RESEARCH ARTICLE

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Evaluating the Effects of Equity Incentives Using PSM: Evidence from China

Abstract   This paper investigates the effects of equity incentives on firm performance in Chinese listed firms. We address the sample selection problem by employing the propensity score matching methodology. Results show that, (1) On the whole, performance is positively related to equity incentives even after controlling for sample selection bias; (2) The final control rights have an important impact on the effects of equity incentives. The execution of equity incentives in privately owned firms can significantly decrease the agency costs between shareholders and managers, but such effects cannot be observed in state-owned firms; (3) Effects of equity incentives depend on the incentive type, that is, comparing to stock-based incentives, option-based incentives can reduce the agency costs significantly, thus are more effective; (4) Ownership structure also has important impacts on the effects of equity incentives. The agency costs decrease in firms with more decentralized ownership after introducing equity incentive, while in concentrated firms the effect is negligible.

Keywords   equity incentives, firm performance, propensity score matching, bootstrap

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1   Introduction

Equity incentives are widely adopted in firms of the developed countries to align the interests of management with those of shareholders in order to improve firm performance. Up till January 2006, Chinese security regulations precluded listed firms from offering equity incentive plans to management (Ke, Rui and Yu, 2009). In late 2005, the China Securities Regulatory Commission (CSRC) made certain revisions to its Corporation Regulations and Security Regulations, and released new revisions in the document "Regulation of Equity Incentive Plans (trial)" (REIP) in January, 2006. Under the revised regulations, financial market conditions and the legal environment have improved dramatically. New conditions have made it possible for Chinese listed firms to adopt equity incentive plans. These include: (1) ongoing reform of non-tradable shares,[1] (2) changes in the regulations that allow firms to repurchase shares and allow management to trade shares within their terms, and (3) breakthroughs in the capital system that have made it possible for firms to adopt equity incentive plans.

At present, empirical studies regarding the effectiveness of such plans are limited and inconclusive. Based on 34 observations after the release of REIP, Yang and Li (2008) find that equity incentive plans cannot increase the value of Chinese listed firms. However, the study does not control for the sample selection bias and small sample bias. By focusing on Chinese listed firms that have adopted equity incentive plans from 2001 to 2006, Cheng and Xia (2008) find that equity incentive plans can indeed increase firm value. The effects are further enhanced by the ongoing reform of the split share structure. However, before 2006, Chinese listed firms could informally offer equity incentive plans to management. Thus, some of their observations are prior to the release of REIP. He (2008) finds that Chinese listed firms prefer to choose standardized incentive plans rather than individual plans for each executive. This tendency is more obvious in small firms or firms with highly concentrated ownership. Ke et al. (2009) compare firms cross-listed in both domestic and foreign markets with firms listed only in China. They find that the ability to offer equity incentive plans in the foreign market is an important determinant for Chinese firms to choose cross-listing. Additionally,

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[1] Prior to the stock market reform, the Chinese domestic A-shares were divided into tradable and non-tradable shares with identical cash flow and voting rights. Non-tradable shareholders represent the government, holding about a two-thirds majority, and manage the firms, while tradable shareholders have little power to affect the decisions made by non-tradable shareholders. On April 29, 2005, the CSRC announced a program by which non-tradable shares would be converted into tradable shares. Holders of the non-tradable shares negotiated a compensation plan with holders of the tradable shares in order to make their shares tradable. By the end of 2006, the process was essentially complete, with over 95% of the affected companies completed the conversion (see Yeh, Shu, Lee and Su (2009), and Li, Wang, Cheung and Jiang (2010) for details).

adopting this plan can significantly increase shareholders' wealth, but it cannot improve firm performance, as proxied by ROA.

The literature has demonstrated theoretically that equity incentive plans can effectively improve firm performance (e.g., Baker, Jesen and Murphy, 1988; Shivdasani, 2002; among others). A potential problem in empirical studies on this topic regarding Chinese listed firms is that prior studies do not control for small sample bias. Since this plan is still relatively new, only a limited number of firms have adopted it. Thus, the sample size is small. The second concern, which is more important, is the sample selection bias documented in Heckman (1979). More specifically, firms with good prior performance are more inclined to adopt equity incentive plans. Consequently, observed improved performance may be driven by other reasons, rather than the plan itself. Surprisingly, there is little literature concerns this problem, yet little related evidence is provided.

In this study, we address the sample selection bias by applying the propensity score matching approach (PSM). Additionally, we use the Bootstrap method to control for the small sample bias. We investigate the following issues. First, can firms increase value by adopting equity incentive plans? Second, how does the type of the plan and the ownership structure change the effect of the plan on firm performance? Third, what drives the effectiveness of the plan? We find that equity incentive plans can indeed improve firm performance, as measured by ROE. However, this effectiveness is stronger in firms that offer option plans or in firms with a decentralized ownership structure. Additionally, equity incentive plans result in reduced agency costs and increased investment in fixed assets.

The rest of this paper proceeds as follows: Section 2 reviews the literature and develops the hypotheses. Section 3 presents the experimental design and econometric method. Section 4 describes the sample selection and variable measurement. Section 5 discusses the results, followed by the conclusion in Section 6.

2   Literature Review and Hypotheses Development

2.1   Equity Based Compensation and Firm Performance

The prior literature has shown that equity incentive plans can effectively improve firm performance in the United States (Murphy, 1999; Core, Guay and Larcker, 2003; Frydman and Saks, 2010). With an equity incentive plan in place, agency costs can be mitigated, since management not only tends to align their interests with those of shareholders, but also is motivated to focus, not on short term, but on long term firm performance.

The literature regarding the effectiveness of equity incentive plans in China is limited and inconclusive. One major concern of the financial market in China is

that the government has a large amount of control over it, however, there is still a lack of supervision of financial markets. Furthermore, the government generally not only controls a large portion of shares, but also nominates the management. This can result in corruption and management behavior of over spending and misuse of funds. Thus, agency costs are high in Chinese listed firms. Equity incentive plans seem to be a solution to this problem. With a promise of shares, management is motivated to make decisions for shareholders, including themselves. Therefore, Chinese listed firms should have better performance after adopting an equity incentive plan (Yu, 2006). Empirical studies generally support this view. The stock market generally responds positively to the announcement of the plan (Cui and Zhang, 2008; Zhang and Zheng, 2008). Meanwhile, a few studies argue that equity incentive plans can incur negative effects on corporations due to the unique governance structure in Chinese listed firms. For example, Yu and Gu (2001) find that equity incentive plans can increase the shareholdings of management and thus make the market less liquid. This can make the "insiders' control" problem more severe. Lü and Zhao (2008) argue that with equity incentive plans, management has more incentive to manipulate earnings and utilize "window-dressing" of firm performance.

However, most empirical studies focus on horizons prior to the release of REIP in January, 2006. It is generally believed by market participants that the operation of corporations has become more efficient in recent years due to (1) REIP, the revised Corporation Regulations, and especially (2) reform of the split share structure, a major reform in the Chinese capital market that is expected to resolve problems prevailing in the market for a long time. Hence, under the new capital system and market environment, equity incentive plans are expected to motivate management to enhance shareholder value.

Based on the above analysis, we propose our first hypothesis:

H1   Equity incentive plans can improve firm performance in Chinese listed firms.

2.2   The Impact of Final Control Rights on Equity Based Compensation

Before entering the market as listed firms, the majority of Chinese firms are owned by the government, which also has final ownership control rights, even after those firms have been traded in the market. Along with the development of the economy, more and more private firms have been listed in the market. Consequently, the final control rights of those firms belong to the major shareholders. We argue that the variations of final ownership control rights could have varying impacts on the effectiveness of equity incentive plans.

In order to make an equity incentive plan effective, three necessary conditions have to be met (Yu, 2006). First, there is a competitive market for management,

from which all management is chosen. Second, management is motivated by economic incentives, not by other formats of incentives. Third, the board functions well. This means that management is under the supervision of board members. However, the above three conditions cannot be satisfied among Chinese listed firms controlled by the government. For example, unlike in the United States, there is not a competitive market for management in China. Most of those chosen for management are nominated by the government directly, resulting in management having a greater interest in satisfying the government, rather than shareholders. Thus, equity incentive plans will not be as effective in those firms as in firms controlled by shareholders, since the management in the latter, nominated by the board rather than the government, is expected to represent shareholders to increase shareholder value.

Based on the above analysis, we propose our second hypothesis:

H2 Equity incentive plans are more effective in private firms than in stated-owned firms.

2.3 The Effectiveness and Types of Equity Incentive Plans

A series of empirical studies have shown that the effectiveness of equity incentive plans depends on the type of the plan. For example, Goering (1996) demonstrates theoretically that (1) an optimum choice of a plan relies on the characteristics of a specific management, and (2) different types of plans are associated with varying results. Lazear (2000), Barron and Waddell (2003, 2008) also prove these points.

In China, firms can choose one of four types of equity incentive plans: (a) management stock options, (b) shares transferred to management from shareholders, (c) shares newly issued just for management, or (d) shares purchased for management from the market. In order to simplify the following discussion, we classify them into two categories: (1) option plans (consisting of (a) above), and (2) share plans (consisting of (b), (c) and (d) above).

In comparison with share plans, option plans can be more effective, due to the following reasons. First, option plans are more attractive to reputation management (Oyer and Schaefer, 2005). With option rewards, management has more incentive to improve firm performance in the long run. More specifically, if stock prices do not accelerate, option plans have no value to management, however, with share plans, management can retain certain value regardless of the stock price movement. Additionally, with option plans, management tends to choose more risky projects to boost up stock prices. By doing so, the potential insufficient investment problem, due to the risk adverse nature of management, could be resolved (Hall and Murphy, 2003). Second, option plans can increase the retention rate of management. Third, option plans can help alleviate the

financial constraints (Core and Guay, 2001; Kato, Lemmon, Luo and Schallheim, 2005). Given the fact that the profitability of listed firms in China is generally low, which greatly limits their internal financing capacity, and the Chinese capital market is far from perfect, which made it difficult for the majority of Chinese listed firms to issue new shares in the market (Lian and Chung, 2008), we thus expect the Chinese listed firms tend to adopt option plans relative to stock plans.

Based on the above analysis, we propose our third hypothesis:

H3   Option plans are more effective than share plans in improving firm performance.

2.4   Shareholding Concentration and the Effectiveness of Equity Incentive Plans

One purpose of equity incentive plans is to mitigate agency costs. However, agency costs vary with ownership structure. Variations in ownership structure can result in different effects of equity incentive plans.

Chinese listed firms have two distinctive characteristics. First, ownership is highly concentrated. This is more severe in firms controlled by the government. Second, insiders are powerful and have tight control over firms. The above two features could make equity incentive plans less effective than expected. First, when ownership is highly concentrated, big shareholders play a significant role in firms. This makes the role of both management and equity incentive plans less significant. Mehran (1995) finds that with the existence of large shareholders, firms offer fewer options. Ke, Petroni and Safieddine (1999) argue that large shareholders can supervise management at lower cost. This makes motivating management with option plans unimportant. Thus, large shareholders and option plans seem to be the replacement of each other. Second, when shares are highly concentrated, controlling shareholders (especially government as a major controller) generally have goals other than that of management. Under these conditions, option plans are useless (Ke et al., 1999). For example, the goal of government as the controlling shareholder might be to retain all employees to maintain the prosperity of the society, etc. This is not feasible if management has total control of the firm. Therefore, option plans work better when the ownership is more scattered. In those firms, the goals of management and the shareholders could be easily aligned, and thus agency costs could be reduced. Third, firms with highly concentrated ownership are vulnerable to "tunneling," a kind of financial fraud in which a group of major shareholders of a publicly traded company orders that the company sell off its assets to a second company, owned by the group of shareholders, at unreasonably low prices. The shareholders typically own the second company outright, and thus profit from the otherwise disastrous sale. In the event such a scheme is underway, management has no incentive to enhance stockholder value, and equity incentive plans are, of course,

not applicable. Rational management would rather quit or take no efforts.

Based on the above analysis, we propose our fourth hypothesis:

H4   The effects of equity incentive plans are negatively related to the concentration of ownership.

3   Methodology

To empirically test the hypotheses proposed above, we classify the samples into two groups: (1) The incentive group, including firms with equity incentive plans, and (2) the control group, including firms without such plans. As mentioned above, it is necessary to control for sample selection bias. We apply the propensity score matching (PSM) method developed by Rosenbaum and Rubin (1983). Using this approach, we can obtain propensity scores (*PS*), which measure the extent of matching of the incentive group and the control group in multi-dimensions.

In the following, we briefly introduce how to calculate *PS* values, followed by discussions regarding the three matching approaches and the average effect of treatment on the treated (*ATT*).

3.1   Propensity Score

The propensity score is defined as "the conditional probability of receiving a treatment given pre-treatment characteristics" by Rosenbaum and Rubin (1983).

$$p(X) = \Pr[D = 1 \mid X] = E[D \mid X], \tag{1}$$

where X is the multidimensional vector of characteristics of the control group, D is the indicator variable, which equals 1 if a firm adopts an equity incentive plan and 0 otherwise. Theoretically, if we can get the estimates of propensity score $p(X_i)$ (we will discuss this issue in details in the next section), the *ATT* can be estimated by the differences of the potential outcomes of the incentive group and the control group (Becker and Ichino, 2002),

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\begin{aligned}
ATT &= E[Y_{1i} - Y_{0i} \mid D_i = 1] \\
&= E\left\{ E[Y_{1i} - Y_{0i} \mid D_i = 1, p(X_i)] \right\} \\
&= E\left\{ E[Y_{1i} \mid D_i = 1, p(X_i)] - E[Y_{0i} \mid D_i = 0, p(X_i)] \mid D_i = 1 \right\},
\end{aligned}
\tag{2}
$$

where Y_{1i} and Y_{0i} represent the potential outcomes of the incentive group and the control group, respectively.

To estimate the *PS* score, we follow Dehejia and Wahba (2002) and Becker and Ichino (2002) and use the Logit model with the following steps.

We start with estimating probabilities using the Logit model,

$$p(X_i) = \Pr(D_i = 1 \mid X_i) = \frac{\exp(\beta X_i)}{1 + \exp(\beta X_i)}, \tag{3}$$

where X is the multidimensional vector of independent variables which may affect the propensity of firms to implement equity incentive plans, and β is the vector of coefficients. The propensity score (*PS*) is the predicted values of the Logit model.

3.2 Matching Methods

We cannot estimate the *ATT* of interest directly using (2) even though the propensity scores have been estimated. The reason is that $p(X)$ is a continuous variable, and thus it is impossible to find two units with identical propensity score. Several matching methods have been suggested in the literature to overcome this problem. Three of the most widely used are Nearest-Neighbor Matching, Radius Matching and Kernel Matching.[2]

The nearest neighbor matching method is to search the closest control sample, both backwards and forwards, from the estimated *PS* values of the incentive group. Let T and C represent the incentive group and the control group, and Y_i^T and Y_j^C represent the observed performance of incentive and control units, respectively. Meanwhile, let $C(i)$ represent the set of control units matched to the ith incentive unit with an estimated value of the propensity score of p_i. Then, the nearest neighbor matching method can be described as follows,

$$C(i) = \min_{j} \left\| p_i - p_j \right\|. \tag{4}$$

The radius matching method is to search all units in the control group, and those with estimated propensity scores falling within a radius r from p_i are matched to the incentive unit i. r is a positive real number set beforehand. We can describe the radius matching method as follows,

$$C(i) = \left\{ p_j \mid \left\| p_i - p_j \right\| < r \right\}. \tag{5}$$

After identifying the matching samples using nearest neighbor or radius matching, we can calculate *ATT*. Let the number of controls matched with observation $i \in T$ by N_i^C and define the weights $w_{ij} = 1/N_i^C$ if $j \in C(i)$ and $w_{ij} = 0$ otherwise. Also, suppose there are N^T numbers of observations in the incentive group. Then, according to Becker and Ichino (2002), the *ATT* can be estimated as follows,

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[2] The methods and formulas introduced here are closely related to Becker and Ichino (2002).

$$\tau^M = \frac{1}{N^T} \sum_{i \in T} Y_i^T - \frac{1}{N^T} \sum_{j \in C} w_j Y_j^C, \qquad (6)$$

where M represents the matching method, such as the nearest neighbor matching method or the radius matching method, and w_j is defined as $w_j = \Sigma_i w_{ij}$. Assume that the weights are held constant and the effectiveness of the equity incentive plan in each firm is independent. The variance of τ^M could be estimated as follows,

$$Var(\tau^M) = \frac{1}{N^T} Var(Y_i^T) + \frac{1}{(N^T)^2} \sum_{j \in C} (w_j)^2 Var(Y_j^C). \qquad (7)$$

The idea of the Kernel matching method is somewhat different from the previous two methods. With Kernel matching, a fictitious unit will be constructed to match each incentive firm, that is, each incentive firm is matched with a weighted average of all controls with weights that are inversely proportional to the distance between the propensity scores of incentive and controls. When the Kernel matching method is used, the *ATT* can be estimated as follows,

$$\tau^K = \frac{1}{N^T} \sum_{i \in T} \left\{ Y_i^T - \frac{\sum_{j \in C} Y_j^C G\big((p_j - p_i)/h_n\big)}{\sum_{k \in C} G\big((p_k - p_i)/h_n\big)} \right\}, \qquad (8)$$

where $G(\cdot)$ represents the Gaussian kernel function, and h_n represents bandwidth parameter. Under standard conditions on the bandwidth and kernel,

$$\frac{\sum_{j \in C} Y_j^C G\big((p_j - p_i)/h_n\big)}{\sum_{k \in C} G\big((p_k - p_i)/h_n\big)}$$

is a consistent estimator of the counterfactual outcome Y_{0i}. Since it is difficult to get the estimation of variance of τ^K, bootstrap is instead used. We apply the same approach and estimate the variance of τ^K based on bootstrap with 500 replications.

3.3   Obtaining Robust Variance of *ATT* Using Bootstrap

One problem of the statistical analysis in this study is that the sample size is small. To reduce the small sample size bias, we use the bootstrap approach to estimate the standard errors for further analysis.[3] We follow Efron and Tibshirani

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[3] An important feature of this method is that we need not assume the distribution of the statistic of interest in prior (See Abadie, Drukker, Herr and Imbens (2004), and Abadie and Imbens (2006)).

(1993) and take steps as follows. First, we resample n observations with replacements from the original sample and get the so called empirical sample. Second, we use the above matching approaches to calculate ATT_i. Third, we repeat the first and the second step for K times ($K = 500$ in this study)[4] and obtain ATT_1, ATT_2, $\cdots$, ATT_{500}. Fourth, we calculate the standard deviation of ATT_1, ATT_2, $\cdots$, ATT_{500}, thus get the standard errors of the ATT statistic.

4   Sample and Proxies

4.1   Sample Construction

Our data set is obtained from the China Stock Market and Accounting Research Database (CSMAR) developed by Shenzhen GTA Information Technology Company. CSMAR provides detailed information on CEOs as well as accounting and financial data for Chinese listed firm.

We identified firms with equity incentive plans in 2006 and 2007 (starting from December of 2005) and study the performance of those firms from 2008 to 2009. We deleted the observations without any clear documentation of the offering date and details. Our final dataset has 59 firms that adopt the equity incentives during 2006–2007, among which, 46 firms adopt option plans and the remaining 13 firms offer share plans. Those firms are in our Incentive group. Regarding the control group, we take the following steps to identify them. First, we eliminate firms in the financial sector (banks, insurance, and other financial firms), as they are subject to different disclosure requirements in China. ST/PT firms are also excluded because their financial conditions are abnormal.[5] Second, we delete firms with leverage ratio greater than 100%. Third, we delete firms with sales (or total asset) growth rate greater than 150% as these firms may involves in large asset sales or mergers. Eventually, we find 1 346 firms in the Control group, among which we are going to identify those that can match firms in the Incentive group. Additionally, the key financial variables are winsorized at the 1st and 99th percentiles to avoid the influence of outliers.

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[4] Efron and Tibshirani (1993) suggest that, to get standard error using bootstrap, 200 replications are often good enough to give a good estimate of standard error.

[5] According the Chinese Company Law, listed firms that have been making losses (negative net earnings) for two consecutive years are categorized as "special treatment" (ST), whereas companies that have been making losses for three consecutive years are to be put into "Particular Treatment" (PT) status and are suspended from the Exchanges. ST firms are limited to 5% share-price movements up or down daily. PT firms are given a maximum one-year grace period to return to profitability, failing which they will be permanently de-listed from the Stock Exchange. There are no ST/PT firms in our incentive sub-sample.

4.2   Measurement of Effectiveness of Equity Incentives

Following the literature, we use *ROE* to measure the effectiveness of equity incentive plans (e.g., Xia and Zhang, 2008). We do not use Tobin's *Q* as a measure, due to two reasons. First, Tobin's *Q* reflects long term investment opportunity (Gomes, 2001; Lian and Chung, 2008), whereas *ROE* measures short term performance. Since we focus on a relatively short period, *ROE* is a better indicator of firm performance than Tobin's *Q*. Second, in our sample period, the Chinese stock market is highly volatile. Under this market, it is difficult to separate the performance of firms from that of the market. Thus, Tobin's *Q* is not suitable in this study, since it is based on stock prices.

To measure the effectiveness of equity incentive plans, the first measure that we use is the ratio of management costs to total revenue (*AC*), a proxy for agency costs. We expect *AC* of the Incentive group to be less than that of the Control group. Second, we use both the ratio of investment expenditure over total assets (*INVT*) and the growth rate of total assets (*TAGR*) as other measures of the effectiveness of the plans. In other words, we measure the effectiveness of the plans from the point of view of both investment activities (*INVT*, *TAGR*) and agency cost decreasing (*AC*).

Table 1 shows summary statistics of variables.

Table 1   Summary Statistics of Variables

Variables	Mean	S.D.	Min	Max
ROE	0.041	0.167	−1.015	0.303
AC	0.089	0.084	0.008	0.573
INVT	0.061	0.059	0.000	0.519
TAGR	0.118	0.207	−0.331	0.845

Note: This table presents the summary statistics of the variables. *ROE* is calculated by dividing net income by total equity. *AC* equals the ratio of management costs over sales. *INVT* is calculated by dividing investment expenditure to total assets. *TAGR* represents the percentage change of total assets.

5   Empirical Results

5.1   Propensity to Perform Equity Incentive Plans

The first step to perform propensity score matching analysis it to estimate the propensity scores (*PS*). The *PS* values summarize several pretreatment firm characteristics of each subject into a single-index, which makes matching subjects on an *n*-dimensional vector of characteristics feasible for large *n*. Note that, multi-dimensional matching is typically unfeasible using traditional

methods.

Table 2   Summary Statistics for the Matching Variables

Variable	Mean	S.D.	Min	Max
SIZE	21.514	1.114	18.157	28.003
LEV	0.501	0.179	0.009	0.997
TOBIN	1.661	0.902	0.811	5.889
TANG	0.472	0.170	0.000	0.975
PROF	0.044	0.161	−0.861	0.460
GPAY	13.430	0.834	3.367	17.583
MAGSTK	0.028	0.103	0.000	0.784
HEYI	0.139	0.345	0.000	1.000
HHI5	0.175	0.121	0.004	0.760
TOPONE	0.367	0.153	0.035	0.864
Zindex	20.981	49.288	0.720	802.970
Stated-owned	0.644	0.479	0.000	1.000

Note: This table provides summary statistics for the variables in our sample of firm-years from Chinese publicly traded firms over the period 2005 to 2009. *SIZE* is the natural log of total assets. *LEV* is total debt divided by total assets. *TOBIN* is the ratio of market value to replacement costs, where market value of the firm is defined as the number of tradable shares multiplied by the stock's closing price at the fiscal year-end plus number of non-tradable shares multiplied by the net asset per share, plus the total debt, and replacement costs is measured by book value of the firm. *TANG* is defined as the fixed assets divided by the total assets. *PROF* is defined as the retained profits divided by the sales income. *GPAY* is the natural log of annual salary of the top three managers. *MAGSTK* is defined as the number of shares managers hold divided by the number of the total shares. *HEYI* equals one if the broad chairman is also the top manager, and zero otherwise. *TOPONE* is the shareholding proportion of the top one (largest) shareholder. *HHI5* is the Herfindahl-Hirschman Index, defined as the sum of squared share proportions of top five shareholders. *Zindex* is calculated as the ratio of shares hold by the largest shareholders to the second large shareholder. *Stated-owned* is a dummy variable that equals one if a firm is stated-owned, and zero otherwise.

In line with previous literature, we estimate the Logit model (3) to get the *PS* values. To get a good specification of the Logit model, we follow Tzioumis (2008) among others, and add variables related to firm's financial characters, corporate governance, and manager's compensations in the model. We expect such a multi-dimensional matching can help us find the control firms that are as similar as possible to the incentive ones. The variables included in model (3) are: (1) financial variables, including firm size (*SIZE*), leverage (*LEV*), growth

opportunity (*TOBIN*), asset structure (*TANG)*, profitability (*PROF*), and industry dummies; (2) corporate governance variables, including shareholding concentration (*HHI5*), the shareholding proportion of the top one shareholder (*TOPONE*), the balance of power of large shareholders (*Zindex*), whether the broad chairman is also the top manager (*HEYI*), and a dummy variable (*Stated-owned*) indicating the final control type of the firm; (3) manager's compensation variables, including CEO compensation (*GPAY*), and holding proportion of managers (*MAGSTK*). Table 2 presents the summary statistics of the variables mentioned above.

We estimate model (3) with various specifications, and the results are presented in Table 3. In order to control the industrial effects, we add industry dummies in all the models in Table 3. It is shown that the probability of implementing equity incentive plans is significantly positively related to firm size (*SIZE*), growth opportunity (*TOBIN*), profitably (*PROF*), and CEO compensation (*GPAY*), and is negatively correlated to leverage (*LEV*), shareholding concentration (*HHI5*, *TOPONE*), and the balance of power of large shareholders (*Zindex*). The probability to implement equity incentive plans is not significantly related to the asset structure (*TANG*) which is measured by the ratio of fixed assets to total assets, and the dummy variable indicating whether the broad chairman is also the top manager (*HEYI*). Moreover, the propensity to implement incentive plans is lower in stated-owned firms relative to other firms, as the *Stated-owned* dummies are negatively significant in all specifications.

Table 3   The Estimation Results of Logit Models

Variables	(1)	(2)	(3)	(4)	(5)
SIZE	0.846***	0.850***	0.818***	0.775***	0.843***
	(10.42)	(10.42)	(10.37)	(10.07)	(10.45)
LEV	−1.277**	−1.280**	−1.159**	−1.050**	−1.284**
	(−2.35)	(−2.40)	(−2.19)	(−1.99)	(−2.41)
TOBIN	0.379***	0.380***	0.384***	0.407***	0.378***
	(5.31)	(5.34)	(5.44)	(5.83)	(5.32)
TANG	0.016				
	(0.03)				
PROF	1.253*	1.208*	1.250*	1.012	1.247*
	(1.80)	(1.74)	(1.81)	(1.50)	(1.80)
GPAY	0.410***	0.412***	0.412***	0.433***	0.415***
	(4.10)	(4.16)	(4.17)	(4.35)	(4.20)

(*To be continued*)

(*Continued*)

Variables	(1)	(2)	(3)	(4)	(5)
MAGSTK		0.382			
		(0.60)			
HEYI	0.076				
	(0.38)				
HHI5	−2.729***	−2.727***			−2.725***
	(−3.86)	(−3.86)			(−3.86)
TOPONE			−1.854***		
			(−3.56)		
Zindex				−0.007**	
				(−2.00)	
Stated-owned	−1.371***	−1.355***	−1.370***	−1.414***	−1.376***
	(−8.23)	(−7.96)	(−8.20)	(−8.48)	(−8.28)
Industry dummies	Yes	Yes	Yes	Yes	
Constant	−27.838***	−27.975***	−27.295***	−27.678***	−27.821***
	(−14.43)	(−14.44)	(−14.21)	(−14.24)	(−14.51)
Pseudo-R^2	0.193	0.193	0.191	0.187	0.199
AUC	0.844	0.844	0.842	0.842	0.854
Observations	3 339	3 339	3 339	3 339	3 339

Note: 1. The dependent variable is "Incentive，" which is a discrete variable, equals one if a firm has equity incentive plans, and zero otherwise.
  2. ***, ** and * represent significance at 1%, 5% and 10% level, respectively, with *t*-values in parentheses.
  3. The AUC denotes the area under the ROC curve.

Our final goal is to estimate the propensity scores, according to which we can match the incentive firms to their control pairs. Obviously, the model specification is an important thing to ensure the validity of the matching procedure. Unfortunately, there is no straightforward criterion to properly specify the Logit model in the literature. We use two diagnostic proxies namely pseudo-R^2 which is widely used in Logit analysis, and the area under the ROC curve (AUC). The reason we use AUC is that, the dependent variable in the Logit model is a discrete variable (0/1), while the propensity scores (which is the predicted values of the Logit model) is a continuous variable, thus the traditional statistics (such as Pearson correlation coefficient) can not be use to analyze their correlation (see Hosmer and Lemeshow, 2000). In this case, the AUC which is widely used in the Receiver Operating Characteristic (ROC) literature can give

better inference.[6]

The pseudo-R^2's are in the 0.187–0.199 range. This goodness-of-fit is higher than those reported in Villalonga (2004). Comparing the values of Pseudo-R^2 and AUC in Table 3, we can see that specification (5) is better than others. Stürmer, Joshi, Glynn, Avorn, Rothman and Schneeweiss (2006) find that, when we use Logit model to get propensity scores, an AUC value larger than 0.8 can be regarded as a good indicator that the model is well specified. In model (5), the AUC is 0.854, well above the value suggested by Stürmer et al. (2006). Therefore, we will use model (5) as our basic specification to calculate the propensity scores, and then compare the firm performances between incentive firms and control firms.

5.2   Sample Matching Results

The following discussion is based on the nearest neighbor matching approach. Fig. 1(a) and Fig. 1(b) show the kernel density functions of the Incentive group and the Control group, based on pre- and post-matching of the two groups, respectively. Clearly, the kernel density functions of the two groups are significantly different before matching. Prior studies use all firms in the Control group to compare with the Incentive group, and thus their results are biased. In contrast, we choose firms from the Control group to match those in the Incentive group, based on Propensity scores. After matching, as shown in Fig. 1(b), the kernel density functions of the two groups are a lot closer, indicating that the characteristics of the variables in the two groups are similar, after matching. We also match the two groups using radius matching and kernel matching. The results are similar and are not reported.

## 5.3   Analysis of the Effectiveness of Equity Incentive Plans

5.3.1   Results on H1: The Full Sample Effects of Equity Incentives

We use three approaches, as mentioned above, to estimate *ATT*s. The following discussion is based on the nearest neighbor matching approach. The results from the other two methods are used as robustness tests.

Table 4 shows the *ATT*s based on the nearest neighbor matching method, both pre- and post-matching. In the analysis of either pre or post matching, we find that ROE is significantly different from zero at the 5% level, indicating that equity based compensation can indeed improve firm performance. This is consistent with H1.

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[6] For details on ROC analysis, see Fawcett (2006) and Stein (2005).

(a) before matching

(b) after matching
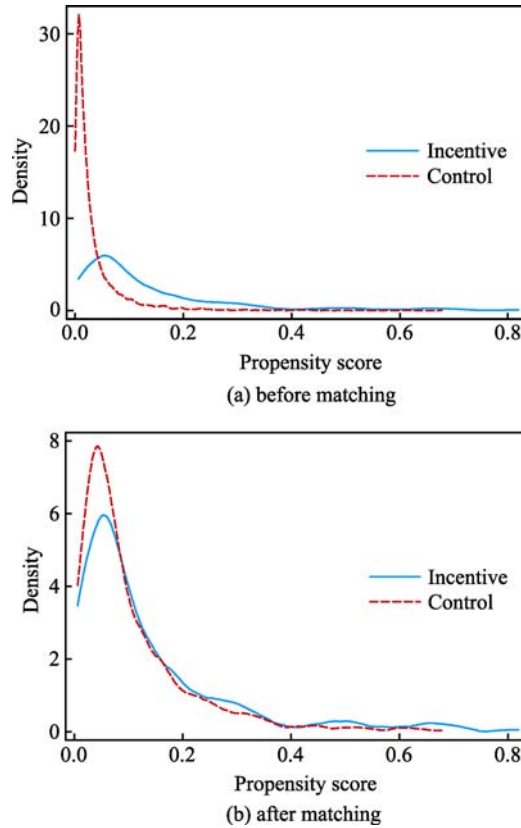
Fig. 1   Kernel Density of the Incentive and Control Groups

   A natural question that comes up is: What drives equity incentive plans to be so effective? To answer this question, we further analyze several economic factors. Regarding agency costs, we do not find any significant differences of ACs between the Incentive group and the Control group after matching. This indicates that agency costs are not significantly reduced by equity incentive plans. In detail, before matching, ACs of the Incentive group and the Control group are 0.077 and 0.09, respectively, significant at the 5% level. This indicates that firms that adopt the plans have lower agency costs than average firms in the market. However, after matching, the ACs of the two groups are 0.077 and 0.083, respectively. Still, the AC of the Incentive group is lower than that of the Control group, but the differences are insignificant at the 10% level. Hence, at least in our sample range, we can not find evidence that it is the agency costs that drive the improvement of ROE caused by equity incentive plans.

Table 4 Comparison of *ATT*s (by Nearest Neighbor Matching Approach)

Variable	Sample	Incentive group	Control group	*ATT*	*s.e.*	*t*-value
ROE	Pre-matching	0.116	0.038	0.078	0.011	6.92[***]
	Post-matching	0.116	0.100	0.016	0.007	2.23[**]
AC	Pre-matching	0.077	0.090	−0.013	0.006	−2.18[**]
	Post-matching	0.077	0.083	−0.005	0.005	−0.99
INVT	Pre-matching	0.072	0.060	0.011	0.004	2.80[***]
	Post-matching	0.072	0.061	0.011	0.005	2.28[**]
TAGR	Pre-matching	0.263	0.112	0.151	0.014	10.80[***]
	Post-matching	0.263	0.192	0.071	0.019	3.65[***]

Note: 1. "Pre-matching" refers to the sample without matching the Incentive group with the Control group, and "Post-matching" refers the groups after matching.
2. "Incentive group" and "Control group" refer to firms with and without equity based compensation, respectively.
3. ***, ** and * represent significance at 1%, 5% and 10% level, respectively.
4. Standard errors are calculated using Bootstrap with 500 replications.

We thus investigate another mechanism through which firms can improve performance: changes in investment behavior. The comparison of *INVT* shows that *INVT* of the Incentive group, 0.072, is greater than that in the control group after matching, 0.061, at the 5% level. In other words, firms with equity incentive plans invest 18% more than those without such plans. A greater level of investment causes these firms to have a greater potential to grow, which is shown in the significant differences of *TAGR* between the Incentive group and the Control group, at the 1% significance level.

In sum, we find that firms with equity incentive plans can improve firm performance; the improvement is mainly via increasing investment, not via reducing agency costs. This seems to be inconsistent with the commonly accepted assertion which states that equity incentive plans motivate management to align its interest with that of shareholders, and thus reduce agency costs.

5.3.2   Results on H2: The Effects of Final Control Right on Equity Incentives

To examine the second hypothesis, we further classify the Incentive group into two subgroups: (1) The stated-owned (government controlled) subgroup, and, (2) the privately owned subgroup. Comparison of the two subgroups with respect to the effectiveness of equity incentive plans is shown in Table 5.

Table 5 The Impact of Final Control Rights on the Effectiveness of Equity Incentives

Variable	A. Full sample		B. Stated owned		C. Privately owned	
	ATT	t-value	ATT	t-value	ATT	t-value
Nearest neighbor matching						
ROE	0.016	2.23**	0.012	0.78	0.029	1.96**
AC	−0.005	−0.99	0.000	0.01	−0.014	−1.99**
INVT	0.011	2.28**	−0.003	−0.36	0.012	1.66*
TAGR	0.071	3.65***	0.058	1.69*	0.112	3.92***
Radius matching						
ROE	0.021	2.85***	0.008	0.53	0.035	2.76***
AC	−0.004	−0.81	−0.004	−0.61	−0.014	−1.57
INVT	0.008	1.69*	0.012	1.33	0.010	1.49
TAGR	0.075	4.15***	0.062	1.84*	0.109	4.07***
Kernel matching						
ROE	0.032	4.42***	0.020	1.56	0.037	3.55***
AC	−0.007	−1.41	−0.001	−0.13	−0.008	−1.97**
INVT	0.011	2.70***	0.001	0.09	0.019	3.13***
TAGR	0.092	5.27***	0.077	2.72***	0.117	4.59***

Note: 1. "Stated owned" and "private owned" refer stated-owned firms and private-owned firms, respectively.
2. ***, ** and * represent significance at 1%, 5% and 10% level, respectively.
3. Standard errors are calculated using Bootstrap with 500 replications.

Panel B and C of Table 5 show the results of *ATT*s of the two subgroups. The results generally support the second hypothesis. Using the nearest neighbor matching method, we find significant differences between the two subgroups. *ROE*s are not significantly different within the stated-owned subgroup, whereas they are different within the privately owned subgroup, significant at the 1% or 5% level. Thus, we argue that the differences of firm performance (*ROE*) in Table 4 between the Incentive group and the Control group are driven mainly by the privately owned subgroup. This further demonstrates that equity incentive plans can effectively motivate management to improve firm performance.

The examination of *AC*, *INVT* and *TAGR* can explain the source of the above difference. Panel B and C of Table 5 show the results of the above variables for the stated-owned subgroup and the privately owned subgroup, respectively. We find that none of the three variables are significant at 5% level in Panel B, whereas all of the three variables are significant at the 5% level in Panel C. In detail: (1) Agency costs in privately owned firms with equity incentive plans are significantly lower than firms without such plans, and (2) The average investment, as measured by *INVT* and the growth rate of total assets (*TAGR*), is

higher in privately owned firms with equity incentive plans than in firms without such plans. In other words, in the privately owned firms, equity based compensation can motivate management to reduce agency costs and increase investment.

Further, we use both radius matching and kernel matching as robustness tests to reexamine the first and second hypotheses. Focusing on the full sample in Panel A of Table 5, we find similar results, by radius matching and kernel matching methods, as those in Table 4. Hence, the robustness tests further confirm the results of the first hypothesis. Focusing on the subgroups in Panel B and Panel C, we also identify the similar patterns by these two approaches. Thus, the robustness of the results for the second hypothesis is also demonstrated.

5.3.3   Results on H3: The Effects of Incentive Type

We test the *ATT*s of the alternative type of the incentive plans: (1) option plans, and (2) share plans. The results, as shown in Panel A and B of Table 6, show that the types of the plans can produce different results in the effectiveness of equity incentive plans.

We find that the option plans can significantly improve firm performance as measured by *ROE*. This result is robust whether we calculate *ATT*s using nearest neighbor matching, radius matching, or kernel matching method. However, the effect of stock plans is much weaker. We observe significant performance improvement of stock plans only when the kernel matching method is used.

Further comparison of *AC*, *INVT* and *TAGR* in Panel A and B shows that the causal factors driving the effectiveness of equity incentive plans differ between the two styles of plans. First, the *ATT*s of *AC* representing agency costs under all three approaches are not significant in Panel A, indicating that stock plans cannot reduce agency costs. In comparison, results in Panel B shows that option plans can significantly reduce agency costs: With the nearest neighbor matching method and the radius matching method, *ATT*s of *AC* are less than 0 at the 5% significance level. Kernel matching is the strictest method among the three. With this method, we find that *ATT*s of *AC* are less than 0 at the 1% significance level. Meanwhile, the *AC* of the Incentive group has been reduced by 0.014, with an average reduction rate over 20%. Regarding *INVT*, in all matching methods, stock plans do not significantly increase firms' investment expenditure. In comparison, option plans can significantly increase firm investment (*INVT*) and especially total assets growth (*TAGR*) as shown in Panel B.

The above results are supportive of the theoretical analysis. Option plans are not going to bring benefits to management unless the future stock price is higher than the exercise price of the option. In contrast, share plans bring benefits to management immediately. Thus, option plans bring more incentive to

management and motivate action to improve firm performance. In reality, among the 95 firms that adopted equity incentive plans in 2008, only 16 firms chose the share plan. The value in 2009 is 87 vs 18. This indicates that option plans became more popular as more firms adopting equity incentive plans.

Table 6 The Impact of Reward Methods on the Effectiveness of Equity Compensation

Variable	A. Stock reward		B. Option reward	
	ATT	*t*-value	*ATT*	*t*-value
Nearest neighbor matching				
ROE	0.025	1.47	0.019	2.11**
AC	−0.031	−1.30	−0.005	−1.98**
INVT	0.004	0.40	0.005	0.95
TAGR	0.050	1.11	0.081	3.77***
Radius matching				
ROE	0.015	0.87	0.019	2.26**
AC	0.009	0.71	−0.008	−2.03**
INVT	0.015	1.40	0.009	1.70*
TAGR	0.020	0.51	0.093	4.66***
Kernel matching				
ROE	0.044	2.99***	0.038	5.21***
AC	0.017	1.25	−0.014	−3.26***
INVT	0.014	1.45	0.010	2.15**
TAGR	0.061	1.52	0.114	6.11***

Note: 1. The examples of "stock rewards" include: transferring shares from other shareholders to management, issuing new stocks to management, or using company funds to purchase shares for management from the market. "Option rewards" include issuing stock options to management.
    2. ***, ** and * represent significance at 1%, 5% and 10% level, respectively.
    3. Standard errors are calculated using Bootstrap with 500 replications.

The above analysis provides evidence to our third hypothesis. The findings suggest that different reward approaches are associated with variant effects. Especially in reducing agency costs, option plans can be very effective.

5.3.4   Results on H4: The Effects of Shareholding Concentration

We classify sample firms into two subgroups based on ownership concentration. In specifically, in each year, we split the sample into two groups according to the

sample mean of Herfindahl-Hirschman Index (*HHI5*). Firms with *HHI5* larger than sample mean are classified into the concentrated-ownership subgroup, while the remaining firms are classified into the scatted-ownership group. The *ATT*s are then calculated in each subgroup. The results are shown in Panel A and B in Table 7.

Table 7 The Impact of Shareholding Concentration on the Effectiveness of Equity Incentives

	A. Concentrated ownership		B. Scattered ownership	
Variable	*ATT*	*t*-value	*ATT*	*t*-value
Nearest neighbor matching				
ROE	0.003	0.23	0.015	1.98**
AC	0.002	0.20	−0.006	−1.84*
INVT	0.003	0.38	0.022	3.92***
TAGR	0.123	3.32***	0.065	2.77***
Radius matching				
ROE	0.003	0.27	0.024	2.22**
AC	0.011	1.25	−0.007	−2.12**
INVT	0.008	0.89	0.014	2.41**
TAGR	0.123	3.19***	0.069	3.16***
Kernel matching				
ROE	0.021	2.31**	0.030	2.59***
AC	0.000	−0.06	−0.009	−2.29**
INVT	0.005	0.67	0.018	3.28***
TAGR	0.133	3.91***	0.073	3.40***

Note: 1. Firms are classified into the subgroup with concentrated ownership when their largest shareholders' ownership is more than the median among all firms. The remaining firms are classified into the subgroup with scattered ownership.
2. ***, ** and * represent significance at 1%, 5% and 10% level, respectively.
3. Standard errors are calculated using Bootstrap with 500 replications.

Using nearest neighbor matching and radius matching, we find that in the concentrated ownership subgroup, the *ATT*s of *ROE* are not significant. They are significant only when the kernel matching method is used. Thus, we can not find strong evidence that equity incentive can improve firm performance when ownerships are highly concentrated. , However, the results in Panel B show that, in scattered ownership subgroup, the *ATT*s of *ROE* are greater than zero, at the 1% significance level, under all three matching methods. Thus, consistent with the fourth hypothesis, we find that the effect of equity based compensation

decreases with ownership concentration. Furthermore, *ATT*s of the *AC* are significantly negative in the scattered ownership subgroup, whereas they are insignificant in the concentrated ownership subgroup. This indicates that agency costs can be significantly reduced among firms with scattered ownership, in that when firms have scattered ownership the interests of management are more aligned with that of shareholders. The investment expenditure show similar patterns between two sub-groups, which indicates that managers in scattered ownership group invest more. Regarding growth rate of total assets (*TAGR*), the *ATT*s in both groups are significantly positive, indicating that equity incentive plans do enhance firm growth. This is consistent with results reported in Table 4 for the whole sample.

In summary, the effectiveness of equity incentive plans may be affected by the ownership of the largest shareholders. Equity incentive plans are more effective in firms with more scattered ownership. This is consistent with the fourth hypothesis.

6   Conclusion

On January 1st, 2006, new regulations regarding equity incentive plans were released in China. During year 2006–2007, 59 companies adopted equity incentive plans. In this study, we focus on those 59 firms to study the effectiveness of equity incentive plans in China.

Prior studies in the literature do not control for sample selection bias. We contribute to the literature by using the Propensity Score Matching (PSM) approach to control for sample selection bias. In specific, we use nearest neighbor matching, radius matching and kernel matching, to identify proper target firms for each of the observations in the sample. We further use the Bootstrap method to calculate the standard errors to control for the small sample bias.

We find that option plans can effectively improve firm performance, but such effectiveness can only be observed in firms controlled by major shareholders, not by the government. Further, option plans are more effective than share plans. Lastly, the effectiveness is greater in firms with more scattered ownership.

Additionally, we examine the causal factors that drive the effectiveness. We find that among firms controlled by major shareholders, equity incentive plans can effectively reduce agency costs and increase investment. Moreover, option plans can also significantly reduce agency costs. This effect does not appear among firms with share plans. Lastly, when shareholder ownership is more scattered, agency costs could be reduced through the adoption of an equity incentive plan. We do not find similar results among firms with more concentrated ownership.

In summary, equity incentive plans can effectively motivate managements to align their interest with that of shareholders. However, the effectiveness depends on the ownership structure and the style of the plan, such as option plans or share plans.

The present study has a number of limitations. Firstly, there are only 59 firms adopt equity incentives in our sample, which may induce the small sample bias, though we try to overcome this problem by using the bootstrap techniques. Secondly, Chinese listed firms begin to adopt the new accounting standards,[7] which may have some effects on the definition of financial variables in our study. As our sample ranges from 2005 to 2009, which covers the accounting reform period, this may bias our estimation to some extend. Unfortunately, we can not find a proper method to handle this problem.

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7 See Qu and Zhang (2010) for details.

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