been widely studies in finance and economics literatures. Most importantly, the debate over government control or government ownership, the process of government to exist the state-owned enterprises (SOEs), has been ongoing by many economic researchers. On one aspect of argument, Megginson and Netter (2001), Djankov and Murrell (2002) and Estrin et al (2009) Borisova et al (2013) stress the benefit of privatization and document that companies usually experience substantial improvement over different aspects of corporate mechanisms such as better profitability, better efficiency, or lower cost of funding. Those evidences suggest that states should reduce their holding in companies rather than increasing them. On the other hand, another string of literatures, from Borisova and Megginson (2011), Faccio, Masulis and McConnell (2006) and Brown and Dinc (2011), argue the influences of government purchase target on socially-desirable objectives such as maintaining employment or achieving political goals. From existing literature, government control or government ownership significantly alter firm risk taking behavior since it will change the corporate mechanism. In the meanwhile, corporate innovation activities are highly related to firm risk tolerance since innovation project are usually risky. Changing of government ownership would alter concern of risk-taking behaviors which ultimately would change the corporate innovation activity. Our paper investigate this research question along with firm characteristics and a sample of public and private companies from 67 countries during 1990-2007 since the research of effect of

government ownership on corporate innovations is still sparse (Fang et al 2015, Xiao and Zhao 2012, Tan et al 2015).

Does government's acquisition or withdrawal from a firm encourage or impede corporate innovation? Companies with public shareholders generally target wealth maximization, in terms of maximizing shareholders wealth. However, government control usually have different concern rather than maximizing shareholders value. Governments can purchase equity to maintain socially-desirable targets, such as maintaining certain levels of employment, or to subsidize industries considered vital to the nation's political goals (Borisova and Megginson, 2013). Accordingly, investors come to expect that governments will prevent risky government-owned firms from bankruptcy, thus providing a guarantee of debt repayment (Faccio, Masulis, and McConnell, 2006; Brown and Dinç, 2011; Borisova and Megginson, 2011). Lower risk of default might change companies risk taking behavior, thus further encourage companies to invest more in the innovation which require high risk tolerance.

On the other hand, there are also negative influences from government control. For example, Stiglitz, Jaramillo-Vallejo, and Park (1993) warn that extra protection for companies from government can increase agency problem such as managerial moral hazard, and as a consequence of better protection, government owned companies exhibit poor performance low efficiency and government and taxpayers share the costs of insolvency. These inefficacy will possibly increase the cost of borrowing (Lin, Ma, Malatesta, and Xuan, 2011) and is further enhanced by low CEO entrenchment, as government-owned firms are less likely to go bankrupt. The moral hazard problem will potential decrease the employee's productivity since they are more likely to shirk. On the other hand, companies are not allowed to fire those

employee even at such low level of productivity Furthermore, because of socially-desirable target such as maintaining employment, employee are better protected after the government acquisition. Managers are more likely to shirk and more difficult to tie the incentives with shareholders. (Bradley, Kim and Tian, 2015). Bad monitoring from government might also increase underinvestment problem since managers would enjoy more cash on hands (Jansen, 1986), which might lower the investment of innovation or lead to many bad investments or projects.

Our empirical results show that corporate innovation activities significantly decrease in treatment group after the government acquisition no matter what innovation proxies are used. The magnitude of this decline is statistically and economically nontrivial. Our further investigation show that there is existing a conflict of interest between major shareholders and minor shareholders once the government ownership is over 50 percent of total stake of a firm. The conflict of interest between major and minor shareholders leads to lower efficiency of innovation, therefore contribute to the decline in innovation output.

Our paper at least contribute two strands of current literatures about government ownership and corporate innovations. First of all, our paper provides the empirical evidence that government ownership is another factor that matters for corporate innovation in the existing literatures. We show that government ownership would change the risk-taking behavior of companies which therefore would further affect the motivation of companies to engage in risky innovative projects. The government purchase not only would affect the innovation output, but also would impede the innovation efficiency and inventor's productivity. Our paper is complementary to existing literatures that are looking for

characteristics that alter the companies' risk tolerance. For example, institutional ownership (Aghion et al 2013), private equity (Lerner et al 2011), stock liquidity (Fang et al 2014), financial analyst coverage (He and Tian 2013), labor unions (Bradley et al 2015), employment protection (Francis et al 2015), CEO characteristics (Hirshleifer et al 2012), firm boundaries (Seru 2014).

Secondly, our paper contributes to the controversial about benefit and cost of privatization or nationalization. Subramanian and Megginson (2011) shows that privatization is negatively associated with strictness of labor protections. Megginson, Nash and Van Randenborgh (1994) find evidence that after privatization, companies reduce their debt ratios and increase their capital spending, consistent with enhanced market discipline. Our paper is consistent with those finding that government ownership would negatively affect firm performance in aspect of discouraging innovations (Tan, Tian, Zhang and Zhao, 2015). Social desirable targets are achieving in expense of hurting motivations of innovative activities.

The rest of paper proceed as follows. Section 2 provides the literature review and hypothesis development. Section 3 provides the data description. Section 4 provides the methodology and empirical evidences. Section 5 discuss the potential channel of how government control would affect innovation activity. Section 6 concludes.

2. Related Literature and Hypothesis Development

The literature about innovation has been rapidly growing for the past decade. The corporate innovation research could be started from Aghion and Tirole (1994), who analyzes the organization of the R&D activity in an incomplete contract framework. It provides

theoretical foundations of corporate innovation. For example, how the property rights affect corporate innovation activities; the financing process for innovation and endogeneity of organization of R&D. Furthermore, Aghion et al (2005) investigates the relationship between product market competition and innovation. They find strong evidence of an inverted-U relationship using panel data and develop a model where competition would impede innovation.

Mostly importantly, Manso (2011) shows that to motivate innovation, companies should have optimal contract of employees that are emphasized long-term success and tolerance of short-term failure. Following Manso's spirit, Tian and Wang (2014)'s story is based on a sample of venture capital (VC)-backed IPO firms, they examine whether tolerance for failure spurs corporate innovation. They find that IPO firms backed by more failure-tolerant VC investors are significantly promoting more innovative. On the other hand, Ferreira et al (2012) model the impact of public and private ownership structures on firm's incentives to invest in innovative projects. They show that it is optimal to go public when exploiting existing ideas and optimal to go private when exploring new ideas. They show public ownership would create incentives for conventional projects rather than innovative projects.

Other empirical evidences also show that various characteristics would affect the incentives of companies to invest in innovative projects. For example, institutional ownership (Aghion et al 2013), private equity (Lerner et al 2011), stock liquidity (Fang et al 2014), financial analyst coverage (He and Tian 2013), labor unions (Bradley et al 2014), employment protection (Francis et al 2015), CEO characteristics (Hirshleifer et al 2012), firm boundaries (Seru 2014), credit supply (Amore et al 2013), financial development (Hsu et al 2014),

takeover provisions (Atanassov 2013 and Xuan and Chemmanir 2013) and bank competitions (Chava et al 2013 and Cornaggia et al 2015).

The literature on government ownership could be split into two arguments. One string of literatures, from Borisova and Megginson (2011), Faccio, Masulis and McConnell (2006) and Brown and Dinc (2011), argue the influences of government purchase target on socially-desirable objectives such as maintaining employment or achieving political goals. Thus government ownership would bring some benefit for the companies such as lower cost of borrowing or lower risk of bankruptcy. On the other hand, Megginson and Netter (2001), Djankov and Murrell (2002) and Estrin et al (2009) Borisova et al (2013) stress the benefit of privatization and document that companies usually experience substantial improvement over different aspects of corporate mechanisms such as better profitability, better efficiency, or lower cost of funding. Subramanian and Megginson (2011) shows that privatization is negatively associated with strictness of labor protections, which might be essential for inventor's productivity (Bradley et al, 2015). Megginson (2010) shows that governments typically provide lower levels of monitoring than other private shareholders, and the implicit guarantees they offer remove monitoring incentives for other stakeholders.

Governments, as acquirers, differ from private acquisitions in multiple ways. First of all, governments pursue political targets, such as low unemployment rate, which might increase the efficiency inside the companies. Second, government ownership is often motivated by the desire to maintain competitive advantages of strategic industries; accordingly, governments are not keen on allowing those companies to go bankrupt (Borisova et al (2013)). Finally, politicians and political related managers do not wish to be associated with a bad investment

and would thus hurt their political career. Unwillingness of allowing companies to default provide extreme protection for managers and employees. Moreover, government employees could shirk or they simply do not have necessary skills or knowledge to be employed in the companies because of political appointments and other inefficiencies in the government employment sector. Borisova, Brockman, Salas, and Zagorchev (2012) find a lower quality of corporate governance in publicly traded firms partially owned by the government when compared to firms free from state ownership. Thus we would expect the government ownership would discourage innovation outputs.

H_o: Government ownership would impede corporate innovations.

However, Borisova and Megginson (2011) show that state influence on debt pricing can be non-monotonic, and several factors resulting from state presence could decrease the firms' cost of debt financing. Moreover, Gropp, Hakenes, and Schnabel (2011) find the state-owned banks will decrease the cost of debt of the government-owned firm, so managers would increase levels of risk taking projects, Higher risk tolerance from government would also encourage the manager to switch from conventional project to risky projects, since successful of projects would lead to political reputational awareness and cost of failure is very low. Therefore our alternative hypothesis would be the government ownership would encourage innovation outputs.

H_A: Government ownership would encourage corporate innovations.

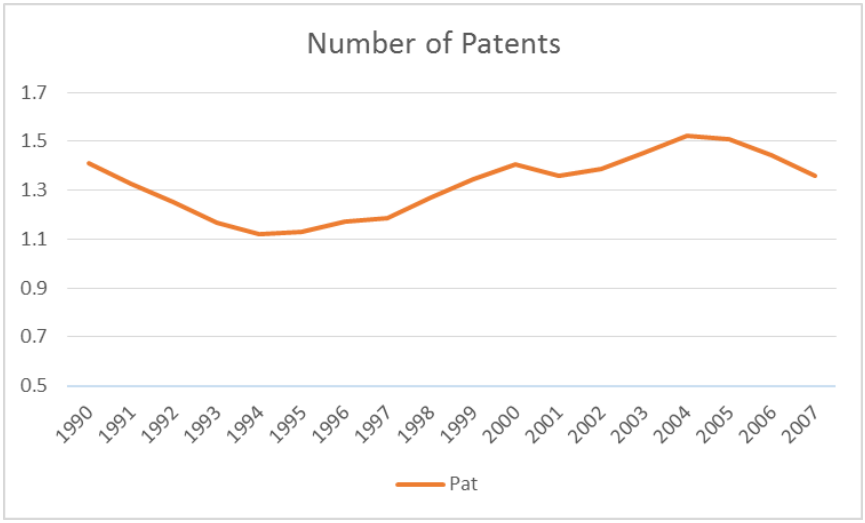
3. Data Description and Summary Statistics

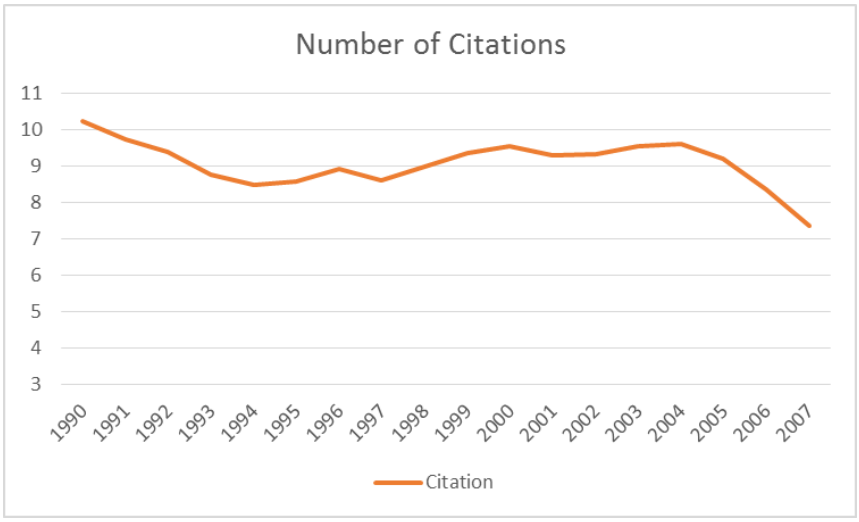
Our international patent information are collected from European Patent and Trademark office (https://www.epo.org/index.html). This database provides the information of filing date, assignee's information, backward and forward citations, inventors' name, inventors' nationalities and inventors' affiliated companies. We construct the complete innovation dataset by merging this database with Global COMPUSTAT. Since there are very few information of patent application before 1986, the complete innovation dataset covers more than 150 countries between 1986 and 2010 along with various firms' financial statement information such as size, tangibility, profitability and investment.

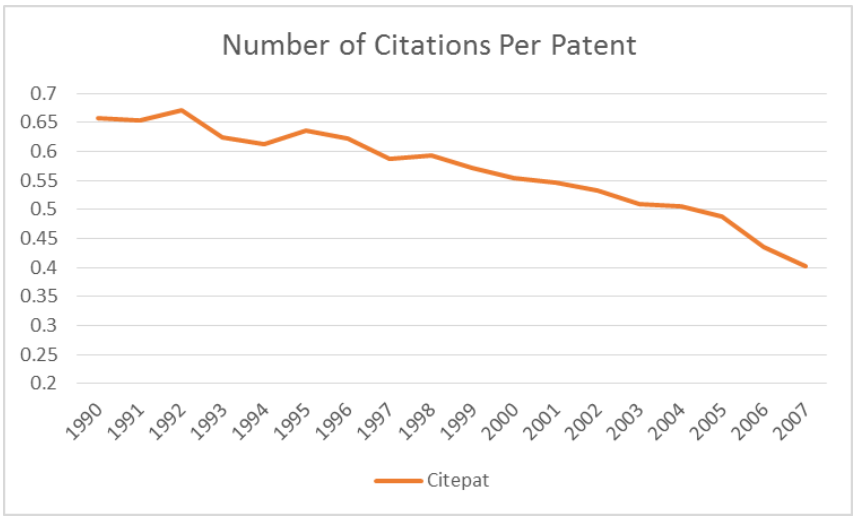
The government acquisition information are from SDC Platinum. The government acquisition database covers the information regarding the effective/withdrawal date of acquisition, acquirers' and targets' nationalities, acquiring percentage, percentage of government ownership after acquisition etc.

Figure 1

This figures plot the average number of patents, citations and citations per patent from 1990 to 2007.







We merge the government acquisition information with our complete innovation dataset based on the 6-digit CUSIP. We delete all transactions before 1990 since there were very few government acquisitions, and all transactions after 2007 to alleviate the truncation bias in the innovation dataset (Hall, Jaffe and Trajtenberg, 2001). In figure 1, we find that there is minor truncation bias for our innovation dataset. We simply retain the first transaction if some companies experienced multiple government acquisition in our sample period. Overall, we have 5572 firm-year observations which include 663 unique government acquisitions from 58 countries in total.

We construct a number of important firm characteristics based on existing literatures. *LnAsset* represents the log-transformed booking value of asset in dollars for each company in our sample period. ROA represents the profitability of companies, calculated by net income divided by asset. *R&D expenditure* is the firm's R&D expenditure divided by assets. *Tangibility* is a firm's net property, plant and equipment divided by assets. *Investment* is a firm's capital expenditure divided by assets. *Leverage* is a firm's total debts divided by assets. *HHI index* is a Herfindahl-Hirschman index based on sales in the first two digits of the SIC code. *LnAge* is log-transformed number of years existing in our sample for a firm in a given calendar year. We also construct the following variables as proxies for innovation activities. We use $LnPat_{t,}$ log-transformed number of patents applied by each company in our sample period as a representative of quantities of innovation. Many researchers believed the patent application year is better at capturing the real effect of corporate innovation (Chava et al., $SLnPat_{t+N}$ is the number of patents of divided by median number of patents applied within the same industry in a country *j* at year $t+N$ ($N=0, 1, 2, 3$). $SLnCite_{t+N}$ is number of citations divided by mean number of citations received within the same industry in country *j* at year $t+N$

(N=0, 1, 2, 3). $SLnCitePat_{t+N}$ is number of citations per patent divided by mean number of citations per patent received within the same industry in country *j* at year *t+N* (N=0, 1, 2, 3). We do not exactly follow the procedure of Hall et al (2001) by simply scaling patents or citations by median number of patents or citations within same technological class since our research is corporate innovation in international level, and we believe there are significant difference in inventing abilities of companies across countries. A firm applied 5 patents in Bangladesh might be a very innovative company compared with a firm in US with the same patent application. Detailed definition of all variables are given in the appendix. Table 1 provides the summary statistics of all variables in our sample.

In table 1, the mean number of patents applied by each firm in each year is about 1.97, and on average each company will receive 11.63 citations. Each patent will be cited 0.46 times on average. The innovation variables are highly skewed, which is consistent with previous literature. We do not delete zero patent observation to avoid selection bias. Before the government acquisition, the firms had a government ownership of 9.21 percent.

Table 1
Descriptive Statistics

This table presents descriptive statistics of 5,572 firm-year observations across 58 countries in the world. Panel A presents all variables used in our sample. Panel B presents the innovation output and government acquisition by country. *Patent (Pat)* is a number of patents applied by a firm in a given calendar year. *Citation (Cite)* is a number of citations received for a firm's patents in a given calendar year. *Cite per Patent (Citepat)* is a number of average citations per patent received for a firm's patents in a given calendar year. *Ownership Before (OB)* is the percentage of government ownership before a government acquisition for a firm in a given calendar year. *Acquiring Percentage (AP)* is the percentage of ownership acquired by government for a firm in a given calendar year. *Ownership After (OA)* is the percentage of government ownership after a government acquisition for a firm in a given calendar year. *Firm size* is a firm's book value of assets measured in U.S. dollars. *ROA* represents profitability of the firm, calculate as net income divided by book value of assets. *R&D expenditure* is firm's R&D expenditure divided by assets. *Tangibility* is a firm's net property, plant and equipment divided by assets. *Investment* is a firm's capital expenditure divided by assets. *Leverage* is a firm's total debts divided by assets. *HHI index* is a Herfindahl-Hirschman index based on sales in the first two digits of the SIC code. *Firm age* is a number of years existed in our sample for a firm in a given calendar year.

Panel A. Summary Statistics for All Variables

Variable	*N*	*Min*	*Max*	*Median*	*Mean*	*Std Dev*
Patents (Pat)	5572	0.000	567.000	0.000	1.971	21.666
Citations (Cite)	5572	0.000	2931.000	0.000	11.627	116.002
Cite Per Patent (Citepat)	5572	0.000	25.000	0.000	0.455	1.895
Ownership Before (OB)	5572	0.000	99.070	0.000	9.209	20.814
Acquiring Percentage (AP)	5572	0.000	100.000	15.000	26.766	27.446
Ownership After (OA)	5572	0.100	100.000	22.400	35.972	32.413
Firm size ($ Millions)	5572	0.725	70299.160	274.641	2484.590	7977.630
ROA	5572	-0.865	0.279	0.034	0.010	0.153
R&D Expenditure	5572	0.000	0.131	0.000	0.006	0.022
Tangibility	5572	0.001	0.911	0.364	0.387	0.240
Investment	5572	0.000	0.369	0.045	0.065	0.068
Leverage	5572	0.000	0.903	0.231	0.250	0.195
HHI index	5572	0.018	1.000	0.241	0.326	0.280
Firm Age	5572	0.000	20.000	6.000	6.623	4.442

Panel B. Innovation Outputs and Government Acquisitions across Countries

Country	*Pat*	*Cite*	*Citepat*	*OB*	*AP*	*OA*	*Country*	*Pat*	*Cite*	*Citepat*	*OB*	*AP*	*OA*
ARG	0.000	0.000	0.000	11.058	37.717	48.775	*ITA*	0.064	0.382	0.239	12.429	32.344	44.770
AUS	0.026	0.259	0.152	1.732	24.866	26.593	*JPN*	6.973	58.664	2.107	8.318	18.304	26.618
AUT	0.000	0.000	0.000	25.720	12.415	38.119	*KOR*	2.095	10.270	1.694	2.390	23.679	26.065
BEL	0.214	1.071	0.750	0.000	48.761	48.754	*LKA*	0.000	0.000	0.000	0.000	51.000	51.000
BGD	0.000	0.000	0.000	55.500	6.500	62.000	*LTU*	0.000	0.000	0.000	4.091	43.375	47.455
BHR	0.000	0.000	0.000	75.030	6.670	81.700	*MAR*	0.000	0.000	0.000	0.000	11.700	11.700
BMU	0.004	0.036	0.036	6.812	17.323	24.128	*MEX*	0.000	0.000	0.000	0.000	15.000	15.000
BRA	0.076	0.386	0.133	4.708	33.885	38.588	*MLT*	0.000	0.000	0.000	0.000	48.882	48.882
CHE	0.419	2.453	0.716	8.723	29.390	38.113	*MYS*	0.000	0.000	0.000	15.561	23.218	38.777
CHL	0.000	0.000	0.000	12.796	55.859	68.655	*NOR*	0.014	0.058	0.058	15.400	33.741	49.139
CHN	0.008	0.050	0.037	8.365	25.957	34.316	*NZL*	0.000	0.000	0.000	25.698	11.287	36.980
COL	0.000	0.000	0.000	0.000	7.792	7.792	*OMN*	0.000	0.000	0.000	0.000	49.000	49.000
CYM	0.000	0.000	0.000	23.970	16.875	40.842	*PAK*	0.000	0.000	0.000	0.008	15.256	15.264
CZE	0.000	0.000	0.000	0.241	28.493	28.726	*PER*	0.000	0.000	0.000	0.000	60.000	60.000
DEU	7.444	55.715	2.722	16.407	43.036	59.442	*PHL*	0.000	0.000	0.000	0.007	18.902	18.902
DNK	0.048	0.095	0.095	47.010	21.562	68.571	*POL*	0.000	0.000	0.000	18.091	17.607	35.698
EGY	0.000	0.000	0.000	0.000	7.600	7.600	*PRT*	0.013	0.092	0.092	2.055	32.500	34.555
ESP	0.000	0.000	0.000	12.802	27.479	40.281	*RUS*	0.033	0.319	0.106	21.543	20.166	41.707
EST	0.000	0.000	0.000	0.000	50.400	50.400	*SEN*	0.000	0.000	0.000	0.000	33.300	33.300
FIN	0.817	5.585	1.913	21.679	30.048	51.727	*SGP*	0.008	0.106	0.106	6.722	26.626	33.346
FRA	20.899	112.345	1.472	6.843	26.953	33.794	*SVK*	0.000	0.000	0.000	0.030	8.370	8.400
GBR	0.838	5.771	1.262	3.991	48.140	52.128	*SVN*	0.000	0.000	0.000	8.884	9.469	18.353
GRC	0.000	0.000	0.000	9.482	40.895	50.378	*SWE*	0.887	4.911	0.964	19.510	46.039	65.548
HKG	0.000	0.000	0.000	23.900	14.302	38.197	*THA*	0.000	0.000	0.000	16.576	22.303	38.878
HUN	0.000	0.000	0.000	24.789	35.576	60.365	*TUN*	0.000	0.000	0.000	0.000	35.000	35.000
IDN	0.000	0.000	0.000	0.221	26.917	27.133	*TUR*	0.000	0.000	0.000	0.000	15.000	15.000
IND	0.681	5.700	0.982	1.580	12.197	13.772	*TWN*	0.308	1.385	0.974	0.000	10.000	10.000
ISL	2.000	12.800	5.000	0.000	5.800	5.800	*VNM*	0.000	0.000	0.000	0.000	10.000	10.000
ISR	0.000	0.000	0.000	11.000	18.856	29.856	*ZAF*	0.000	0.000	0.000	5.035	20.825	25.859

After the government acquisition, the government ownership in a firm will increase to 35.97 percent with a mean acquiring percentage of 26.77 of total stake of a company. A firm's asset has a mean booking value of 2484 (in millions). Tangible assets, R&D expenditure and capital expenditures take up to 38.7, 0.006 and 6.5 percentage of total assets respectively. A firm has a mean ROA of 1 percent. A Herfindahl-Hirschman index of 32.6 percent shows that a firm will face a moderate competition within the industry. For further investigating how government acquisition would affect the corporate innovation across countries, we break down our sample into 58 countries. In panel B, most innovative countries including Germany, France and Japan, for which mean number of patents are all greater than 5, along with a mean number of citations greater than 50. However, many firm-year observations in our sample have zero patents and citations information. Government ownership is higher in common law countries such as Germany, France, Denmark and Finland. Countries from Middle East and Latin America also have relatively higher government control.

In table 2, we investigate the distribution of our sample observations based on different characteristics. From panel A, the number of observations is almost monotonically increasing over time. In panel B, based on the nationalities of acquirers and targets, China is the most important country in our sample. About 20 percent of observations are either targets or acquirer of Chinese firms. Companies from Australia, France, Hong Kong and Malaysia are the other top 4 acquiring targets.

4. Methodology and Empirical Results

Table 2

Distribution of the Observations Based on Different Characteristics

This table presents the distribution and proportion of observations in our sample based on different year, acquirer and target and different industries. Panel A presents the number of observations for each year in our sample. Panel B presents the proportion of observations based on nationalities of acquirer and target in our sample. Panel C presents the proportion of observations from different industries in our sample.

Panel A. Proportion of Observations for Each Year

YEAR	*N*	*Proportion*
1990	3	0.0005
1991	7	0.0013
1992	14	0.0025
1993	26	0.0047
1994	110	0.0197
1995	130	0.0233
1996	199	0.0357
1997	291	0.0522
1998	396	0.0711
1999	439	0.0788
2000	450	0.0808
2001	475	0.0852
2002	501	0.0899
2003	515	0.0924
2004	518	0.0930
2005	519	0.0931
2006	502	0.0901
2007	477	0.0856

Panel B. Proportion of Observations Based on Nationalities of Acquirer and Target

Acquirer			*Target*		
Country	*N*	*Proportion*	*Country*	*N*	*Proportion*
China	1191	0.2137	*China*	1107	0.1987
France	455	0.0817	*Australia*	407	0.0730
Singapore	408	0.0732	*France*	397	0.0712
Malaysia	316	0.0567	*Hong Kong*	395	0.0709
Hong Kong	244	0.0438	*Malaysia*	371	0.0666
Australia	228	0.0409	*India*	307	0.0551
Italy	181	0.0325	*UK*	254	0.0456
UK	160	0.0287	*Singapore*	225	0.0404
Brazil	159	0.0285	*Brazil*	210	0.0377
Other	2230	0.4002	*Other*	1899	0.3408

Panel C. Proportion of Observations in Different Industries

Target SIC	*Description of Target SIC*	*N*	*Proportion*
0	Agriculture, forestry and fishing	49	0.0088
1	Mining, construction	437	0.0784
2	Manufacturing (food, fabric, wood, chemical)	1309	0.2349
3	Manufacturing (rubber, plastic, glass, metal; boat, rail, air equipment)	1397	0.2507
4	Transportation, communications, electric, gas and sanitary service	1399	0.2511
5	Trade (Wholesale, retail)	385	0.0691
6	Finance, insurance and real estate	43	0.0077
7	Services (hotel, beauty, funeral, computer, car rental & repair, movie)	412	0.0739
8	Services (doctor's offices, legal, schools, religious, accounting)	63	0.0113
9	Public and non-classified establishments	78	0.0140

To investigate how government acquisition would affect the corporate innovation, we construct the following model which could be expressed as:

$$Inno_{t+N} = \alpha + Year_t + Country_j + Indus_k + \beta_1 OA + \theta_n X + \epsilon_{t+N}$$

$Inno_{t+N}$ are the innovation proxies specified in the previous section, including $LnPat_t$, $LnCite_t$ or $LnCitePat_t$. We use the leading innovation output at year $t+N$ ($N=1, 2, 3$) to capture the potential lagging effect of government acquisition on innovation (Hall et al, 2001). $Year_t$, $Country_j$, $Indus_k$ represent year, country and industry fixed effect. *OA* represents the percentage of government ownership after acquisition. *X* represents firm characteristic variables that are defined in the previous section. In this model, *OA* is the main variable which indicates the relationship between government ownership and corporate innovation activities. Standard errors are corrected for heteroskedasticity. Table 3 provides the detailed results of baseline regressions.

In table 3, we find that corporate innovation is negatively related to the government ownership. Coefficients for *OA* are all negatively significant for all innovation proxies, which indicates a strong negative effect of government control on innovation. Specially, the number of patents, citations and citations per patent will decrease 15.23 percent, 24.26 percent and 10.27 percent one year after the government acquisition respectively. The effect of government control is statistically and economically nontrivial. Additionally, the results of baseline regressions also real that larger firm with less tangible assets or leverage and more R&D expenditures will have higher innovation output, which are consistent with previous literatures.

Table 3

Baseline Regressions: Ownership after Acquisitions and Innovation

This table presents OLS results regressing percentage of government ownership after acquisition and other firm characteristics on corporate innovation measures with year, country and industry fixed effects. $LnPat_{t+N}$ is a log-transformed number of patents applied by a firm at year $t+N$ (N=1, 2, and 3). $LnCite_{t+N}$ is a log-transformed number of citations received by a firm at year $t+N$ (N=1, 2, and 3). $LnCitepat_{t+N}$ is a log-transformed number of citations per patent received by a firm at year $t+N$ (N=1, 2, and 3). *OA* is the percentage of government ownership after acquisition. *LnAssets* is the log-transformed of firm size. *ROA* represents profitability of the firm, calculate as net income divided by book value of assets. *R&D* is firm's R&D expenditure divided by assets. *Tangibility* is a firm's net property, plant and equipment by assets. *Investment* is a firm's capital expenditure divided by assets. *Leverage* is a firm's total debts divided by assets. *HHI index* is a Herfindahl-Hirschman index based on sales in the first two digits of the SIC code. *LnAge* is the log-transformed of firm age. All coefficients for year, country and industry dummies are omitted for brevity. Numbers in parentheses are t-statistics computed using standard errors that are heteroskedasticity-adjusted. ***, **, and * indicate significance at the 1% 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		$LnPat_{t+N}$			$LnCite_{t+N}$			$LnCitepat_{t+N}$	
	N=1	N=2	N=3	N=1	N=2	N=3	N=1	N=2	N=3
OA	-0.1523***	-0.1619***	-0.1638***	-0.2426***	-0.2495***	-0.2501***	-0.1027***	-0.1014***	-0.1006***
	(-6.63)	(-6.97)	(-7.15)	(-6.30)	(-6.51)	(-6.63)	(-4.75)	(-4.83)	(-4.86)
LnAssets	0.1004***	0.1030***	0.1031***	0.1398***	0.1427***	0.1394***	0.0449***	0.0457***	0.0427***
	(10.19)	(10.11)	(9.98)	(10.32)	(10.29)	(9.97)	(8.29)	(8.51)	(7.99)
Tangibility	-0.1747***	-0.1853***	-0.1826***	-0.2732***	-0.2893***	-0.2663***	-0.1100***	-0.1196***	-0.0956***
	(-5.82)	(-6.13)	(-6.02)	(-5.54)	(-5.96)	(-5.56)	(-4.07)	(-4.59)	(-3.80)
ROA	-0.1079**	-0.1252***	-0.1254***	-0.1259*	-0.1747**	-0.1520**	-0.0198	-0.0551	-0.0244
	(-2.38)	(-2.74)	(-2.76)	(-1.65)	(-2.29)	(-1.99)	(-0.44)	(-1.29)	(-0.54)
Debt	-0.1455***	-0.1368***	-0.1306***	-0.1984***	-0.1880***	-0.1723***	-0.0582*	-0.0602*	-0.0439
	(-3.55)	(-3.30)	(-3.15)	(-3.06)	(-2.89)	(-2.66)	(-1.66)	(-1.72)	(-1.30)
Invest	0.1183	0.1308*	0.1260*	0.1651	0.1868	0.1947	0.0510	0.0769	0.0812
	(1.61)	(1.79)	(1.69)	(1.28)	(1.52)	(1.58)	(0.66)	(1.12)	(1.18)
R&D	4.8145***	4.3910***	4.1145***	8.4879***	7.4408***	6.9547***	4.3044***	3.4899***	3.3616***
	(7.74)	(6.91)	(6.63)	(8.25)	(7.21)	(6.94)	(7.45)	(6.31)	(6.00)
HHI	0.0824**	0.0847**	0.0626*	0.1775***	0.1728***	0.1371**	0.1321***	0.1276***	0.1127***
	(2.39)	(2.42)	(1.85)	(2.96)	(2.91)	(2.39)	(3.54)	(3.50)	(3.17)
LnAge	0.0007	0.0006	-0.0010	0.0170	0.0191	0.0163	0.0221*	0.0255**	0.0233**
	(0.06)	(0.05)	(-0.07)	(0.79)	(0.89)	(0.78)	(1.82)	(2.23)	(2.11)
Constant	-1.1106***	-1.1275***	-0.8788***	-1.6983***	-1.6954***	-0.7539	-0.7210***	-0.6994***	0.2244
	(-6.70)	(-6.08)	(-2.87)	(-6.10)	(-5.50)	(-0.92)	(-4.20)	(-3.91)	(0.32)
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	5,572	5,572	5,572	5,572	5,572	5,572	5,572	5,572	5,572
Adj. R^2	0.284	0.283	0.277	0.301	0.296	0.284	0.269	0.262	0.246

The baseline model reveals a naive negative relationship between government control and innovation. However, this relationship might subject to many endogeneity issues. For example, the corporate innovation might be already lower for the companies with higher government ownership, and it would be reasonable to suspect there are some other factors impede the corporate innovation rather than government acquisition. To further addressing those concerns, we employ a difference-in-difference regressions and investigate how the corporate innovation varies after government acquisition between treatment group and control group. We define the treatment group as the companies that are experiencing a government acquisition in our sample, and the control group as the companies that are never owned by government in our sample period. To correct for systematical difference between treatment group and control group, we use a propensity score matching method, which match each observation from treatment group with an observation from control group based on several firm characteristics. Following D'Agostino (1998) and Smith and Todd (2005), we use the following nearest neighbor matching which could be expressed as:

$$C(P_i) = \min_j \|P_i - P_j\|$$

Where P_i and P_j are the propensity scores calculated from treatment group and control group based on different firm characteristics respectively. There will be a 1 on 1 matching between treatment and control group if the distance of propensity score is minimized. However, some observations from treatment might not have the matching observations if we could not find them. After the matching, we use the following model to conduct difference-in-difference regressions:

$$Inno_{t+N} = \alpha + Year_t + Country_j + Firm_i + \beta_1 Post * Acquire + \theta_n X + \epsilon_{t+N}$$

Again $Inno_{t+N}$ are the innovation proxies specified in the previous section, including $LnPat_t$, $LnCite_t$ or $LnCitePat_t$ at year *t, t+1* and *t+2*. We still include year, country and firm fixed effects in our regressions. *Post*Acquire* is an indicator variable that is equal to one after the government acquisition for treatment group at year *m* ($t \geq m$) and zero otherwise. Comparing the difference of innovation activities between treatment and control group reveals the real effect of government control and further controls the endogeneity. Standard errors are clustered at firm level since Bertrand and Mullainathan (2003) believe firm clustering standard error is better at correcting serial correlation across firms. *X* represents firm characteristic variables that are specified in the previous section. Table 4 provides the results of difference-in-difference regressions.

Panel A provides the results of propensity score matching. There are 10,467 observations in total after the matching. The Probit regression of different firm characteristics on the dummy variable which separates the treatment and control group indicates that there are no systematically difference for the observations between treatment and control except that the tangibility is significant at 10 percent level. Panel B provides the results of difference-in-difference regressions. The coefficients for *Post*Acquire* are all negatively significant at 1 percent level except of *LnCitePat* at year *t+1* and *t+2*. Especially the quantity of innovation will decrease 12.17 percent and quality of innovation will also decrease 17.47 percent after the government acquisition. This negative relationship shows that compared with control group, the treatment group exhibits a significant decline in corporate innovation after the government acquisition.

Table 4

Difference-in-Difference Regressions after Propensity Score Matching

The table presents the results of difference-in-difference (DD) regressions after propensity score matching (PSM). Panel A presents the results of PSM. *Treat* is equal to 1 for a firm-year observation experiencing a government acquisition in our sample and zero otherwise. We match each observation in our sample with another firm-year observation that is never owned by government using the method of nearest neighbor based on different firm characteristics. Panel B presents the results of DD regressions with year, country and firm fixed effects. $LnPat_{t+N}$ is a log-transformed number of patents applied by a firm at year $t+N$ (N=0, 1, and 2). $LnCite_{t+N}$ is a log-transformed number of citations received by a firm at year $t+N$ (N=0, 1, and 2). $LnCitepat_{t+N}$ is a log-transformed number of citations per patent received by a firm at year $t+N$ (N=0, 1, and 2). *Post*Acquire* is equal to one after a firm experiencing any government acquisition in year m ($t \geq m$) and zero otherwise. All coefficients for year, country and firm dummies are omitted for brevity. Numbers in parenthesis are t-statistics computed using standard errors that are clustered at the firm level. ***, **, and * indicate significance at the 1% 5%, and 10% levels, respectively.

Panel A. Results of Propensity Score Matching

	Treat
LnAssets	0.0029
	(0.44)
Tangibility	0.0997*
	(1.65)
ROA	0.0247
	(0.99)
Debt	-0.0494
	(-1.20)
Invest	-0.0187
	(-0.10)
HHI	0.0676
	(1.58)
LnAge	-0.0080
	(-0.49)
Constant	0.0337
	(0.75)
N	10,467

Panel B. Results of Difference-in-Difference Regressions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		$LnPat_{t+N}$			$LnCite_{t+N}$			$LnCitepat_{t+N}$	
	N=0	N=1	N=2	N=0	N=1	N=2	N=0	N=1	N=2
*Post*Acquire*	-0.1217***	-0.1151***	-0.1157***	-0.1747***	-0.1398***	-0.1392***	-0.0791***	-0.0361	-0.0359*
	(-3.36)	(-3.12)	(-3.07)	(-3.48)	(-2.93)	(-2.94)	(-2.98)	(-1.61)	(-1.74)
LnAssets	0.0376***	0.0247*	0.0113	0.0608***	0.0331	0.0180	0.0286*	0.0123	0.0083
	(3.19)	(1.94)	(0.68)	(2.68)	(1.38)	(0.67)	(1.83)	(0.78)	(0.57)
Tangibility	-0.0283	-0.0419	-0.0261	-0.0416	-0.0581	-0.0847	-0.0194	-0.0120	-0.0756
	(-0.60)	(-0.82)	(-0.59)	(-0.48)	(-0.61)	(-1.01)	(-0.35)	(-0.19)	(-1.29)
ROA	0.0066	0.0071	0.0007	0.0172	0.0186	0.0008	0.0130*	0.0134*	-0.0010
	(1.39)	(1.30)	(0.24)	(1.64)	(1.61)	(0.13)	(1.87)	(1.79)	(-0.20)
Debt	0.0011	0.0013	-0.0003	0.0047	0.0054	-0.0004	0.0045	0.0045	-0.0008
	(0.52)	(0.52)	(-0.17)	(1.04)	(1.05)	(-0.14)	(1.44)	(1.35)	(-0.33)
Invest	0.0282	0.0617	0.0454	0.0450	0.1300	0.0860	0.0169	0.0910	0.0592
	(0.54)	(1.18)	(0.91)	(0.41)	(1.17)	(0.85)	(0.20)	(1.03)	(0.76)
HHI	0.0471	0.0310	-0.0030	0.0553	0.0281	-0.0927	0.0089	-0.0103	-0.1252
	(0.66)	(0.47)	(-0.05)	(0.41)	(0.22)	(-0.76)	(0.10)	(-0.11)	(-1.47)
LnAge	0.0356	0.0402	0.0462*	0.0575	0.0543	0.0768*	0.0260	0.0133	0.0324
	(1.49)	(1.61)	(1.77)	(1.33)	(1.24)	(1.76)	(0.90)	(0.45)	(1.14)
R&D	-0.0000	0.0179	0.1331	-0.0705	0.0527	0.2387	-0.1097	0.0160	0.1243
	(-0.00)	(0.15)	(0.95)	(-0.23)	(0.21)	(0.71)	(-0.54)	(0.09)	(0.49)
Constant	-0.3009	-0.2472	-0.0090	-0.4287	-0.2989	-0.0717	-0.1139	-0.0355	-0.0598
	(-0.70)	(-0.55)	(-0.03)	(-0.56)	(-0.39)	(-0.11)	(-0.28)	(-0.09)	(-0.13)
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	10,467	10,467	10,467	10,467	10,467	10,467	10,467	10,467	10,467
Adj. R^2	0.803	0.787	0.782	0.758	0.743	0.746	0.641	0.629	0.636

We rerun the model by using bootstrap standard errors and heteroskedasticity-corrected standard errors and still obtain very strong negative relationship between government acquisition and corporate innovation. We also provide the results by using scaled patent and citations in the appendix and we still have very consistent results.

Difference-in-difference regressions provide the direct evidence that government control do relevant for corporate innovation activities. However, there is still a concern of reverse causality, which implies that corporate innovation might happen before the government acquisition or bad performance of companies in corporate innovation induces the government to step in and take control to monitor. To further considering those effects, we construct the following model which could be expressed as:

$$Inno_{t+N} = \alpha + Year_t + Country_i + Firm_j + \tau_1 Acquire\ (t \leq -3) + \tau_2 Acquire\ (t = -2) + \tau_3 Acquire\ (t = 0) + \tau_4 Acquire\ (t = 1) + \tau_5 Acquire\ (t = 2) + \tau_5 Acquire\ (t \geq 3) + \theta_i X + \epsilon_{t+N}$$

We still use $LnPat_t$, $LnCite_t$ or $LnCitePat_t$ at year *t*, *t+1* and *t+2* as proxies for corporate innovation. *Acquire (t=N)* is an indicator variable that is equal to 1 representing *N* years before or after the year of government acquisition (*N=0, 1, 2, 3*). Acquire (t=0) is the event year for government acquiring. We still include year, country and firm fixed effects along with firm characteristics in our model. The standard errors are clustered at firm level. If there is no pre-trend or reverse causality issue for corporate innovation activities, we will expect the coefficients of τ_1 and τ_2 to be insignificant. Table 5 provides the results of dynamic model.

Table 5
Dynamic Model

The table presents the results of dynamic model with year, country and firm fixed effects. $LnPat_t$ is a log-transformed number of patents applied by a firm at year *t*. $LnCite_t$ is a log-transformed number of citations received by a firm at year *t*. $LnCitepat_t$ is a log-transformed number of citations per patent received by a firm at year *t*. *Acquire (t=n)* represents *n* years *(-3 ≤n ≤3)* before or after the government acquisition for treatment firms. Acquire (t=0) is the event year for the treatment firms. All coefficients for firm characteristics, year, country and firm dummies are omitted for brevity. Numbers in parenthesis are t-statistics computed using standard errors that are clustered at the firm level. ***, **, and * indicate significance at the 1% 5%, and 10% levels, respectively.

	(1)	(2)	(3)
	$LnPat_t$	$LnCite_t$	$LnCitepat_t$
Acquire (t<=-3)	0.0203	0.0233	-0.0003
	(1.13)	(0.68)	(-0.01)
Acquire (t=-2)	-0.0186	-0.0338	-0.0254
	(-1.12)	(-1.00)	(-0.95)
Acquire (t=0)	-0.0989***	-0.1479***	-0.0772***
	(-3.38)	(-3.33)	(-2.75)
Acquire (t=1)	-0.1153***	-0.1698***	-0.0833***
	(-3.26)	(-3.30)	(-2.71)
Acquire (t=2)	-0.1259***	-0.1727***	-0.0753**
	(-3.02)	(-2.86)	(-2.19)
Acquire (t>=3)	-0.1885***	-0.2852***	-0.1373***
	(-3.83)	(-4.03)	(-3.33)
Control	YES	YES	YES
Firm FE	YES	YES	YES
Country FE	YES	YES	YES
Year FE	YES	YES	YES
N	10,467	10,467	10,467
Adj. R^2	0.803	0.759	0.641

In table 5, we find that the coefficients for are all insignificant no matter what innovation proxies are used. However, the coefficients for concurrent dummy variables are also very significant at 1 percent level. This is puzzling since it takes time to innovate. Kondo (1999) believes that R&D investment creates patent application at a time lag of two or three years. Chava et al (2013) also document an immediate impact of bank deregulation on innovation even though this phenomenon is quite surprising. Overall, the results of dynamic model alleviate the concerns of reverse causality. We also provides the results by using scaled patents and citations in the appendix and we still have consistent results.

5. Potential Channel

In this section we turn to the question why government control impede the corporate innovation and through what channels. First of all, we separate our sample into two groups; one group of observations that have no government ownership before acquisition, and the other group observations that have some government ownership before the acquisition. We rerun the propensity score matching for each sub-sample and difference-in-difference regressions again to investigate which group is more likely to be affected by stronger government control. Because from our statistical software we cannot tell which observation from control group is matched to which observation from treatment group, we could not simply divide the sample based on matching results from table 4. However, when we rerun the propensity score matching, the matching observations might change when compared with the matching observations from table 4.

Table 6

Difference-in-Difference regressions: Sub-sample Propensity Score Matching

The table presents the results of difference-in-difference regressions after propensity score matching (PSM) for two sub-sample group: firms that have some government ownership before acquisition, and firms that have no government ownership before the acquisition. Panel A presents the results of PSM. Treat is equal to 1 if firms are from treatment group and zero otherwise. We match each observation from each sub-sample group with another firm-year observation that is never owned by government using the method of nearest neighbor based on different firm characteristics. Panel B presents the results of difference-in-difference regressions for each sub-sample group with year, country and firm fixed effect after PSM. Numbers in parenthesis are t-statistics computed using standard errors that are clustered at the firm level. ***, **, and * indicate significance at the 1% 5%, and 10% levels, respectively.

Panel A. Results of Propensity Score Matching

	No Government Ownership Before Acquisition	Owned by Government Before Acquisition
	Treat	*Treat*
LnAssets	0.0012	-0.0011
	(0.14)	(-0.11)
Tangibility	-0.0276	0.0374
	(-0.34)	(0.47)
ROA	0.1000*	0.0144
	(1.88)	(0.22)
Debt	-0.0061	0.0257
	(-0.12)	(0.31)
Invest	0.0976	-0.2336
	(0.40)	(-0.86)
HHI	0.0177	0.0104
	(0.32)	(0.16)
LnAge	0.0016	-0.0405*
	(0.07)	(-1.65)
Constant	0.0407	0.0781
	(0.69)	(1.12)
N	5,769	5,119

Panel B. Result of Difference-in-Difference Regressions

	No Government Ownership Before Acquisition			Owned by Government Before Acquisition		
	(1)	(2)	(3)	(1)	(2)	(3)
	$LnPat_t$	$LnCite_t$	$LnCitepat_t$	$LnPat_t$	$LnCite_t$	$LnCitepat_t$
*Post*Acquire*	-0.1342**	-0.1924**	-0.0748**	-0.0327	-0.0402	-0.0004
	(-2.38)	(-2.55)	(-2.16)	(-0.71)	(-0.55)	(-0.01)
LnAssets	0.0399*	0.0667*	0.0315	0.0044	0.0009	0.0011
	(1.93)	(1.92)	(1.53)	(0.31)	(0.02)	(0.05)
Tangibility	-0.0985	-0.1472	-0.0538	-0.0505	-0.0975	-0.0556
	(-1.43)	(-1.19)	(-0.70)	(-1.24)	(-1.10)	(-0.89)
ROA	-0.0035	-0.0038	0.0006	0.0120	0.0334	0.0286
	(-0.48)	(-0.24)	(0.05)	(0.70)	(0.84)	(0.92)
Debt	-0.0030	-0.0044	-0.0013	0.0227	0.0621	0.0553
	(-0.88)	(-0.60)	(-0.22)	(0.91)	(1.07)	(1.15)
Invest	0.0397	0.0790	0.0490	0.0178	0.0177	0.0102
	(0.49)	(0.48)	(0.42)	(0.29)	(0.14)	(0.12)
HHI	0.0501	0.0936	0.0633	0.0467	0.0834	0.0499
	(0.47)	(0.46)	(0.45)	(0.68)	(0.62)	(0.54)
LnAge	0.0488	0.0840	0.0386	0.0121	0.0037	-0.0052
	(1.46)	(1.39)	(1.00)	(0.31)	(0.05)	(-0.11)
R&D	0.0312	0.0639	-0.0059	-0.1928	-0.4663	-0.3016
	(0.17)	(0.18)	(-0.02)	(-0.89)	(-0.93)	(-0.88)
Constant	0.0810	0.1876	0.1436	0.1142	0.2295	0.1185
	(0.45)	(0.58)	(0.70)	(1.35)	(1.28)	(1.09)
Firm FE	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
N	5,769	5,769	5,769	5,119	5,119	5,119
Adj. R^2	0.834	0.798	0.696	0.880	0.838	0.724

The Table 6 provides the results of sub-sample matching and difference-in-difference regressions. In panel A, we find that there is no systematical difference between treatment and control group for both sub-sample based on the results of Probit regressions. In panel B, we find that the negative impact of government control is only significant for the group that has no government ownership before the acquisition. La Porta et al (2001) argue that government ownership are usually associated with political requirements or targets rather than simply maximizing shareholders value. Innovation is somehow risky project with uncertainty. Managers who have political connect might resist to invest in risky projects since failure of those projects will damage their careers. We observe that the group with no government ownership before is more likely to be influenced by these negative impact once government become shareholders. However, the negative impact will be shrink for the group that has governmental shareholders already.

The other potential channel is the conflict of interest between major and minor shareholders. Shleifer and Vishny (1997) believe major shareholders would like to pursue private benefits at the cost of minor shareholders, for example, the major shareholders might initial investment that are too risky for minor shareholders. If government become the major shareholders and to achieve their political goals, managers will be more likely to shut down risk projects and turn to conventional projects. Maintaining stability of companies' earning becomes priority even though innovative projects might bring abnormal returns in the future. To confirm our prediction, we use a regression discontinuity design (RDD) and examine whether corporate innovation decrease after government becomes major shareholders. We

employ a nonparametric local linear estimation around the threshold of 50% defined by Imbens and Kalyanaraman (2012). The model could be expressed as:

$$Inno_{t+N} = \alpha + \beta_1 Ownership + P_l(v,c) + P_r(v,c) + \varepsilon_{t+N}$$

$Inno_{t+N}$ still represents $LnPat_{t,}$, $LnCite_t$ or $LnCitePat_t$ at year *t*, *t+1* and *t+2* as proxies for corporate innovation. *Ownership* is a dummy variable which is equal to one if the government ownership is greater than or equal to 50 percent, and zero otherwise. $P_l(v,c)$ and $P_r(v, c)$ is the polynomial function on the left and right hand side of threshold. *c* equals 50 percent in our setting. *v* represents the total government ownership. Triangle and uniform kernel are used in the regressions. Table 7 provides the results of regression discontinuity design.

In table 7, we find that the coefficients for ownership are all negatively significant across all innovation proxies, which indicates the corporate innovation significantly drops after the government become the major shareholders in the company. The magnitude of decline in corporate innovation is also nontrivial. For example, the number of citations drops about 14.03 percent and 16.83 percent one year and two years after the government becomes major shareholders respectively. In figure 2, we also can observe a gap around the cutoff point for all innovation proxies. The results of RDD confirm that there is a conflict of interest between major and minor shareholders.

Our next question will be whether conflict of interest between major and minor shareholders would lead to an underinvestment problem. Managers will have concerns that an unsuccessful risky project might damage their political career, which will make the managers resist to invest in risky project and lower their risk tolerance. To further investigate this issue,

Table 7

Regression Discontinuity Design: Conflict of Interest between Major and Minor Shareholder

The table presents results of local regression discontinuity design using optimal bandwidth by Imbens and Kalyanaraman (2012). Triangle and uniform kernel is used in the regressions. $LnPat_{t+N}$ is a log-transformed number of patents applied by a firm at year $t+N$ (N=1, 2, and 3). $LnCite_{t+N}$ is a log-transformed number of citations received by a firm at year $t+N$ (N=1, 2, and 3). $LnCitepat_{t+N}$ is a log-transformed number of citations per patent received by a firm at year $t+N$ (N=1, 2, and 3). *Ownership* is a dummy variable that is equal to one if acquiring percent is greater than or equal to 50 percent, and zero otherwise.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		$LnPat_{t+N}$			$LnCite_{t+N}$			$LnCitepat_{t+N}$	
	N=1	N=2	N=3	N=1	N=2	N=3	N=1	N=2	N=3
Ownership	-0.0344***	-0.0359**	-0.0476***	-0.1403***	-0.1376***	-0.1683***	-0.0384	-0.0477**	-0.0455*
	(-2.73)	(-2.47)	(-2.71)	(-3.60)	(-3.37)	(-3.65)	(-1.58)	(-1.97)	(-1.86)
Kernal	Rectangle	Rectangle	Rectangle	Rectangle	Rectangle	Rectangle	Rectangle	Rectangle	Rectangle
N	5,572	5,572	5,572	5,572	5,572	5,572	5,572	5,572	5,572
		$LnPat_{t+N}$			$LnCite_{t+N}$			$LnCitepat_{t+N}$	
	N=1	N=2	N=3	N=1	N=2	N=3	N=1	N=2	N=3
Ownership	-0.0393**	-0.0443**	-0.0576***	-0.1087**	-0.1190**	-0.1391***	-0.0815**	-0.0829**	-0.1530***
	(-2.27)	(-2.41)	(-2.64)	(-2.33)	(-2.46)	(-2.68)	(-2.36)	(-2.52)	(-3.27)
Kernal	Uniform	Uniform	Uniform	Uniform	Uniform	Uniform	Uniform	Uniform	Uniform
N	5,572	5,572	5,572	5,572	5,572	5,572	5,572	5,572	5,572

Table 8
Innovation Efficiency

The table presents the results of difference-in-difference regression for R&D expenditure and innovation efficiency with year, country and firm fixed effects. *R&D* is firm's R&D expenditure divided by assets. $Pat/\sum R\&D_{(t,t-3)}$ is the number of patents applied for a firm scaled by weighted R&D expenditure between year *t-3* and year *t* in a given year. $Cite/\sum R\&D_{(t,t-3)}$ is the number of citations received for a firm scaled by weighted R&D expenditure between year *t-3* and year *t* in a given year. $CitePat/\sum R\&D_{(t,t-3)}$ is the number of citations per patent received for a firm scaled by weighted R&D expenditure between year *t-3* and year *t* in a given year. Numbers in parenthesis are t-statistics computed using standard errors that are clustered at the firm level. ***, **, and * indicate significance at the 1% 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
	R&D	$Pat/\sum R\&D_{(t,\,t-3)}$	$Cite/\sum R\&D_{(t,\,t-3)}$	$CitePat/\sum R\&D_{(t,\,t-3)}$
*Post*Acquire*	0.0013	-0.0157***	-0.1009**	-0.0359**
	(0.42)	(-2.73)	(-2.50)	(-2.10)
LnAssets	-0.0062***	0.0000	-0.0087	-0.0045
	(-2.65)	(0.01)	(-0.33)	(-0.41)
Tangibility	0.0038	0.0078	0.0514	-0.0031
	(0.29)	(0.50)	(0.50)	(-0.07)
ROA	-0.0057	0.0078**	0.0504**	0.0242**
	(-1.23)	(2.03)	(1.99)	(2.11)
Debt	-0.0021	0.0030*	0.0201*	0.0100**
	(-1.13)	(1.92)	(1.93)	(2.10)
Invest	0.0050	0.0261	0.2311	0.0949
	(0.48)	(0.88)	(1.21)	(1.09)
HHI	-0.0004	-0.0078	-0.0607	-0.0461
	(-0.09)	(-0.51)	(-0.62)	(-1.11)
LnAge	0.0057*	-0.0100	-0.0529	-0.0176
	(1.79)	(-1.17)	(-0.95)	(-0.74)
Constant	0.0489***	-0.0088	0.0038	0.0600
	(3.68)	(-0.27)	(0.02)	(0.82)
Firm FE	YES	YES	YES	YES
Country FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
N	10,467	10,467	10,467	10,467
Adj. R^2	0.709	0.570	0.545	0.539

we replace the innovation proxies with R&D expenditure, which is usually considered as the direct input of corporate innovation activities and rerun the difference-in-difference regressions. Table 8 provides the results. However, we did not find the R&D expenditure significant decrease after the government acquisition for treatment firms.

Even though the investment for innovation is not decreasing after government acquisition, the declining in corporate innovation is still puzzling. La Porta et al (2002) find that countries associated with higher government ownership of banks usually exhibit lower efficiency, low growth and more severe corruption. Inspired by their spirits, we create following three variables representing efficiency of innovation.

$$\frac{Pat}{\sum_{T-2}^{T} R\&D\ Expense} = \frac{Patent_t}{0.8 * R\&D_t + 0.6 * R\&D_{t-1} + 0.4 * R\&D_{t-2} + 0.2 * R\&D_{t-3}}$$

$$\frac{Cite}{\sum_{T-2}^{T} R\&D\ Expense} = \frac{Citations_t}{0.8 * R\&D_t + 0.6 * R\&D_{t-1} + 0.4 * R\&D_{t-2} + 0.2 * R\&D_{t-3}}$$

$$\frac{CitePat}{\sum_{T-2}^{T} R\&D\ Expense} = \frac{CitePat_t}{0.8 * R\&D_t + 0.6 * R\&D_{t-1} + 0.4 * R\&D_{t-2} + 0.2 * R\&D_{t-3}}$$

The innovation efficiency variables are the innovation output scaled by all past three years input-R&D expenditures and they indicate the innovation output per R&D expenditure. As we mentioned, government ownership might have some social-desirable targets such as maintaining employment in the company. Even though the employee might face lower dismissal risk, better protection might increase their shirking behavior and company will have difficulty to fire inefficiency employees. (Bradley et al, 2015; Francis et al, 2015). If this prediction is true, we will expect the innovation efficiency also drops after

the government acquisition. We replace all dependent variables with innovation efficiency variables and rerun the difference-in-difference regressions.

From second to forth column of table 8, we find that all three innovation efficiency variables are significant decreased after the acquisition, which confirm our prediction that government control leads to lower efficiency of investment. The decline in corporate innovation might be partially due to the lower efficiency of employees.

Finally, we separate our entire sample into two groups based on difference characteristics. First of all, we divide the sample into two groups based on the government ownership of banks. La Porta et al (2002) provide the evidence that higher government ownership of banks are usually associated with lower efficiency, lower growth, bad monitoring and more sever corruption problems. We expect the group with higher government ownership of banks will be experiencing higher decline in corporate innovation since agency problem between employers and employees will be more severe. From table 9, we find the results are consistent with our prediction. The group with higher government ownership of banks is experiencing more significant decrease in corporate innovation. Secondly, we divide our sample into two groups based on creditor right, and we find that negative effect of government control is more severe for group with better creditor protections. Finally, we divide our sample into two groups based on stock market development, which is calculated by stock market capitalization/GDP. Better financial development provides more external funding medium so the negative effect from government will be mitigated if government decide to cut the internal investment funding directly. Companies still could raise the fund which is necessary for innovative projects

Table 9
Sub-Sample Analysis

The table presents results of difference-in-difference regressions with different sub-sample analysis. $LnPat_{t+N}$ is a log-transformed number of patents applied by a firm at year $t+N$ (N=0 and 2). $LnCite_{t+N}$ is a log-transformed number of citations received by a firm at year $t+N$ (N=0 and 2). $LnCitepat_{t+N}$ is a log-transformed number of citations per patent received by a firm at year $t+N$ (N=0 and 2). *Post*Acquire* is equal to one after a firm experiencing any government acquisition in year m ($t \geq m$) and zero otherwise. Government ownership of banks, creditor rights index and stock market Cap./GDP are from La Porta et al (2002). All coefficients for firm characteristic variables, year, country, firm dummies are omitted for brevity. Numbers in parenthesis are t-statistics computed using standard errors that are clustered at the firm level. ***, **, and * indicate significance at the 1% 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	$LnPat_{t+N}$		$Lncite_{t+N}$		$LnCitepat_{t+n}$		$LnPat_{t+N}$		$Lncite_{t+N}$		$LnCitepat_{t+n}$	
	N=0	N=2	N=0	N=2	N=0	N=2	N=0	N=2	N=0	N=2	N=0	N=2
	High Government Ownership of Banks						*Low Government Ownership of Banks*					
*Post*Acquire*	-0.1610***	-0.1666***	-0.2269***	-0.2189***	-0.0906***	-0.0727***	-0.0543*	-0.0339	-0.0923	-0.0259	-0.0645	0.0075
	(-3.20)	(-3.18)	(-3.33)	(-3.35)	(-2.66)	(-2.65)	(-1.83)	(-1.31)	(-1.45)	(-0.57)	(-1.38)	(0.25)
N	5,159	5,159	5,159	5,159	5,159	5,159	5,308	5,308	5,308	5,308	5,308	5,308
Adj. R^2	0.791	0.765	0.761	0.752	0.645	0.661	0.824	0.813	0.755	0.741	0.629	0.607
	Better Creditor Rights						*Worse Creditor Righter*					
*Post*Acquire*	-0.1650***	-0.1549***	-0.2583***	-0.2009***	-0.1289**	-0.0702*	-0.0957**	-0.0882*	-0.1222**	-0.1024*	-0.0454	-0.0197
	(-2.82)	(-2.92)	(-2.97)	(-2.69)	(-2.56)	(-1.79)	(-2.06)	(-1.73)	(-1.99)	(-1.71)	(-1.55)	(-0.91)
N	4,824	4,824	4,824	4,824	4,824	4,824	5,643	5,643	5,643	5,643	5,643	5,643
Adj. R^2	0.816	0.782	0.755	0.737	0.620	0.616	0.782	0.780	0.757	0.754	0.656	0.652
	High Stock Mkt Cap/GDP						*Low Stock Mkt Cap/GDP*					
*Post*Acquire*	-0.0670**	-0.0345	-0.1225*	-0.0172	-0.0853	0.0177	-0.1497***	-0.1602***	-0.2042***	-0.2129***	-0.0785**	-0.0728***
	(-2.01)	(-1.18)	(-1.70)	(-0.33)	(-1.61)	(0.52)	(-3.16)	(-3.24)	(-3.21)	(-3.49)	(-2.52)	(-2.92)
N	5,156	5,156	5,156	5,156	5,156	5,156	5,311	5,311	5,311	5,311	5,311	5,311
Adj. R^2	0.829	0.809	0.761	0.735	0.624	0.600	0.782	0.763	0.750	0.752	0.639	0.659
Control	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

from open market. We find the results is consistent with our prediction, the group with worse financial development is more likely to be affected.

6. Conclusion

We provide the evidence that government ownership impede the corporate innovation by using a difference-in-difference regressions. We show that there is conflict of interest between major shareholders and minor shareholders. The corporate innovation efficiency also decline after the government acquisition. We find that this negative relationship is more severe for the group with higher government ownership of banks, better creditor rights and worse stock market development.

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Appendix A
Definition of Variables

Variable	Description
$LnPat_{t+N}$	Log transform of number of patents granted by a firm in year *t+N (N=0,1,2,3).*
$LnCite_{t+N}$	Log transform of number of non-self-citations received by a firm in year *t+N (N=0,1,2,3).*
$LnCitePat_{t+N}$	Log transform of number of non-self-citations per patent received by a firm in year *t+N (N=0,1,2,3).*
$SPat_{t+N}$	The number of patents of divided by median number of patents applied within the same industry in a country j at year t+N (N=0, 1, 2, 3)
$SCite_{t+N}$	The number of citations divided by mean number of citations received within the same industry in country j at year t+N (N=0, 1, 2, 3).
$SCitePat_{t+N}$	The number of citations per patent divided by mean number of citations per patent received within the same industry in country j at year t+N (N=0, 1, 2, 3).
Ln(asset)	Log transform of firm total assets. Assets are Global COMPUSTAT item [AT].
ROA	Returns on Asset: net income divided by book value of total assets. Net income is Global COMPUSTAT item [NICON].
Tangibility	Tangible assets as a proportion of total assets: Net property, plant and equipment divided by total assets. Net property, plant and equipment is Global COMPUSTAT item [PPENT].
Invest	Capital expenditure divided by total assets: capital expenditure is Global COMPUSTAT item [CAPX].
Leverage	Book debt ratio: total debts divided by total assets. Total debts=Global COUPUSTAT item ([DLC]+[DLTT]).
R&D	R&D expenses divided by total assets. R&D expenses are Global COMPUSTAT item [XRD].
HHI	Herfindahl-Hirschman index scaled by the sales; constructed by using total sales in each company based on the first two digits of SIC code.
LnAge	The log-transformed number of years existing in our sample for a firm in a given calendar year.
OB	Percentage of government ownership before acquisition, from SDC Platinum
OA	Percentage of government ownership after acquisition, from SDC Platinum
*Post*Acquire*	An indicator variable that is equal to one after the government acquisition for treatment group at year m ($t \geq m$) and zero otherwise.

Appendix B
Baseline Regressions: Scaled Innovation Proxies

This table presents OLS results regressing percentage of government ownership after acquisition and other firm characteristics on corporate innovation measures with year, country and industry fixed effects. $SPat_{t+N}$ is a log-transformed number of patents applied by a firm scaled by average number of patents applied in industry *k* of country *i* at year *t+N* (N=1, 2, and 3). $SCite_{t+N}$ is a log-transformed number of citations received by a firm scaled by average number of citations received in industry *k* of country *i* at year *t+N* (N=1, 2, and 3). $SCitepat_{t+N}$ is a log-transformed number of citations per patent received by a firm scaled by average number of citations per patent received in industry *k* of country *i* at year *t+N* (N=1, 2, and 3). *OA* is the percentage of government ownership after acquisition. *LnAssets* is the log-transformed of firm size. *ROA* represents profitability of the firm, calculate as net income divided by book value of assets. *R&D* is firm's R&D expenditure divided by assets. *Tangibility* is a firm's capital expenditure divided by assets. Investment is a firm's capital expenditure divided by assets. *Leverage* is a firm's total debts divided by assets. *HHI index* is a Herfindahl-Hirschman index based on sales in the first two digits of the SIC code. *LnAge* is the log-transformed of firm age. All coefficients for year, country and industry dummies are omitted for brevity. Numbers in parentheses are t-statistics computed using standard errors that are heteroskedasticity-adjusted. ***, **, and * indicate significance at the 1% 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		$SPat_{t+N}$			$SCite_{t+N}$			$SCitepat_{t+n}$	
	N=1	N=2	N=3	N=1	N=2	N=3	N=1	N=2	N=3
OA	-0.4328	-0.6203***	-0.7249***	-0.4712	-0.6458***	-0.7690***	0.0327	-0.1122	-0.2537**
	(-1.40)	(-2.61)	(-4.64)	(-1.53)	(-2.74)	(-5.00)	(0.11)	(-0.54)	(-2.21)
LnAssets	0.5000***	0.5135***	0.5154***	0.4900***	0.5109***	0.4892***	0.1693***	0.2080***	0.1601***
	(7.07)	(7.22)	(7.86)	(7.00)	(7.25)	(7.50)	(3.51)	(4.43)	(3.47)
Tangibility	-0.6659**	-0.6463**	-0.5956**	-0.7314**	-0.6755**	-0.5503**	-0.3006	-0.2575	-0.0512
	(-2.37)	(-2.56)	(-2.48)	(-2.52)	(-2.53)	(-2.26)	(-1.09)	(-1.08)	(-0.22)
ROA	-0.5851*	-0.6583*	-0.5486*	-0.4398	-0.5839*	-0.3194	0.3222	-0.0802	0.2478
	(-1.68)	(-1.91)	(-1.69)	(-1.28)	(-1.72)	(-0.99)	(0.89)	(-0.25)	(0.86)
Debt	-1.5426***	-1.3081***	-1.1976***	-1.3792***	-1.1370***	-1.1519***	-0.3775	-0.1784	-0.1033
	(-3.86)	(-3.40)	(-3.15)	(-3.50)	(-3.00)	(-3.05)	(-1.53)	(-0.83)	(-0.53)
Invest	2.8298*	2.8658***	2.5914**	2.6264*	2.1757**	2.3435**	1.2124	0.6159	0.5811
	(1.88)	(2.61)	(2.53)	(1.75)	(2.29)	(2.41)	(0.85)	(0.85)	(0.79)
R&D	23.9225***	21.0303***	21.4643***	24.3320***	21.4991***	22.9929***	13.7355***	8.4593**	10.3850***
	(5.52)	(5.01)	(5.07)	(5.49)	(5.02)	(5.11)	(2.73)	(2.00)	(2.79)
HHI	0.3655*	0.2317	0.1664	0.3910**	0.2548	0.2069	0.1111	0.0174	0.0303
	(1.86)	(1.12)	(0.80)	(2.04)	(1.25)	(1.02)	(0.76)	(0.11)	(0.19)
LnAge	0.0122	0.0011	0.0265	0.0191	-0.0020	0.0380	-0.0292	-0.0643	-0.0111
	(0.08)	(0.01)	(0.26)	(0.13)	(-0.02)	(0.37)	(-0.22)	(-0.52)	(-0.12)
Constant	-4.3673***	-4.3939***	-3.0489**	-4.3093***	-4.3393***	-2.8860**	-2.1777***	-2.1990***	-0.6629
	(-4.53)	(-4.32)	(-2.50)	(-4.51)	(-4.30)	(-2.37)	(-2.88)	(-2.78)	(-0.58)
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	5,572	5,572	5,572	5,572	5,572	5,572	5,572	5,572	5,572
Adj. R^2	0.0805	0.0918	0.108	0.0762	0.0861	0.0998	0.0278	0.0327	0.0426

Appendix C
Difference-in-Difference Regressions: Scaled Innovation Proxies

The table presents the results of difference-in-difference (DD) regressions after propensity score matching (PSM). Panel A presents the results of PSM. *Treat* is equal to 1 for a firm-year observation experiencing a government acquisition in our sample and zero otherwise. We match each observation in our sample with another firm-year observation that is never owned by government using the method of nearest neighbor based on different firm characteristics. Panel B presents the results of DD regressions with year, country and firm fixed effects. $SPat_{t+N}$ is a log-transformed number of patents applied by a firm scaled by average number of patents applied in industry *k* of country *i* at year *t+N* (N=1, 2, and 3). $SCite_{t+N}$ is a log-transformed number of citations received by a firm scaled by average number of citations received in industry *k* of country *i* at year *t+N* (N=1, 2, and 3). $SCitepat_{t+N}$ is a log-transformed number of citations per patent received by a firm scaled by average number of citations per patent received in industry *k* of country *i* at year *t+N* (N=1, 2, and 3). *Post*Acquire* is equal to one after a firm experiencing any government acquisition in year *m* ($t \geq m$) and zero otherwise. All coefficients for year, country and firm dummies are omitted for brevity. Numbers in parenthesis are t-statistics computed using standard errors that are clustered at the firm level. ***, **, and * indicate significance at the 1% 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		$SPat_{t+N}$			$SCite_{t+N}$			$SCitepat_{t+n}$	
	N=0	N=1	N=2	N=0	N=1	N=2	N=0	N=1	N=2
*Post*Acquire*	-0.9704**	-1.0478***	-0.9524**	-0.9551**	-0.9725***	-0.9219**	-0.9083**	-0.8148***	-0.6593**
	(-2.27)	(-2.80)	(-2.49)	(-2.21)	(-2.62)	(-2.49)	(-2.32)	(-2.62)	(-2.17)
LnAssets	0.0910	0.3015	0.0251	0.0152	0.3172	-0.0050	-0.1206	0.3673	0.0664
	(0.30)	(0.74)	(0.07)	(0.04)	(0.76)	(-0.01)	(-0.30)	(1.00)	(0.25)
Tangibility	0.6437	-1.2130	-0.4924	0.4698	-1.2188	-0.6558	0.2380	-1.0017	-0.8766
	(0.74)	(-1.01)	(-0.58)	(0.54)	(-1.01)	(-0.76)	(0.28)	(-0.82)	(-1.16)
ROA	0.0732*	0.0691	0.2098	0.0815*	0.0758	0.2069	0.0868**	0.0665	0.1689
	(1.81)	(0.96)	(0.91)	(1.89)	(1.05)	(0.90)	(2.11)	(0.95)	(0.82)
Debt	0.0233	0.0021	0.0863	0.0299	0.0045	0.0869	0.0373	-0.0015	0.0687
	(0.88)	(0.06)	(0.96)	(0.99)	(0.12)	(0.97)	(1.28)	(-0.04)	(0.87)
Invest	0.8376	1.6048	1.4608	0.5740	1.8835	1.0599	0.2587	1.9945	0.7758
	(0.81)	(0.92)	(0.64)	(0.54)	(1.08)	(0.48)	(0.27)	(1.16)	(0.44)
HHI	-0.4135	-0.8512**	-0.2040	-0.4365	-0.7964*	-0.2457	-0.6770*	-0.9035**	-0.5489
	(-1.15)	(-1.97)	(-0.34)	(-1.19)	(-1.85)	(-0.41)	(-1.65)	(-2.09)	(-0.94)
LnAge	0.0663	-0.6374	0.4072	0.1760	-0.6813	0.4095	0.2558	-0.6490	0.3738
	(0.23)	(-1.08)	(0.81)	(0.59)	(-1.15)	(0.81)	(0.75)	(-1.09)	(0.79)
R&D	0.5831	0.4079	-0.0425	0.3988	0.3801	0.0851	-0.5682	0.1617	0.5668
	(0.61)	(0.37)	(-0.04)	(0.36)	(0.35)	(0.08)	(-0.48)	(0.17)	(0.68)
Constant	2.2787	-2.0766	0.5734	3.1437	-1.8403	0.8385	4.6152	-1.6621	-0.8528
	(0.63)	(-0.69)	(0.28)	(0.86)	(-0.64)	(0.42)	(1.24)	(-0.63)	(-0.29)
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	10,467	10,467	10,467	10,467	10,467	10,467	10,467	10,467	10,467
Adj. R^2	0.631	0.477	0.453	0.600	0.466	0.449	0.432	0.368	0.389

Appendix D
Dynamic Model: Scaled Innovation Proxies

The table presents the results of dynamic model with year, country and firm fixed effects. $SPat_t$ is a log-transformed number of patents applied by a firm scaled by average number of patents applied in industry *k* of country *i* at year *t*. $SCite_t$ is a log-transformed number of citations received by a firm scaled by average number of citations received in industry *k* of country *i* at year *t*. $SCitepat_t$ is a log-transformed number of citations per patent received by a firm scaled by average number of citations per patent received in industry *k* of country *i* at year *t*. *Acquire (t=n)* represents *n* years $(-3 \leq n \leq 3)$ before or after the government acquisition for treatment firms. Acquire (t=0) is the event year for the treatment firms. All coefficients for firm characteristics variables, year, country and firm dummies are omitted for brevity. Numbers in parenthesis are t-statistics computed using standard errors that are clustered at the firm level. ***, **, and * indicate significance at the 1% 5%, and 10% levels, respectively.

	(1)	(2)	(3)
	$SPat_t$	$SCite_t$	$SCitepat_t$
Acquire (t<=-3)	-0.2161	-0.3090	-0.3415
	(-0.63)	(-1.09)	(-1.09)
Acquire (t=-2)	-0.2803	-0.1657	-0.2180
	(-0.84)	(-0.47)	(-0.55)
Acquire (t=0)	-1.0343**	-1.0324**	-1.0299**
	(-2.01)	(-2.09)	(-2.20)
Acquire (t=1)	-1.1961**	-1.1765**	-1.1429**
	(-2.05)	(-2.07)	(-2.14)
Acquire (t=2)	-1.0823**	-1.0669**	-1.0361**
	(-2.10)	(-2.14)	(-2.36)
Acquire (t>=3)	-1.2911**	-1.2615**	-1.2151**
	(-2.01)	(-1.98)	(-2.26)
Control	YES	YES	YES
Firm FE	YES	YES	YES
Country FE	YES	YES	YES
Year FE	YES	YES	YES
N	10,467	10,467	10,467
Adj. R^2	0.631	0.600	0.432

Chapter 2

Leverage-Decreasing Exchange Offer and Corporate Governance: New Evidence

1. Introduction

In an exchange offer or swap, one class of securities is exchanged for another in a deal that involves no cash. As no cash changes hands, such an action is assumed as a pure case of capital structure adjustment by firms towards its optimal capital structure. Consequently, researchers expected a positive market reaction to both leverage-increasing and leverage-decreasing exchange offers. However, empirical results point to positive market reactions only to leverage-increasing exchange offer but contrarily negative reactions to leverage-decreasing exchange offers. For example, Masulis (1980), by employing a sample of 106 leverage-increasing and 57 leverage-decreasing exchange offers, find positive announcement returns (7.6%) for leverage-increasing exchange offers and negative abnormal returns (-5.4%) for leverage-decreasing exchange offers. Pinegar and Lease (1986) find a statistically significant 4.05% positive returns for 15 leverage-increasing preferred-for-common exchange offers. The equity return for leverage-decreasing exchange offers is a significantly negative .73%. Copeland and Lee (1991) find that 61 out of 90 firms with leverage-increasing exchange offers experience decreases in systematic risk following the completion data and 75 out of 127 leverage-increasing firms experience increases in systematic risk.

This phenomenon continues to puzzle researchers who have provided several potential explanations and tested their implications. For example, Masulis (1980)

provides evidence that the negative return is because of expropriation of bondholder wealth, however the empirical results do not strongly support this claim when a larger sample is considered. Pinegar and Lease (1986) conclude that their results favor the signaling hypothesis over the tax hypothesis but cannot be used to reject tax hypothesis because it may still be relevant to the some type of exchange offer where the interest tax shield is affected. Copeland and Lee (1991) provide evidence that supports that the signaling interpretation of exchange offers. The free cash flow theory (i.e., the negative market reaction to the possibility of managers misusing cash flows generated by equity offerings) does not apply to exchange offers as they do not bring in new cash flows.

This essay falls in this line of research and provides an alternative explanation for the negative market reaction to leverage-reducing exchange offers, with respect to stocks-for-bonds exchange offers to be specific. Our basic premise is as follows: the ongoing assumption that all exchange offers are designed to adjust a firm's capital structure towards the target desired by shareholders might not be correct. Liao, Mukherjee and Wang (LMW) (2015) test the idea presented by Morellec, Nikolov and Schurhoff (2012) that mangers prefer low debt to avoid loss of control of cash flows to bondholders. LMW show that firms with poor corporate governance system follow their self-determined capital structure target that is significantly lower than the target desired by shareholders. This being the case, these firms attempt to lower their leverage even when they are underleveraged relative to the shareholders' target. Consequently, a negative market reaction is likely especially if a stock-for-bond exchange sample contains a large number of poorly-governed firms that are making adjustments in the wrong direction.

We test the above hypothesis by employing the following steps;

1. Covering a period from 1990 to 2014, we collect all firms that were involved in stocks-for-bonds exchange offers. The final sample consists of 143 exchange offers with complete information.

2. By employing four separate models, we compute abnormal announcement returns for the total sample. We expect the announcement returns to be significantly negative (consistent with existing research).

3. Following Liao, Mukherjee and Wang (2015), we estimate the shareholders' leverage target and separate 143 exchange offers into two groups; one group with actual leverage lower than estimated shareholders' target (under-leveraged) and the group with leverage ratio higher than estimated shareholders' target (over-leveraged).We then compute the announcement returns for the two groups. Our expectations are: a) exchange offers by the under-levered groups will receive negative market reaction since their adjustments are in the wrong direction, while b) exchange offers by the over-leveraged group are likely to receive market reaction that is insignificantly different from zero (or even positive).

4. We test to see if the under-levered group is largely (or wholly) represented by poorly-governed firms.

The event study of 143 exchange offers for companies who were involved in stocks-for-bonds exchanges receive negative returns around the announcement dates. Upon dividing the total sample in two groups, we find actual leverage of the under-

leveraged group to be almost 21 percent lower than estimated shareholders' target and show that announcement returns are over 5% negative for this group (significant at the 1% level) For the over-leveraged group on the other hand, the abnormal returns are not significantly different from zero. In our efforts to show that under-levered firms are predominantly under-levered, we then compute the corporate governance index for these firms. Lacking the available data, we are able to compute the governance index for only 20 of 52 firms in this group. Our results show that 18 of these 20 are poorly-governed firms. We are the process of collecting data from other potential sources to collect complete data on all firms in the sample. We will also perform further analyses on the firms that are over-leveraged and involved in stocks-for-bonds exchanges in order to see how many firms in this group are financially distressed firms.

Our paper contributes in the following manner: First, we provide further evidence in support of the trade-off theory: our empirical results confirm that shareholders prefer firms to follow the desired optimal capital structure target (based on trade-off between the costs and benefits of debt); second, in further support of Liao, Mukherjee and Wang (2015), we demonstrate that poorly-governed firms are more likely to deliberately stay under-leveraged relative stockholders' preferred target.

The paper proceeds as follows. In the second section, we present a short survey of the relevant literature leading to the hypothesis to be tested. Section 3 descript data, sample and methodology. Section 4 provides empirical results. Section 5 concludes.

2. Literature Review and Testing Hypothesis

There are four major building blocks of corporate financing and capital structure theory: (1) the Modigliani–Miller theory of capital-structure irrelevance, in which firm values and real investment decisions are unaffected by financing; (2) the trade-off theory, in which firms balance the tax advantages of borrowing against the costs of financial distress; (3) agency theory, in which financing responds to managers' personal incentives; and (4) the pecking-order theory, in which financing adapts to mitigate problems created by information asymmetry between managers and shareholders.

The modern theory of optimal capital structure starts with Modigliani and Miller's (MM's) proof (1958) that financing doesn't matter in perfect capital markets. Modigliani and Miller (1963) recognized the potential value of interest tax shields and claim that the company should borrow as much as they could. However, Miller (1977) argues that the tax advantages of equity could completely offset the tax-deductibility of interest at the corporate level. The "Miller equilibrium" shows how the tax advantages of corporate debt could be eroded by supply responses and shifts in investors' portfolios.

The trade of theory suggests that optimal capital structure occurs at a point where the costs of financial distress of debt is equal to the benefits of tax shield derived from the use of debt. The pecking-order theory of Myers and Majluf (1984) and Myers (1984) does not recognize the existence of an optimal capital structure but asserts that due to information asymmetry the firms are reluctant to raise money externally and look to their internal resources first, low-risk debt second, and to common equity as the last resort.

Empirical researchers over the years have attempted to explain firms' capital structure decisions. An important branch of the capital structure literature has focused on

the issue of the negative market reaction to leverage-decreasing adjustments by firms. Specifically, the researchers provide the following three explanations: tax-effect hypothesis, wealth transfer hypothesis and signaling hypothesis. For example, Masulis (1984) use a sample containing 106 leverage-increasing and 57 leverage decreasing exchange offers from 1962 to 1976 and find that an announcement return of 7.6 percent for leverage-increasing exchange offers and -5.4 percent for leverage-decreasing exchange offers. He concludes that the results are possibly consistent with following theories: (1) the tax shield benefit, discussed by Modigliani and Miller (1963) has been created whenever more leverage is utilized by the companies and because of those benefit, market reacts positively for leverage-increasing exchange offers, and/or (2) high leverage indicates that managers are confident about companies' future prospects. Copeland and Lee (1991) provide evidence that confirms the signaling explanation proposed by Masulis (1984) above.). In their sample, they find that over two-third of leverage-increasing companies exhibits lower system risk which implies better future prospects. Most importantly, important indicator of companies' wellness such as sales, earnings all improved after the issuing date of leverage-increasing exchange offers. Similarly, Pinegar and Lease (1986) use a sample of preferred-for-equity exchange offers and confirm the signaling hypothesis since preferred stock usually are considered to be the same as debt.

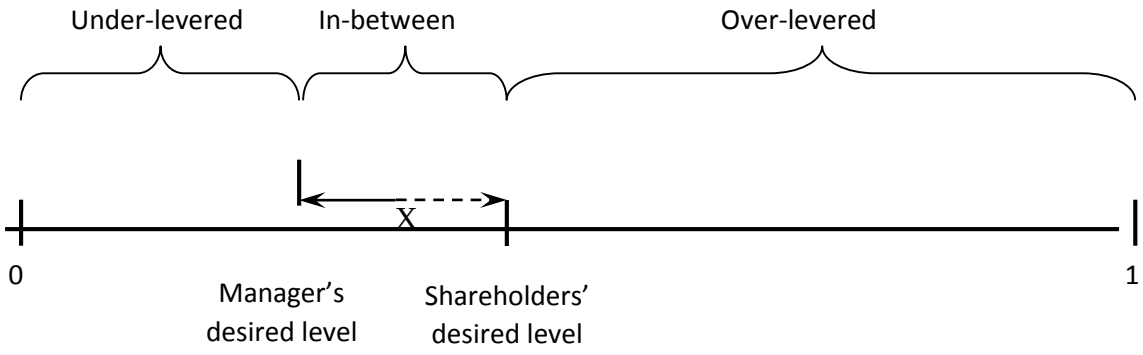
Negative market reaction to seasoned equity issuance (Masulis and Korwar (1986), Mikkelson and Partch (1986), Kolodny and Suhler (1985)) has given rise to another explanation---the free cash flow problem implying that the money raised through free cash flow theory because it provides cash flows to the managers who then can use

the cash flows (Jansen (1986)) to better their own interests, or make investments in negative NPV projects. Exchanges of stocks for bonds do not bring in new cash flows and are not expected to send a signal—good or bad. It is still puzzling why do researchers find negative abnormal returns (similar to that of seasoned equity offerings) around the announcement of these exchange offers? In conclusion, the empirical results is somehow weakly consistent with tax-shield effects and wealth expropriation theory, and strongly consistent with signaling theory. The market interpret debt-for-equity offers as good news and equity-for-debt as bad news.

On the other hand, trade-off theory provides another angel to explain why company adjusts theirs capital structure. There exists an optimal level of leverage in a typical firm and this level of leverage is the trade-off between the financial distress cost and tax-shield benefit. Company will adjust their leverage ratios from time to time if actual level of leverage is away from this optimal or target level. Most recently, Flannery and Rangan (2006) provides the assessments about how firms choose their capital structures. They present a partial-adjustment model of firm leverage indicates that firm do have target capital structures. Lemmon, Roberts and Zender (2008) also examine the persistency of corporate capital structure. However, they find that the majority of variation in leverage ratios is driven by an unobserved time-invariant effect that generates surprisingly stable capital structure.

Our explanation for exchange offer phenomenon is originated from Morellec, Nikolov and Schurhoff (2012), who propose a dynamic tradeoff model and examine the manager-shareholder conflicts in capital structure. They conclude that when making

financial decisions, the manager consider benefit of debt against cost of debt, including the cost of losing free cash flow due to the disciplining effect of debt. Therefore on average would tend to have a leverage target lower than shareholder's desire level. Liao, Mukherjee and Wang (2015) provide the empirical evidence that the greater the severity of agency conflicts, the lower is the manager's desired leverage level and the slower is the SOA toward the shareholder's desired level. In contrast, managerial incentive compensation on average discourages use of debt or adjustments toward the shareholders' desired level, consistent with its entrenchment effect. The effect of corporate governance on leverage adjustments is most pronounced when initial leverage is between the manager's desired level and the shareholders' desired level where the interests of managers and shareholders conflict.



As shown in the graph, whenever a typical company's leverage is located within over-levered area, it is well above both manager's and shareholders' target. In this case, there is no conflict of interest since both manager and shareholders intend to bring down

leverage. Similarly, when company's leverage is located within under-levered regime, both manager and shareholders prefer to increase leverage ratio since the company does not fully utilize their borrowing, which is still not associated with any conflict of interest. However, if the company's leverage is located within in-between regime, good-governed company will force manager to borrow more and move the leverage to what the shareholders expect. On the other hand, bad-governed company cannot efficiency monitor manager's behavior so that managers tend to keep the leverage ratio low to benefit their personal privilege.

Based on these rationality, the exchange offer phenomenon could be re-explained by following hypothesis: we are expecting poor-governed companies are mostly under-levered regime (below shareholders' target) so whenever there is a leverage-decreasing exchange offer announcement, market would react negatively since it is moving away from shareholders' desired level, possibly indicating an erosion of corporate governance monitoring for those companies. As long as those poor-governed companies dominated in our sample, we would expect a negative market returns.

Our premise can be concluded as follows: well-governed firms resort to stock-for-bond exchange to correct the imbalances in their capital structures (i.e., these firms are over-leveraged firms). The market reaction to such offers by well-governed firms should be insignificantly different from zero (or maybe even positive). Poorly-governed firms, on the other hand, resort to such offers because of two reasons: 1) they are over-leveraged and distressed firms that are being "forced" to resort to the offers by lenders, or 2) these firms are taking such actions even when they are under-levered (because of their dislike

of debt). If poorly-governed firms dominate in our sample, abnormal negative returns are the likely results.

After calculating the shareholders' target from Liao et al (2015), we divide the sample into two groups into under-leveraged companies and over-leveraged companies. We are testing whether the underleveraged group is dominated by poorly-governed firms and whether the abnormal returns for this group is negative. Then finally we divide the over-leveraged group into two categories: Poor governance and good governance. Measure abnormal returns of the two groups and we are testing whether the abnormal returns of the first group significantly negative while for the second group it is not. Based on these prediction, we construct two hypothesis as following:

Hypothesis 1: If the company's leverage ratio located in over-levered area, issuing of leverage increasing exchange offer (debt for common) would lead to a negative market reaction since it is deviated further from Shareholder's target level.

Hypothesis 2: For those companies whose leverage ratio below the shareholder's target, we expect poor-governed companies are dominated. For those companies whose leverage ratio below the shareholder's target, we expect good-governed companies are dominated.

3. Data and Sample

Our firm characteristic variables are obtained from COMPUSTAT and the sample period is from 1996 to 2014. We follow Liao et al (2015) and construct log-transformed of firm assets, market-to-book ratio, ROA, tangibility, depreciation, R&D expenses,

R&D indicator and industry median leverage, etc. as the control variables. *Leverage* is total debt divided by the sum of total debt and market value of equity. *Firm Size* is the total assets. *Market-to-Book* is book liabilities plus market value of equity divided by book value of assets. *Profitability* is operating income before depreciation divided by total assets. *Tangibility* is property, plant, and equipment as a proportion of total assets. *Dividend Payer* equals 1 if dividend is paid in the fiscal year, and 0 otherwise. *R&D Expenses* is the R&D expenses divided by sales. *R&D Indicator* equals 1 if firm reports R&D expenses, and 0 otherwise. *Depreciation* is the depreciation divided by total assets. *Industry Leverage* is the median market leverage ratio in each year for firms in the same two-digit SIC industry.

Governance variables are obtained from RiskMetrics covering the information of senior managers during the period between 1996 and 2014. Institutional holding information is obtained from Thomson Reuters during the period of 1996 and 2014. We define CEO-Chairman separation, board independency, institutional holding and managerial delta (Morellec et al 2012) as proxies as measurement of corporate governance efficiency. If the companies have better corporate governance system, we would expect less severe manager-shareholders conflicts which implies a non-duality CEO, more independency board and higher institutional holding. Moreover, the managerial delta would be lower based on Morellec et al (2012) and Liao et al (2015). In our paper, *Chairman Separation* equals 1 if the CEO is not the chairperson of the board, and 0 otherwise. More independent board are considered as evidence of efficient and better monitor of managers. We define two variables as proxies regarding board independence. *Outside Directors* is the number of outside directors divided by total

number of directors on a board. More outside directors are believed to be more likely in behave on shareholders' interest (Byrd and Hickman (1992)). *Holdings* is the number of institutional investor-held shares divided by total number of shares outstanding. Shleifer and Vishny (1986) argue large shareholders are more likely to make tender offer, or lead to a proxy battle. Higher exposure to the risk motivates institutional shareholders better monitor self-interested managers. *Managerial Delta* is the sensitivity of the total value of stock and option holding of top five executives to a change in the stock price. Daily stock price returns are obtained from CRSP to conduct event study analysis.

We collect all exchange offers regarding leverage-decreasing or leverage-increasing capital restructuring from LexisNexis academic between 1990 and 2014. We find 238 leverage-decreasing and 30 leverage-increasing exchange offer. Because of no simultaneous change in the assets structure of the issuing firms, the pure effect of exchange offers allows us to isolate the effects of change in capital structure. Most importantly, there is no cash transaction involved in those exchange offers. In order to match those exchange offers with corresponding identity in COMPUSTAT, we manually collect each issuing company of exchange offer with GVEKY, PERMNO, and PERMCO in COMPUSTAT or CRSP by using WRDS company identifier. Besides, we combine our exchange offers with Danis (2013)[1] data if there is any missing exchange offer that could not be found in LexisNexis. Finally we have 143 exchange offers with complete information from COMPUSTAT and CRSP (some companies have duplicate exchange offers issuance).

[1] We are very grateful to author for sharing the data

Table 10
Summary Statistics

This table presents summary statistics for leverage, governance variables, and firm characteristics for nonfinancial, nonutility U.S. firm-year observations in our sample during 1996–2008. *Leverage* is total debt divided by the sum of total debt and market value of equity. *Firm Size* is the total assets. *Market-to-Book* is book liabilities plus market value of equity divided by book value of assets. *Profitability* is operating income before depreciation divided by total assets. *Tangibility* is property, plant, and equipment as a proportion of total assets. *Dividend Payer* equals 1 if dividend is paid in the fiscal year, and 0 otherwise. *R&D Expenses* is the R&D expenses divided by sales. *R&D Indicator* equals 1 if firm reports R&D expenses, and 0 otherwise. *Depreciation* is the amount of deprecation divided by total assets. *Industry Leverage* is the median market leverage ratio in each year for firms in the same two-digit SIC industry. *CEO-Chairman Separation* equals 1 if the CEO is not the chairperson of the board, and 0 otherwise. *Holdings* is the number of institutional investor-held shares divided by total number of shares outstanding. *Outside Directors* is the number of outside directors divided by total number of directors on a board. *Managerial Delta* is the sensitivity of the total value of stock and option holding of top five executives to a change in the stock price. Panel B provides the summary statistics for the companies who issues leverage-increasing exchange offers.

Panel A: Summary Statistics for Full Sample

Variable	Mean	Median	Std Dev	Minimum	Maximum
Leverage	0.1904	0.1441	0.1874	0	0.9844
Firm Size (in million)	7.2854	7.1350	1.4483	2.9866	13.3542
Market-to-Book	1.8543	1.3893	1.4603	0.0425	9.4784
Profitability	0.1499	0.1459	0.1027	-1.3192	0.9651
Tangibility	0.2852	0.2278	0.2119	0.0023	0.9662
Dividend Payer	0.5434	1	0.4981	0	1
R&D Expense	0.0332	0.0056	0.0559	0	0.9379
R&D Indicator	0.6596	1	0.4739	0	1
Depreciation	0.0461	0.0405	0.0345	0.0009	1.1925
Industry Leverage	0.1420	0.1104	0.1285	0	0.9474
CEO-Chairman Separation	0.4408	0	0.4965	0	1
Holdings	0.7361	0.7654	0.1935	0	0.9997
Outside Directors	0.6755	0.7	0.1679	0	0.9167
Managerial Delta	6.4222	6.4438	1.4666	0	13.7473

Panel B: Summary Statistics for Companies Issuing Exchange Offers

Variable	Mean	Median	Std Dev	Minimum	Maximum
Leverage	0.4680	0.4469	0.2412	0.0178	0.9749
Firm Size (in million)	8.1215	7.7734	1.7631	5.0067	12.7072
Market-to-Book	1.0233	0.8870	0.5282	0.3679	5.0257
Profitability	0.1095	0.1155	0.0856	-0.3138	0.3014
Tangibility	0.2772	0.2310	0.2114	0.0065	0.7396
Dividend Payer	0.5846	1	0.4947	0	1
R&D Expense	0.0223	0.0075	0.0394	0	0.2789
R&D Indicator	0.5846	1	0.4947	0	1
Depreciation	0.0436	0.0398	0.0252	0.0023	0.1355
Industry Leverage	0.1817	0.1571	0.1496	0.0024	0.6447
CEO-Chairman Separation	0.4370	0	0.4981	0	1
Holdings	0.7092	0.7284	0.2265	0.0514	0.9991
Outside Directors	0.7111	0.7273	0.1575	0.2857	0.9091
Managerial Delta	5.5841	5.7838	1.5417	0.8194	8.7887

Table 1 provides the summary statistics of all variables in our sample from 1996-2006, which is the sample period that is used to estimate the shareholders' target leverage ratio. The company in our sample has an asset of 7.3 million on average. The mean leverage ratio is 19 percent, with a book-to-market ratio of 1.8 and profitability of 15 percent. There are 28 percent of the assets are tangible, and over 54 percent of our sample firms are dividend payers. A typical company spends over 3 percent of total sales on research and development, over 65 percent of our sample firms report a R&D expenses with an annual depreciation over 4 percent of total assets. On the other hand, over 44 percent of our sample firms have non-dual directorship with over 67 percent of directors with independent affiliations. The mean managerial delta is 6.42.

Panel B of table 1 provides the summary statistics for 141 firms issuing exchange offers. The mean leverage ratio of those treatment firms is much higher than a typical firm in the full sample, which is about 46.8 percent. However, the other firm characteristics are somehow similar to a typical in our full sample. Moreover, corporate governance variables are also similar, indicating that a treatment firm is not systematically different from a sample firm.

4. Testing Methodology and Empirical Results.

4. I Event Study of All Leverage-Decreasing Exchange Offers

To test our hypothesis, we follow previous literatures and conduct an event study to show the cumulative abnormal returns (CAR) around the announcement date for those exchange offers. The entire event period is [-256, 10]. Estimation period is [-245, -10].

We calculate the CAR within the event window [-1, 1] and test the significance of the CAR based on the standard errors of cumulative returns for all exchange offers. We define four different ways to calculate the abnormal return; market model, adjusted market model, Fama-French 3-factor model and 4 factor model with momentum. The market model is the simple abnormal return which is calculated by subtracting individual stock return from S&P 500 value-weighted market return. Adjusted market model calculates the abnormal return by regressing individual stock returns on S&P 500 value-weighted market returns. 3-factor and 4-factor model calculate the abnormal returns by regression excess individual stock return on HML, SMB and excess market returns/momentum. HML, SMB and excess market returns are obtained from Kenneth French's website and momentum variable is from Pastor and Stambaugh (2003).

Table 2 provides the cumulative abnormal returns for all 145 leverage-decreasing exchange offers in our sample. Figure 1 provides the abnormal return and cumulative abnormal returns within the event window of [-10. 10]. Our finding is consistent all previous finding. There is negative cumulative abnormal returns round the window [-1, 1] no matter what specification of model is used and the negative effect is significant at 10 percent level. 4-factor model provides the most negative return in magnitude. From the figure we can clearly find that a dramatically drop of cumulative abnormal return round the announcement date, especially for the 4-factor model with momentum.

Table 11

Event Study of Leverage-Decreasing Exchange Offers

This table presents the results of event study for 143 companies exchanging debt for common equity. Panel A presents the abnormal return (AR) from ten days before announcement of exchange offers to ten days after the announcement of exchange offers. Estimation window used to calculate the abnormal returns is between [-245, 10]. *Market* abnormal returns is calculated as difference between daily stock returns and value-weighted S&P 500 market returns. *Adjusted* market return is the abnormal return calculated from the regressing daily stock returns on excess value-weighted market returns. 3-Factors return is the abnormal return calculated from Fama-French 3-factor model. 4-Factors return is the abnormal return calculated from 4-factor model including momentum. Panel B presents the cumulative abnormal return (CAR) from ten days before announcement of exchange offers to ten days after the announcement of exchange offers and the CAR for event window between [-3, -1], [-1, 1] and [1, 3]. Numbers in parenthesis are standard errors and ***, **, and * indicate significance at the 1% 5%, and 10% levels, respectively.

Panel A: Abnormal Returns

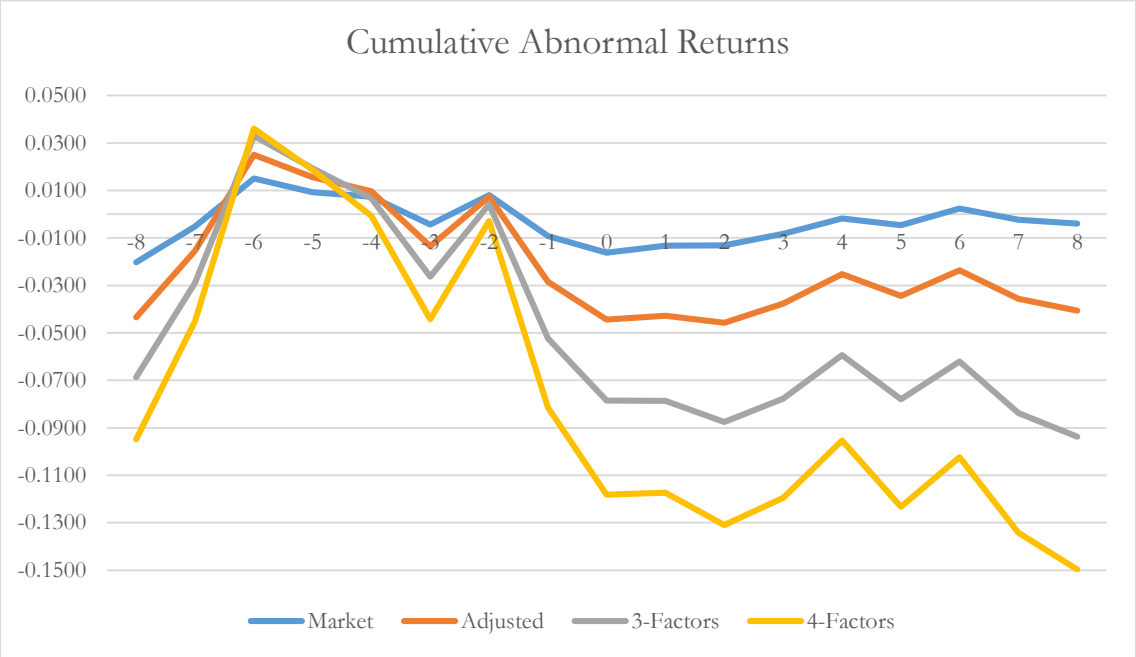
Window	*Market*	*Adjusted*	*3-Factors*	*4-Factors*
-8	-0.0136	-0.0120	-0.0127	-0.0128
-7	0.0152	0.0128	0.0117	0.0101
-6	0.0202	0.0203	0.0215	0.0192
-5	-0.0058	-0.0037	-0.0043	-0.0036
-4	-0.0019	-0.0040	-0.0067	-0.0069
-3	-0.0117	-0.0116	-0.0100	-0.0104
-2	0.0124	0.0085	0.0096	0.0109
-1	-0.0174	-0.0185	-0.0205	-0.0221
0	-0.0070	-0.0088	-0.0104	-0.0105
1	0.0030	-0.0014	-0.0016	0.0009
2	0.0002	-0.0032	-0.0060	-0.0046
3	0.0048	0.0034	0.0018	0.0015
4	0.0066	0.0058	0.0060	0.0058
5	-0.0028	-0.0065	-0.0094	-0.0093
6	0.0070	0.0039	0.0052	0.0049
7	-0.0047	-0.0073	-0.0098	-0.0100
8	-0.0017	-0.0033	-0.0049	-0.0057

Panel B: Cumulative Abnormal Returns

Window	*Market*	*Adjusted*	*3-Factors*	*4-Factors*
-8	-0.0203	-0.0232	-0.0252	-0.0262
-7	-0.0051	-0.0103	-0.0135	-0.0161
-6	0.0151	0.0100	0.0080	0.0031
-5	0.0093	0.0063	0.0038	-0.0006
-4	0.0074	0.0023	-0.0029	-0.0075
-3	-0.0043	-0.0092	-0.0129	-0.0179
-2	0.0081	-0.0007	-0.0033	-0.0070
-1	-0.0093	-0.0192	-0.0238	-0.0291
0	-0.0163	-0.0281	-0.0342	-0.0396
1	-0.0133	-0.0295	-0.0358	-0.0388
2	-0.0131	-0.0327	-0.0418	-0.0434
3	-0.0083	-0.0293	-0.0401	-0.0419
4	-0.0017	-0.0235	-0.0341	-0.0360
5	-0.0046	-0.0299	-0.0435	-0.0453
6	0.0024	-0.0261	-0.0384	-0.0404
7	-0.0023	-0.0334	-0.0482	-0.0504
8	-0.0040	-0.0367	-0.0530	-0.0561
		CAR[-3, -1]		
	-0.0177	-0.0231	-0.0220	-0.0228
	(0.0199)	(0.0196)	(0.0194)	(0.0192)
		CAR[-1, 1]		
	-0.0239	-0.0321	-0.0360*	-0.0352
	(0.0211)	(0.0216)	(0.0224)	(0.0225)
		CAR[1, 3]		
	0.0095	-0.0006	-0.0049	-0.0014
	(0.0154)	(0.0154)	(0.0147)	(0.0145)

Figure 2. Abnormal Returns and Cumulative Abnormal Returns of Equity for Debt Exchange Offers

This graph reports the cumulative abnormal returns (CAR) between the event window [-10, 10], which is calculated from Market model, Adjusted Market model, FF 3-Factors model and 4-Factors model with momentum.



The event study of all leverage-decreasing exchange offers in our sample indicates the negative market reaction around the announcement date. Our results confirm the previous finding that are originally detected by Masulis (1984) and Copeland and Lee (1991).

4. II Estimation of Shareholders' Target Leverage Ratio

We follow the Liao et al (2015) to estimate the shareholders' target leverage by using Blundell and Bond (1998) GMM estimation. We measure capital structure by using market debt-to-capital ratio which could be expressed as:

$$L_{it} = \frac{FD_{it}}{FD_{it} + S_{it}P_{it}}$$

Where FD_{it} is the financial debt of firm $\underline{i}$ at year t, that is, the sum of long term debt and current liability; S_{it} is the number of common share outstanding; and P_{it} is the stock price of firm i at year t.

The conventional partial adjustment model for leverage evolution is as below:

$$L_{it} - L_{i,t-1} = \lambda\left(L_{it}^{*} - L_{i,t-1}\right) + \varepsilon_{it}$$

Where L_{it}^{*} is target leverage ratio and λ captures speed of adjustment. We estimate the target leverage with $L_{it}^{*} = \beta X_{i,t-1}$. Our model would become:

$$L_{it} = (1-\lambda)L_{i,t-1} + \lambda\beta X_{i,t-1} + \varepsilon_{it}$$

$X_{i,t-1}$ represent a set of firm characteristics, time and firm fixed effect, the median leverage for two-digit Standard Industrial Classification (SIC). Given actual corporate governance quality, the predicted target from $L_{it}^{*} = \beta X_{i,t-1}$ captures managers' desired target. We assume perfect corporate governance quality takes 99th percentile value of corporate governance variables. This predicted ratio would serve as our estimate of the shareholders' desired leverage level.

Table 3 presents the results of GMM estimation. The entire sample includes 10,577 firm-year observations from 1996 to 2008 consisting 1634 unique companies. Specification one is result of conventional partial adjustment model without the corporate governance variables. Lagging leverage ratio is positively significant at 1 percent level indicating an adjustment speed of 0.315, which is similar to finding of Liao et al (2015). Moreover, *Firm size*, *Market-to-book* ratio, *Profitability*, *R&D Expenses* and *Industry Leverage* ratio are also significant at 1 percent level and sign of coefficients are also as expected. Frank and Goyal (2009) define those variables as the most important variables for capital structure research.

Specification two of table 3 presents the result of conventional partial adjustment model after including all four corporate governance variables; The Morellec, Nikolov and Schurhoff (2012) predict that a self-interested manager tends to use leverage lower than optimal

Table 12
Corporate Governance and Leverage

This table presents the estimation results for partial adjustment model as following:

$$L_{it} = (1-\lambda)L_{i,t-1} + \lambda\beta X_{i,t-1} + \varepsilon_{it}$$

Where L_{it} is leverage ratio of a typical firm, $X_{i,t-1}$ represent a set of firm characteristics, time and firm fixed effect, the median leverage for two-digit Standard Industrial Classification (SIC). Specification (1) only includes firm characteristics such as firm size, market-bo-book ratio, profitability, depreciation, tangibility, R&D expense, dividend payer indicator, R&D indicator and industry leverage ratio with year and firm fixed effect. Specification (2) includes additional corporate governance variables such as CEO-director separation, outside directors, institutional holdings and managerial delta. Numbers in parenthesis are standard errors and ***, **, and * indicate significance at the 1% 5%, and 10% levels, respectively.

	(1)	(2)
Lag Leverage	0.6852***	0.7238***
	(0.037)	(0.030)
Firm Size	0.0077***	0.0080
	(0.001)	(0.005)
Market-to-Book	-0.0087***	0.0033
	(0.001)	(0.003)
Profitability	-0.0812***	-0.1710***
	(0.018)	(0.040)
Depreciation	0.0315	-0.0742
	(0.060)	(0.109)
Tangibility	0.0187**	-0.0320
	(0.009)	(0.031)
R&D Expense	-0.1236***	-0.2712***
	(0.026)	(0.080)
Dividend Payer	-0.0032	0.0072
	(0.003)	(0.005)
R&D Indicator	-0.0059*	-0.0021
	(0.003)	(0.015)
Industry leverage	0.1044***	0.1248***
	(0.021)	(0.030)
CEO-Director Separation		0.0040
		(0.004)
Outside Directors		-0.0136
		(0.019)
Holdings		0.1145***
		(0.032)
Managerial Delta		-0.0099*
		(0.006)
N	10,557	10,187
Number of Firms	1,634	1,597
Year FE	YES	YES
Robusted SE	YES	YES

The presence of efficient corporate governance would alleviate this problem. We expect the *CEO-Director Separation*, *Independent Directors* and *Holdings* to be positively related to leverage ratio. On the other hand, the *Managerial Delta* would be negatively related to the leverage. The second column of table 3 confirms our expectation. After adding corporate governance variable into our model, λ decreases to 0.277 indicating a lower speed of adjustment. Coefficients of *CEO-Director Separation* and *Holdings* are positive and Holdings is significant at 1 percent level. However, the sign of *Outside Director* is not as expected, which is negative 0.014 and not significant. Only *Profitability*, *R&D Expense* and *Industry Leverage* still remain significant in the second specification.

Based on the coefficients estimated in our conventional partial adjustment model, we calculate the shareholder's target leverage and divide all sample firms into two group; underleveraged firms and overleveraged firms. The 99th percentile value for CEO-Director Separation, Holding, Outside Directors and Managerial Delta are 1, 0.99, 0.91667 and 3.1107 respectively. However, we end up with 90 companies with non-missing financial information from COMPUSTAT which is needed for calculating shareholder's target, at the year when those companies issued exchange offers. There are 38 companies issuing exchange offers with an actual leverage ratio lower than shareholders' target and 52 companies with an actual leverage ratio higher than shareholders' target.

Table 13

Shareholders' Leverage Targets

This table provides the summary statistics of actual leverage ratio and shareholders' target leverage ratio for under-levered companies and over-levered companies. There are 52 under-levered companies and 38 over-levered companies.

	Mean	Median	Std Dev	1st Pctl	99th Pctl
Actual Leverage Level					
All Companies	0.5677	0.6192	0.3171	0	0.9987
Below the Target	0.4419	0.4531	0.2826	0	0.8715
Above the Target	0.7565	0.8686	0.2716	0.0841	0.9987
Estimated Shareholders' Targets					
All Companies	0.6390	0.7195	0.2506	0	0.9375
Below the Target	0.6580	0.6966	0.2274	0.1659	0.9375
Above the Target	0.6104	0.7383	0.2831	0	0.9358

Table 4 provides the results of actual leverage ratio and shareholders' target for all 90 companies. The mean actual leverage for all companies is 0.568. For those who have an actual leverage lower than shareholders' target, the mean actual leverage is 0.442 which is about 20 percent below the target. On the other hand, for those who have an actual leverage higher than shareholders' target, the mean actual leverage is 0.757 which is about 14 percent higher than target.

4. III Event Study for Sub-Sample

We then conduct event study analysis for these two sub groups based on whether companies leverage are below or above the shareholders' target. We still use market model, adjusted market model, FF 3-factor model and 4-factor model to calculate the abnormal returns. Estimation window is [-245, -10]. Event window is [-10, 10]. Table 5 and 6 provide the results of event study.

Based on our hypothesis, the companies with leverage ratio lower than target still issue a leverage-decreasing exchange offer, signaling a possible erosion of corporate governance. In table 5, we find that there are significant negative CAR around the announcement date [-1, 1] no matter what model is used to calculate the abnormal return. All CAR are significant at 1 percent level indicating a strong market reaction. Moreover, the negative return is over 5 percent for all specifications. From figure 1, we clearly find a dramatically drop of CAR around the event window [-2, 2].

Table 14
Abnormal Returns for Under-Levered Companies

This table presents the results of event study for 58 companies exchanging debt for common equity where actual leverage ratios are lower than estimated shareholders' target. Panel A presents the abnormal return (AR) from ten days before announcement of exchange offers to ten days after the announcement of exchange offers. Estimation window used to calculate the abnormal returns is between [-245, 10]. *Market* abnormal returns is calculated as difference between daily stock returns and value-weighted S&P 500 market returns. *Adjusted* market return is the abnormal return calculated from the regressing daily stock returns on excess value-weighted market returns. 3-Factors return is the abnormal return calculated from Fama-French 3-factor model. 4-Factors return is the abnormal return calculated from 4-factor model including momentum. Panel B presents the cumulative abnormal return (CAR) from ten days before announcement of exchange offers to ten days after the announcement of exchange offers and the CAR for event window between [-3, -1], [-1, 1] and [1, 3]. Numbers in parenthesis are standard errors and ***, **, and * indicate significance at the 1% 5%, and 10% levels, respectively.

Panel A: Abnormal Returns

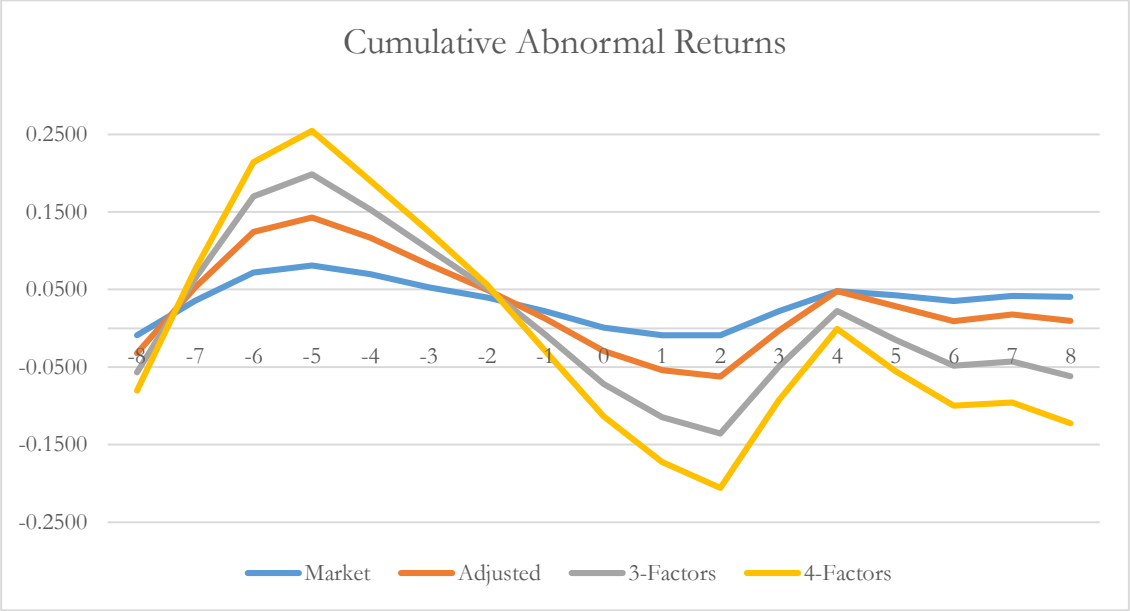
Window	*Market*	*Adjusted*	*3-Factors*	*4-Factors*
-8	-0.0145	-0.0167	-0.0174	-0.0157
-7	0.0446	0.0401	0.0364	0.0354
-6	0.0365	0.0349	0.0342	0.0326
-5	0.0089	0.0098	0.0100	0.0117
-4	-0.0111	-0.0150	-0.0192	-0.0190
-3	-0.0168	-0.0180	-0.0162	-0.0143
-2	-0.0134	-0.0189	-0.0185	-0.0179
-1	-0.0177	-0.0196	-0.0225	-0.0256
0	-0.0209	-0.0204	-0.0219	-0.0211
1	-0.0097	-0.0153	-0.0181	-0.0156
2	-0.0003	-0.0078	-0.0130	-0.0124
3	0.0310	0.0281	0.0268	0.0266
4	0.0263	0.0246	0.0212	0.0205
5	-0.0057	-0.0135	-0.0180	-0.0174
6	-0.0074	-0.0120	-0.0138	-0.0116
7	0.0066	0.0017	-0.0032	-0.0011
8	-0.0010	-0.0072	-0.0105	-0.0080

Panel B: Cumulative Abnormal Returns

Window	*Market*	*Adjusted*	*3-Factors*	*4-Factors*
-8	-0.0091	-0.0229	-0.0248	-0.0238
-7	0.0355	0.0173	0.0116	0.0116
-6	0.0719	0.0522	0.0458	0.0442
-5	0.0809	0.0620	0.0558	0.0559
-4	0.0697	0.0470	0.0366	0.0369
-3	0.0529	0.0290	0.0204	0.0226
-2	0.0395	0.0101	0.0019	0.0047
-1	0.0218	-0.0095	-0.0206	-0.0208
0	0.0009	-0.0299	-0.0425	-0.0420
1	-0.0088	-0.0452	-0.0607	-0.0575
2	-0.0091	-0.0530	-0.0737	-0.0700
3	0.0218	-0.0249	-0.0468	-0.0433
4	0.0481	-0.0003	-0.0256	-0.0228
5	0.0424	-0.0138	-0.0436	-0.0402
6	0.0351	-0.0258	-0.0575	-0.0517
7	0.0417	-0.0240	-0.0607	-0.0528
8	0.0407	-0.0313	-0.0712	-0.0608
		CAR[-3, -1]		
	-0.0517***	-0.0608***	-0.0614***	-0.0622***
	(0.0222)	(0.0213)	(0.0203)	(0.0202)
		CAR[-1, 1]		
	-0.0526***	-0.0601***	-0.0678***	-0.0676***
	(0.0224)	(0.0227)	(0.0274)	(0.0278)
		CAR[1, 3]		
	0.0243	0.0069	-0.0024	0.0005
	(0.0223)	(0.0224)	(0.0181)	(0.0185)

Figure 3. Abnormal Returns for Companies Where Leverage Lower than Shareholders' Targets

This graph reports the cumulative abnormal returns (CAR) for under-levered firms between the event window [-10, 10], which is calculated from Market model, Adjusted Market model, FF 3-Factors model and 4-Factors model with momentum.



The results clearly show the evidence that market react negatively to companies who issued a leverage-decreasing exchange offer when they do not fully utilize the debt. Managers might retire more debt to benefit personal privilege and somehow corporate board could not efficiently monitor this behavior.

On the other hand, table 6 provides the results for the companies with an actual leverage ratio lower than the targets. The CAR around the announcement date for this group is also negative, however not significant at any confidence level. The negative returns are all lower than 2.2 percent. Compared with the other group, the magnitude and significance of negative return are much weaker. From figure 3, we do not find obvious decline of CAR around the announcement date. Actually the CAR is positive on date +1, indicating a non-negative reaction from the market.

The sub-sample event study analysis provides the evidence that market reacts negatively to a leverage-decreasing exchange offer is mostly because of a worry of possible eroding corporate governance system. Since the group with leverage lower than targets dominates our sample, which shows a much stronger negative CAR compared with the other group. We could reach out the conclusion that the results confirm our prediction and hypothesis.

4. IV Poor and Good Governed Firms

Table 15
Abnormal Returns for Over-Levered Companies

This table presents the results of event study for 32 companies exchanging debt for common equity where actual leverage ratios are higher than estimated shareholders' target. Panel A presents the abnormal return (AR) from ten days before announcement of exchange offers to ten days after the announcement of exchange offers. Estimation window used to calculate the abnormal returns is between [-245, 10]. *Market* abnormal returns is calculated as difference between daily stock returns and value-weighted S&P 500 market returns. *Adjusted* market return is the abnormal return calculated from the regressing daily stock returns on excess value-weighted market returns. 3-Factors return is the abnormal return calculated from Fama-French 3-factor model. 4-Factors return is the abnormal return calculated from 4-factor model including momentum. Panel B presents the cumulative abnormal return (CAR) from ten days before announcement of exchange offers to ten days after the announcement of exchange offers and the CAR for event window between [-3, -1], [-1, 1] and [1, 3]. Numbers in parenthesis are standard errors and ***, **, and * indicate significance at the 1% 5%, and 10% levels, respectively.

Panel A: Abnormal Returns

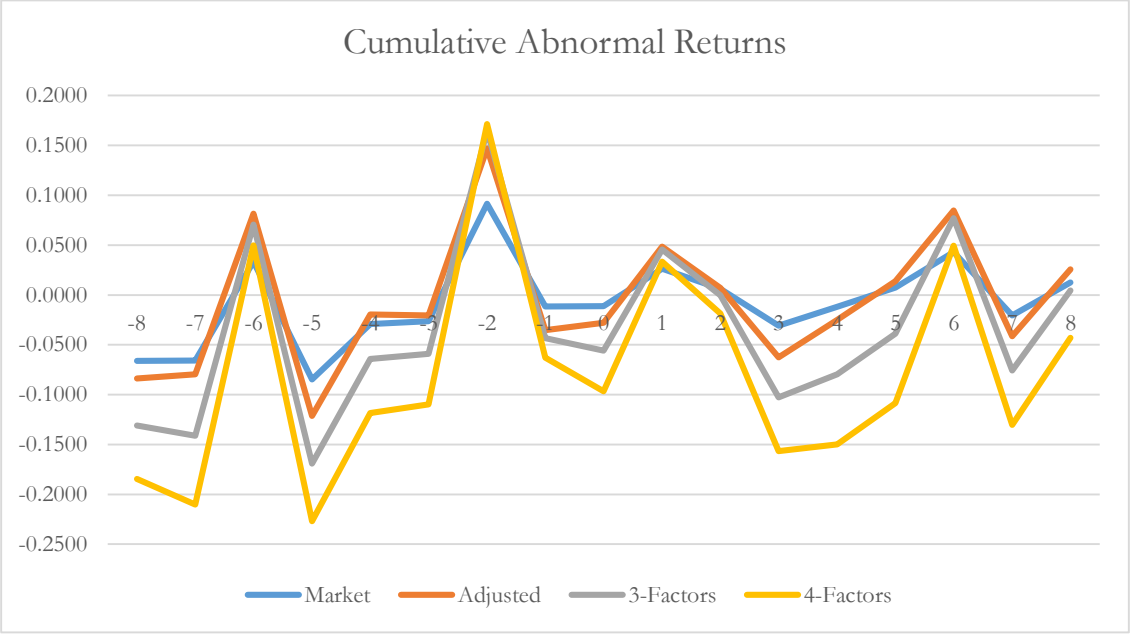
Window	*Market*	*Adjusted*	*3-Factors*	*4-Factors*
-8	-0.0225	-0.0177	-0.0225	-0.0248
-7	-0.0110	-0.0140	-0.0147	-0.0150
-6	0.0441	0.0480	0.0508	0.0478
-5	-0.0370	-0.0367	-0.0369	-0.0367
-4	0.0093	0.0094	0.0031	0.0035
-3	0.0061	0.0056	0.0062	0.0036
-2	0.0619	0.0554	0.0563	0.0573
-1	-0.0205	-0.0239	-0.0258	-0.0262
0	-0.0111	-0.0168	-0.0200	-0.0212
1	0.0264	0.0220	0.0251	0.0285
2	0.0060	0.0010	-0.0045	-0.0060
3	-0.0308	-0.0319	-0.0327	-0.0356
4	-0.0119	-0.0133	-0.0144	-0.0163
5	0.0075	0.0063	0.0020	0.0004
6	0.0430	0.0416	0.0450	0.0423
7	-0.0204	-0.0211	-0.0267	-0.0272
8	0.0126	0.0132	0.0131	0.0068

Panel B: Cumulative Abnormal Returns

Window	*Market*	*Adjusted*	*3-Factors*	*4-Factors*
-8	-0.0663	-0.0177	-0.0469	-0.0538
-7	-0.0657	-0.0140	-0.0616	-0.0689
-6	0.0335	0.0480	-0.0108	-0.0211
-5	-0.0846	-0.0367	-0.0477	-0.0577
-4	-0.0291	0.0094	-0.0446	-0.0543
-3	-0.0262	0.0056	-0.0384	-0.0507
-2	0.0915	0.0554	0.0179	0.0066
-1	-0.0114	-0.0239	-0.0080	-0.0196
0	-0.0111	-0.0168	-0.0279	-0.0408
1	0.0264	0.0220	-0.0028	-0.0123
2	0.0060	0.0010	-0.0074	-0.0183
3	-0.0308	-0.0319	-0.0401	-0.0538
4	-0.0119	-0.0133	-0.0545	-0.0701
5	0.0075	0.0063	-0.0525	-0.0698
6	0.0430	0.0416	-0.0075	-0.0275
7	-0.0204	-0.0211	-0.0343	-0.0546
8	0.0126	0.0132	-0.0211	-0.0478
		CAR[-3, -1]		
	0.0499	0.0394	0.0389	0.0369
	(0.0343)	(0.0337)	(0.0326)	(0.0318)
		CAR[-1, 1]		
	-0.0054	-0.0194	-0.0214	-0.0196
	(0.0252)	(0.0261)	(0.0260)	(0.0265)
		CAR[1, 3]		
	0.0017	-0.0092	-0.0126	-0.0135
	(0.0304)	(0.0304)	(0.0315)	(0.0310)

Figure 4. Abnormal Returns for Companies Where Leverage Higher than Shareholders' Targets

This graph reports the cumulative abnormal returns (CAR) for over-levered firms between the event window [-10, 10], which is calculated from Market model, Adjusted Market model, FF 3-Factors model and 4-Factors model with momentum.



In this section, we investigate how many under-levered or over-levered companies are actually poor governed. We construct an aggregate governance quality variable, which is the weighted average of all four corporate governance variables specified in the previous section. We construct this aggregate variable based on PCA. PCA gives a comprehensive all-in-one variable as well as removing multi-collinearity among four individual corporate governance variables. The factor loadings for *CEO-Director separation*, *outside directors*, *holdings* and *Managerial Delta* are 0.329, 0.493, 0.54 and -0.275, respectively. Based on these factor loadings, the median aggregate governance qualify is 0.095.

Table 7 presents the summary statistics of aggregate governance qualify for under-lever and over-levered companies. Due to the missing value in individual corporate governance variables, we are unable to calculate the aggregate governance qualify for all firms: only 20 out of 52 under-levered firms and 8 out 38 over-levered firms have all complete information of individual corporate governance variables. Based on the information we retrieve, 18 out of 20 under-levered firms have an aggregate governance value below than sample median. On the other hand, 4 out of 8 over-levered firms have an aggregate governance value below than sample median. The mean aggregate governance qualify for under-levered firms is way below the sample mean, which is at -0.515, an almost 35 percent lower than mean aggregate qualify of over-levered firms. However, this result potentially indicates that under-levered firms are dominated by poor-governed firms, which is over 90 percent of entire under-levered firms.

Table 16
Aggregate Governance Qualify

Table 7 presents the summary statistics of aggregate governance qualify for under-lever and over-levered companies. The factor loadings for *CEO-Director separation*, *outside directors*, *holdings* and *Managerial Delta* are 0.329, 0.493, 0.54 and -0.275, respectively. Due to the missing value in individual corporate governance variables, we are unable to calculate the aggregate governance qualify for all firms: only 20 out of 52 under-levered firms and 8 out 38 over-levered firms have all complete information of individual corporate governance variables.

	Aggregate	Below Median	Above Median	Not Sure
Below Shareholders' Target	-0.5149	18	2	32
Above Shareholders' Target	-0.0760	4	4	30

5. Conclusion

In conclusion, we find actual leverage is almost 21 percent lower than estimated shareholders' target for the under-lever group. Most importantly, we particularly find that negative announcement returns are driven by the group with leverage level lower than target: a negative return over 5 percent at 1 percent significance no matter what specifications of calculations of abnormal returns are used. On the other hand, for the group with leverage lever higher than target, the event study analysis indicates there is no significant negative return associated in this group, indicating a possible eroding of corporate governance monitor system for those companies. Subsample event study confirms our prediction that the negative market reaction of an equity for debt exchange offer reflects worsen corporate governance since those companies do not behave on shareholders' interest.

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Appendix
Variable Definition

Variable	Description
Leverage	Book debt ratio: total debts divided by total assets. Total debts=COUPUSTAT item ([9]+[34]).
Firm Size	Log transform of firm total assets. Assets are COMPUSTAT item [AT].
Profitability	Returns on Asset: net income divided by book value of total assets. Net income is COMPUSTAT item [172].
MB	Market to book ratio: Market equity value divided by book value of total assets. Market value of equity =COMPUSTAT item ([9]+[34]+[10]+[199]*[25]).
Tangibility	Tangible assets as a proportion of total assets: Common equity divided by total assets. Common equity is COMPUSTAT item [11].
Depreciation	The amount of deprecation divided by total assets
R&D/Assets	R&D expenses divided by total assets. R&D expenses is COMPUSTAT item [46].
R&D Indicator	Equals 1 if firm reports R&D expenses, and 0 otherwise.
Dividend Payer	Equals 1 if dividend is paid in the fiscal year, and 0 otherwise
Industry Leverage	Median market leverage ratio in each year for firms in the same two-digit SIC industry
CEO-Chairman Separation	Equals 1 if the CEO is not the chairperson of the board, and 0 otherwise.
Holdings	The number of institutional investor-held shares divided by total number of shares outstanding.
Outside Directors	Number of outside directors divided by total number of directors on a board
Managerial Delta	Sensitivity of the total value of stock and option holding of top five executives to a change in the stock price

Vita

Zhengyi Zhang was born in Xiamen, P.R. China. He obtained his B.S. in Finance from Jimei University, China in 2006. He also earned his M.S. in Mathematical Finance from University of North Carolina at Charlotte in 2012. He joined the University of New Orleans to pursue the Ph.D in Financial Economics in 2012. His research interest includes corporate governance, capital structure, and corporate innovation.