International Journal of Business and Finance Research
Vol. 9, No. 2, 2015, pp. 21-38
ISSN: 1931-0269 (print)
ISSN: 2157-0698 (online)

IBFR
www.theIBFR.org

HOW DO BROAD-BASED STOCK OPTION GRANTS AFFECT FIRMS' OVERALL FUTURE PRODUCTIVITY?

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ABSTRACT

We investigate the impact of broad-based stock option grants on future firm productivity using a sample of U.S. firms from 1990-2006. We focus on stock option grants predominantly to rank-and-file employees (broad-based stock options) because significant amount of stock options are granted to rank-and-file employees other than the top five named executives. This study documents that the extent of broad-based stock option grants are negatively associated with future firm productivity. Further tests show this negative relation is attenuated by a firm's financial constraints and stock price informativeness but is exacerbated in "new economy" industry firms. We interpret these results as evidence that the expected incentive effect of broad-based stock options fails to compensate for the additional direct and indirect costs associated with such compensation programs. In cases when it is necessitated by a firm's financial condition or when stock price informativeness closely link its value with firm performance, the broad-based stock option less likely leads to diminished productivity. However, it more likely does so in firms where resources for R&D and capital investment are crucial for growth. Robustness tests show endogeneity issues do not drive our results. Other than making significant contribution to the academic literature, this study also has important practical implications in designing efficient compensation packages.

JEL: G30, J33

KEYWORDS: Broad-Based Stock Options, Productivity, Financial Constraints, New Economy Industry, Stock Price Informativeness

INTRODUCTION

We investigate the impact of broad-based stock options on future firm productivity, and the extent to which this relationship is influenced by a firm's financial condition, industry practice, and stock price informativeness. Firms implement stock option programs to attract risk-neutral entrepreneurial employees and to motivate these employees by giving them the opportunity to share the wealth created through their added effort (Oyer and Schaefer, 2005; Core and Guay, 2001). This view seems to be well received by corporate boards such that adoption of option programs permeates through a wide spectrum of firms across many industries. Over the course of a few decades, the number of U.S. employees holding stock options exploded from as few as 250,000 in the late 1970s to about 3.1 million in 2002 (Revsine, Collins, Johnson, and Mittelstaedt, 2012). For firms in the S&P 500 index, Murphy (2012a) estimates that the dollar value of stock options per company increased from $27 million in 1992 to roughly $300 million in 2000 even though the average fell to $88 million in 2005. From 1992 through 2005, between 85% – 90% of annual option grants were awarded invariably to employees other than the top five named firm executives (Hall and Murphy, 2003; Murphy, 2012a).

Even though employees below the top five executives receive a significant portion of stock option grants, the implication of such grants on future firm productivity is not well understood. Sesil, Kroumova, Blasi, and Kruse (2002) investigate the performance of "New Economy" firms after implementation of broad-based stock option programs and report higher value added per employee but not higher Tobin's Q or

knowledge generation. Using a panel data, Sesil and Lin (2011) re-examine the issue of broad-based stock option granted in 206 firms. Their finding generally indicates that value added per employee marginally improves one year after initiation of broad-based stock option but then dissipates afterwards. Similarly, Aboody, Johnson, and Kasznik (2010) show firms that re-price underwater stock options for non-executive employees do not show improvement in their subsequent performance. In contrast, Hochberg and Lindsey (2010) show evidence that suggests a positive association between existence of broad-based option programs and higher adjusted ROA, particularly in small or high growth firms.

Given the prevalence and significance of broad-based stock options, understanding that whether such programs deliver the desired outcome is important to those interested in designing efficient compensation contracts. Our study documents the performance implication of broad-based options. By doing so, we direct investors' and regulators' attention toward the consequence of a significant part of option grants that is generally neglected. We hypothesize that broad-based stock options are negatively related to future productivity. Our prediction is based on the premise that employee risk aversion necessitates options with low value-to-cost ratio and that options are generally granted as add-on compensation (Hall and Murphy, 2003). Because employees are not diversified, the value of option grants should be greater than the amount that would have been paid in cash. Put differently, the value of the options to the employee is generally lower than the cost of these instruments to the employer.

Furthermore, implementation of broader incentive programs fail to incent individual employees because individuals' rewards depend on increase in the value of the firm as opposed to directly measurable outcome (Core and Guay, 2001; Oyer and Schaefer, 2005), not to mention stock prices may not fully reflect the value of firm fundamentals (Wurgler, 2000; Durnev, Morck, and Yeung, 2004; Chen, Goldstein, and Jiang, 2007). As rewards are shared among a large number of participants based on a broad performance measure, an individual employee is likely to free ride off other members by holding back his effort (Alchian and Demsez, 1972; Weitzman and Kruse, 1990). Collectively, the existing literature suggests that broad-based stock options constitute increase in compensation without a matching downward adjustment to other forms of compensation, and too diffused to incent individual employees. Prior research also shows that stock options are predictors of share repurchase and that such repurchases prompt firms to divert funds away from necessary investments in productive assets and R&D (Bens et al., 2002; Bhargava, 2013). If stock options generally represent costly compensation that trigger resource diversion, widespread distribution of options to rank-and-file employees is likely to lead to greater resource diversion and cuts culminating in diminished future productivity.

We test our hypothesis using a sample of 12,067 firm-year observations for 1,976 U.S. firms over the period from 1996 to 2006. Our results show that broad-based stock option grants are negatively associated with future productivity measured by the relative efficiency score of the firm. Specifically, we find that the future productivity is lower in the presence of more broad-based stock options compared to when there are less broad-based stock options. Additionally, our results show that the future productivity of the firm decreases as the proportion of option granted to rank-and-file employees increases. Results are robust to using both continuous and dichotomous proxies of broad-based stock options and to controls of CEO and executive stock options. These results support our hypothesis that broad-based stock options lead to diminished future productivity. Our tests to examine the effect of broad-based stock options in New Economy industries, where such programs are prevalent, show that the negative relationship between broad-based stock options and future productivity is exacerbated in these industry firms.

This result supports that argument that, being an add-on compensation, broad-based stock options more likely diminish future productivity in firms that resources for R&D and capital investment are crucial for growth. On the other hand, we find the negative relationship is attenuated when firms face financial constraints at the time of granting these options or when stock prices are more informative of the value of firm fundamentals. These evidence suggest when broad-based stock options are necessitated by a firm's

financial condition or when stock price informativeness closely link the option value with firm performance, such option grants less likely lead to diminished productivity. In robustness tests, we discuss endogeneity issues, the employee size effect, and the impact of enhanced corporate governance. We get consistent results supporting previous arguments. We extend the literature by showing the relationship between the specific extent of granted broad-based stock options and future productivity. Sesil and Lin (2011) and Sesil et al. (2002) study the performance of firms subsequent to initiation of broad-based stock option programs. Similarly, Aboody et al. (2010) examine firm performance after re-pricing of underwater executive and employee stock options. Different from these studies that focus on the existence of broad-based stock options, we examine the relationship between the extent of broad-based stock options and future productivity. Our results show that when the extent is considered, granting relatively more broad-based stock options actually reduces firm productivity. In addition, our study uses a more comprehensive measure of future productivity under Data Envelopment Analysis (DEA).

The output of the DEA model is a relative efficiency score for each Decision Making Unit (DMU) determined using a linear programming method that was initially developed by Charnes, Cooper, and Rhodes (1978) and later extended by Banker, Charnes, and Cooper (1984). DEA does not require the researcher to make assumptions about the particular production function of sample firms; it rather allows measurement of relative productivity based on the observed input and output relationships for all decision-making units. Prior studies generally assume the Cobb-Douglas production function and use ROA or sales per employee as performance measures. In contrast, our performance metric is less subjective, more comprehensive, and less susceptible to mechanical change.

Our study also extends the current research that examines corporate actions subsequent to option grants. Bhargava (2013) and Bens et al. (2002) show that firms appear to divert resources required for R&D and capital expenditure toward prevention of dilution of earnings per share (EPS) following option grants and exercises. We extend this literature by showing that these corporate actions, which are prompted by option grants, are followed by decline in productivity. In addition, this study contributes to the literature of stock price informativeness. Existing studies show more informative stock prices improves managerial decisions (Wurgler, 2000; Durnev et al., 2004; Chen et al., 2007). This paper provides new evidence that this information enhances the positive impact of broad-based stock options on future productivity. Finally, we inform the studies on compensation in general. The existing literature shows that executive stock options constitute a significant part of incentive-based compensation and that properly designed stock-based compensation aligns the interests of executives and shareholders (Hall and Murphy, 2002; Murphy, 2012b). We provide new evidence that the extent of broad-based stock option grants, which represents option grants to non-executive employees, do not benefit shareholders in that it is negatively associated with future productivity. The rest of the paper proceeds as follows. We review the related literature and develop our hypotheses in section 2. In section 3, we describe our empirical methods and the sample selection process. We discuss our empirical results in section 4 and summarize our findings in section 5.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

The significant increase, over the last few decades, of executive pay has been fueled by the grant-date value of stock options. Hall and Murphy (2003) show that the value of option grants, mainly to nonexecutive employees, by S&P 500 companies increased approximately tenfold between 1992 and 2002. Over the same period, the use of stock option as a form of compensation has expanded to lower level employees. For example, a 2002 survey by National Center for Employee Ownership shows that over a quarter of all public firms granted options to all or most of full time employees. This phenomenon is widespread across many industries and trends show that the majority of such option grants are for employees below the top five named executives (Hall and Murphy 2003; Oyer and Schaefer 2005; Mehran and Tracy 2001). The upward trend and prevalence of stock-based compensation has attracted considerable research interest in recent years.One view holds that these programs incent employees toward better performance. Typical option

plans lead to realized compensation if stock prices increase subsequent to the grant date. The resulting partial stake in company's performance is expected to induce desirable outcome by aligning employees' incentive with that of shareholders' (Conyon and Murphy, 2000; Hillegeist and Panalva 2003). Another view suggests that the primary motivation behind broad-based stock option grants is perhaps sorting and retention of entrepreneurial employees. Oyer and Schaefer (2005) show that stock options can be efficient instruments to attract sufficiently optimistic employees who are willing to accept large reduction in cash compensation. In addition, the required vesting period of options helps companies prevent costly employee turnover. Other studies suggest that incentive, sorting, and retention motives may not be mutually exclusive (Hochberg and Lindsey, 2010; Core and Guay 2001). Hochberg and Lindsey (2010) show that implied incentive in broad-based employee options is associated with future performance while Core and Guay (2001) document that firms use employee stock options to incent employees and when those firms face cash constraints or when they need [equity] financing.

We focus on the implication of broad-based stock options on future firm performance regardless of the stated objective of program initiations. Our hypotheses are predicated on the premise that future firm performance is related to stock option grants. Employee motivation through profit sharing is generally presumed to promote modes of behavior that enhance productivity; however, theory also suggests that the associated increase in risk and co-determination may inhibit productivity (Weitzman and Kruse, 1990). Remunerations based upon production outputs represent a shift from fixed wage to variable wage system where employees' pays will be subjected to risk. As employee income is less diversifiable, variable compensation will have a deleterious effect on employee motivation. Profit sharing also transfers profit from capitalists, with the consequent decline in the capitalists' incentive and decision-making authority. For top-executives, the direct link between their effort and stock price performance provides a potent motivation. As a result, incentives through option grants or re-pricing are likely to enhance firm performance (Aboody et al. 2010; Sesil and Lin, 2011).

We posit that stock options granted to rank-and-file employees are less effective in soliciting more efforts from employees than options to named top executives. Unlike top executives, rank-and-file employees do not consider their efforts directly affect stock price performance. In addition, the number of participants who share the outcome of greater effort is large. Such lack of direct effort-output relationship and division of reward among a large number of participants tends to prompt each member to free ride off other members by holding back his effort (Alchian and Demsetz, 1972; Weitzman and Kruse, 1990). In the context of stock option awards, Aboody et al. (2010) examine performance consequence of re-pricing of under-water stock options for 300 firms and show that re-pricing of options to rank-and-file employees does not appear to lead to improvement in operating income or cash flows. Similarly, Sesil and Lin (2011) report that after the broad-based stock option grants the improvement in employee value-added is short lived.

In addition, broad-based options bring more cost burden to the granting firm. Most broad-based stock option plans are added on top of existing compensation packages (Hall and Murphy, 2003). The economic cost of option grants is greater than that of other forms of compensation because it increases the stock-price risk. More specifically, the option's value-to-cost ratio is 50% or less (Hall and Murphy, 2002). This means that the value of compensation a company has to offer is greater if it is in the form of stock option than it is in another form of compensation. Another cost burden to the granting firm comes from the fact that stock option grants lead to diminished long-term growth. Bhargava (2013) shows that the executive stock option grants and exercises are positively associated with subsequent stock repurchases in an effort to avoid EPS dilution. However, funds used in stock repurchases are those diverted away from R&D and capital expenditures needed for long-term growth (Bens et al., 2002). If firms granting stock options generally tend to invest less optimally due to resource diversion, their future productivity is likely to diminish. Because broad-based stock options do not induce efforts from employees but divert resources needed for future growth, we hypothesize the following:

H1: Broad-based stock option grants are negatively associated with future productivity.

Core and Guay (2001) document that broad-based stock options are more likely granted by firms with greater capital requirements and financing constraints. Since the primary motivation of constrained firms to grant broad-based options is to conserve resources, we argue that these firms less likely experience 'add-on compensation' or 'low value-to-cost' problem mentioned above. Firms in New Economy industries are characterized by aggressive use of stock-based executive and non-executive compensation (Ittner, Lambert, and Larcker, 2003). Meanwhile, these firms are also characterized by being in the innovation-driven competitive environment. In order to succeed in such a competitive environment, firms should invest in infrastructure and intellectual property. To the extent that extensive use of stock option compensation forces them to scale back R&D and capital expenditures, their future productivity is likely to suffer to a greater extent. Because of the unique characteristics of financially constraint firms and firms in New Economy industries, we hypothesize the following:

H2a: The relationship between broad-based stock options and future productivity is less negative for firms facing financial constraints.

H2b: The negative relationship between broad-based stock options and future productivity is exacerbated for firms in the New Economy industries.

The channel through which stock option grants solicit better employee performance depends on the assumption that stock prices reflect firm performance. A series of studies show stock prices can reflect different amounts of information about firm performance (Wurgler, 2000; Durnev et al., 2004; Chen et al., 2007). When stock prices are more informative, managers whose compensation has high pay-performance sensitivity are more likely to react to stock price changes in making corporate decisions (Kau, Linck, and Rubin, 2008). It suggests that because stock price informativeness increases the link between the value of stock-based compensation and firm performance it intensifies the positive impact of stock-based compensation in aligning the interests between managers and shareholders. One of the purposes to grant broad-based stock options is also to align the interests between rank-and-file employees and shareholders. If stock prices more closely reflect the value of firm fundamentals, we expect broad-based option grants more likely solicit better performance from non-executive employees.

H3: The relationship between broad-based stock options and future productivity is less negative when stock prices are more informative of firm fundamentals.

DATA AND METHODOLOGY

Determining productivity of a firm requires observation of the input-output process of a firm and comparing output with the expected performance level. Since expected performance level is not observable, such an assessment can best be achieved by constructing a benchmark from observed practice of other firms operating under similar conditions (Athanassopoulos and Ballantine, 1995). We perform our analyses using output from Data Envelopment Analysis (DEA). The output of the DEA model is a relative efficiency score for each Decision Making Unit (DMU) determined using a linear programming method that was initially developed by Charnes, Cooper, and Rhodes (1978) and later extended by Banker, Charnes, and Cooper (1984). A distinct advantage of DEA over parametric methods is that estimation of productivity under DEA does not require the researcher to impose specific functional form of the production process. Furthermore, DEA allows development of an overall performance measure when DMUs use multiple inputs to produce single or multiple outputs. We obtain DEA output (efficiency score) for each firm-year of our sample firms from output used in Demerjian, Lev, and McVay (2012). Demerjian et al. (2012) construct the DEA output for firms on COMPUSTAT based on annual data for 1980 – 2009. To estimate the productivity measure, they identify seven input and one output variables. The seven input variables used are net property, plant

and equipment; net operating leases; net R&D; goodwill; other intangible assets; cost of goods sold; and selling, general and administrative expenses while the output variable is sales.

Each productivity score under DEA is a measure of firm performance in a given year relative to the best-observed practice in the industry. Demerjian et al. (2012) construct the best-observed practice using observed annual input-output relationships of all firms in each Fama-French industry classification. More specifically, the relative efficiency measure for each DMU_j is developed using the model shown below where θ_j is computed as the reciprocal of the inefficiency measure (Φ_j):

$$\Phi_j = \max \Phi \tag{1a}$$

$$subject\ to: \quad X_{ji} \geq \sum_{j=1}^{N} \lambda_j X_{ji} \tag{1b}$$

$$\Phi Y_j \leq \sum_{j=1}^{N} \lambda_j Y_j \tag{1c}$$

$$\sum_{j=1}^{N} \lambda_j = 1 \tag{1d}$$

$$\lambda_j \geq 0 \tag{1e}$$

where X_{ji} is the quantity of input consumed by firm j; Y_j is the quantity of output produced by firm j; and λ_j is the weight placed on the inputs or output of firm j. The relative efficiency measure that results from solving the above linear program for each DMU_j falls between 0 and 1. A DMU with a DEA efficiency score of 1 (and 0 slack) is efficient; and the lower the score, the less efficient the unit is compared to the rest of the population.

Productivity Regressions

To assess the effect of broad-based stock options on productivity, we use the efficiency scores as dependent variable in the regression specification shown under equation 2. Banker and Natarajan (2008) show that OLS regression where DEA efficiency score is the dependent variable yield consistent estimators of coefficients. Hoff (2007) and McDonald (2009) validate the claim. Thus, we use the following OLS regression to assess the impact of broad-based stock options (NON_EXE_OPT) on productivity:

$$PROD_{i,t+1} = \beta_0 + \beta_1 NON\_EXE\_OPT_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 ROA_{i,t} + \beta_4 COMPET_{i,t} + \beta_5 AGE_{i,t} + \beta_6 LEV_{i,t} + \beta_7 PE_{i,t} + \varepsilon_{i,t} \tag{2a}$$

$$PROD_{i,t+1} = \beta_0 + \beta_1 NON\_EXE\_OPT_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 ROA_{i,t} + \beta_4 COMPET_{i,t} + \beta_5 AGE_{i,t} + \beta_6 LEV_{i,t} + \beta_7 PE_{i,t} + \beta_8 EXEC\_OPT_{i,t} + \beta_9 CEO\_OPT_{i,t} + \varepsilon_{i,t} \tag{2b}$$

$PROD_{i,t+1}$ is the productivity score subsequent to the year of option grants. $NON\_EXE\_OPT_{i,t}$, $CEO\_OPT_{i,t}$ and $EXEC\_OPT_{i,t}$ are broad-based, CEO, and executive option grants as a percentage of shares outstanding, respectively. For ease of exposition, we multiply these ratios by 10. We expect that *NON_EXE_OPT* to be negatively related to $PROD_{i,t+1}$. Therefore, we predict a negative coefficient for β_1 in equations 2a and 2b above. We predict negative relation only for broad-based stock options because there appears to be no other source to compensate for the adverse effect of stock options induced resource diversion. $EXEC\_OPT_{i,t}$ includes options granted to the top five named executives of the company. We include executive and CEO stock options as controls for the dynamics between broad based stock options and executive/CEO option and how this dynamic affects productivity. We do not have a theoretical or robust empirical basis to make a prediction regarding the relationship between broad based and executive/CEO options. In equation (2b),

we predict non-negative relation between executive/CEO options and future productivity because decline in productivity from these option grants are likely to be offset by positive effect from other sources (e.g. incentive effect). Following Bulan, Sanyal, and Yan (2010) and Chang, Fernando, Srinivasan, and Tripathy (2013), we include size (SIZE), profitability (ROA), competition (COMPET), firm age (AGE), leverage (LEV), and P/E ratio (PE) as control variables in the regressions. Ittner et al. (2003) find new economy firms that grant significant stock options are cash rich firms. To the extent that their cash reserve permits stock repurchase without cutback of essential investments, the adverse effect of broad-based options on future firm productivity may be attenuated. We include LEV to address this concern. Prior research suggests that the extent of industry competition has significant effect on firm productivity (Tang and Wang, 2005; Griliches, 1986; Bulan et al., 2010). Firms in competitive industries need to find ways to continuously improve their productivity, which is greatly affected by industry structure and competition (Chang et al., 2013; Tang and Wang, 2005). Therefore, we expect COMPET to be positively associated with productivity. More resources and wider economies of scale allow larger and older firms to be more productive (Haltwinger, Lane, and Speltzer, 1999; Lee and Tang, 2001; Bulan et al., 2010). Therefore, we expect SIZE and AGE to be positively related to productivity. Firms with more future growth opportunities measured by PE ratio tend to have higher productivity (Chung and Charenwong, 1991). Finally, we expect firm profitability measured by ROA to be positively related to productivity.

Sample Collection

We obtain an initial sample from the ExecuComp data, which provides information on option grants to the five highest-paid executives of each firm in the S&P 500, S&P MidCap, and S&P Small Capstock indexes during the period from 1996 to 2006. In addition, each firm reports the share of total grants given to the top five executives. Following Desai (2003) and Bergman and Jenter (2007), we extrapolate the total options data with the use of options granted to executives and the corresponding percentage of overall options granted. We use the mean of the total option estimates only when the standard deviation of these estimates from each executive is no more than 10% of the mean. We get 15,028 firm-year observations after this step.

For those records that do not meet this criterion, we adopt the procedure in Kedia and Rajgopal (2009) by calculating the total option grants based on the CEO stock options and the percentage in total granted options. When there are multiple entries for the same CEO's options in a given fiscal year, we require that the standard deviation is no more than 10% of the mean. We get 625 additional observations. Therefore, in total, we get 15,653 firm-year observations for 2,597 firms. This sample size is comparable to that in Bergman and Jenter (2007) and Kedia and Rajgopal (2009). We then match the broad-based stock options data with the productivity data from Demerjian et al. (2012) and other financial data from COMPUSTAT. After matching, our sample decreases to 12,067 observations for 1,976 firms. If we perform our analyses including CEO option grants, our sample decreases to 9,501 observations for 1,832 firms. This is because some firms do not report the CEO identity in the Execucomp database. As a result, observations with our CEO_OPT variable are fewer than the total sample.

RESULTS AND DISCUSSION

Table 1 presents the descriptive statistics of the variables used in our regressions. $PROD_{t+1}$ is the one year ahead productivity score from Demerjian et al. (2012) determined using DEA. NON_EXE_OPT is the stock option grants to non-executive employees as a percentage of total outstanding shares. BROAD_OPT takes a value of 1 when NON_EXE_OPT is more than 20% and 0 otherwise. CEO_OPT is the option grants to CEOs as a percentage of common shares outstanding. The number of option grants is determined based on data from Execucomp following Bergman and Jenter (2007) and Kedia and Rajgopal (2009). CONSTRAINT and BURDEN are indicator variables that take a value of 1 if cash constraint or burden is greater than the sample median and 0 otherwise. Following Core and Guay (2001), we define cash constraint (CONTRAINT) as the three-year average of common and preferred dividends plus cash flow used in

investing activities less cash flow from operations, all divided by total assets. We define interest burden (BURDEN) as the three-year average of interest expense scaled by operating income before depreciation. SIZE and AGE are the natural logarithms of total assets at the beginning of the year and the number of years since the firm's first appearance in COMPUSTAT, respectively. LEV is the sum of current and long-term debt divided by total assets while PE is the price/earnings ratio. ROA is income before extraordinary items divided by average total assets. COMPET is calculated as the sales of the firm as a percentage of the total sales of the firm's industry. We use Fama-French 12 industry classification. INFO is stock price informativeness measured as non-synchronicity of the market model regression using at least 100 daily stock prices during the fiscal year. Following Sesil et al. (2002) and Murphy (2012b), we classify the following four-digit SIC codes as New Economy industries: SIC 3570 – 3572, SIC 3576 -3577, SIC 3661, SIC 5045, SIC 3674, SIC 4812-4813, SIC 5961, and SIC 7370 – 7373.

Table 1: Descriptive Statistics of Variables

	Mean	1st Quartile	Median	3rd Quartile	Std. Dev
$PROD_{t+1}$	0.7354	0.5892	0.7900	0.9144	0.2208
NON_EXE_OPT	0.2200	0.0804	0.1477	0.2725	0.2321
BROAD_OPT	0.3653	0.0000	0.0000	1.0000	0.4815
CEO_OPT	0.0372	0.0100	0.0203	0.0417	0.0518
CONSTRAINT	0.1920	0.0000	0.0000	0.0000	0.3939
BURDEN	0.1763	0.0000	0.0000	0.0000	0.3811
SIZE	7.0146	5.8910	6.8573	7.9912	1.5598
PE	19.0938	9.7649	18.1165	28.3680	56.8323
LEV	0.2155	0.0465	0.2025	0.3302	0.1802
AGE	2.8862	2.3026	2.8904	3.6109	0.7769
ROA	0.0406	0.0159	0.0550	0.0975	0.1211
COMPET	0.0032	0.0003	0.0008	0.0025	0.0073
NEW_ECON	0.1839	0.0000	0.0000	0.0000	0.3874
INFO	2.1343	1.1787	1.8718	2.7891	1.4150

This table lists the descriptive statistics of main variables.

The dependent variable in our regressions is relative productivity of each firm against the ideal benchmark for the year in each industry. The mean (median) productivity ($PROD_{t+1}$) of the average firm is 0.74 (0.79). DEA measures productivity as a scaled score relative to the most efficient firm based on the observed input-output relationship. Therefore, a mean productivity score of 0.74 suggests that the average firm in our sample is 74% efficient compared to the virtual efficient firm. Our main variable of interest is broad-based stock option (NON_EXE_OPT), measured as the percentage of stock options granted to rank-and-file employees out of total shares outstanding. Its average is 22%, close to that in Bergman and Jenter (2007). CEO stock option takes 4% of the total shares outstanding. Also similar to their study, we have an average of 71% of total options granted to rank-and-file employees. In order to construct a more powerful test, we create a dichotomous broad-based stock options variable (BROAD_OPT) based on whether the broad-based stock options is greater than 20%. We choose 20% as the mean and median of broad-based stock option ratio is 22% and 15%, respectively. Using this procedure we classify 36% of firm years as providing significant broad-based stock options, as shown on Table 1. Approximately 18% of the observations are from New Economy industries. To test our second hypothesis, we examine how interest burden and cash constraints affect the relationship between broad-based stock options and productivity. Our sample shows that 19% and 18% of the observations face cash constraint and interest burden, respectively. Stock price non-synchronicity (INFO) has an average of 2.13, suggesting an average market model R^2 of 10.6%. The distributions of other variables are generally similar to those in other studies (Chang et al., 2013).

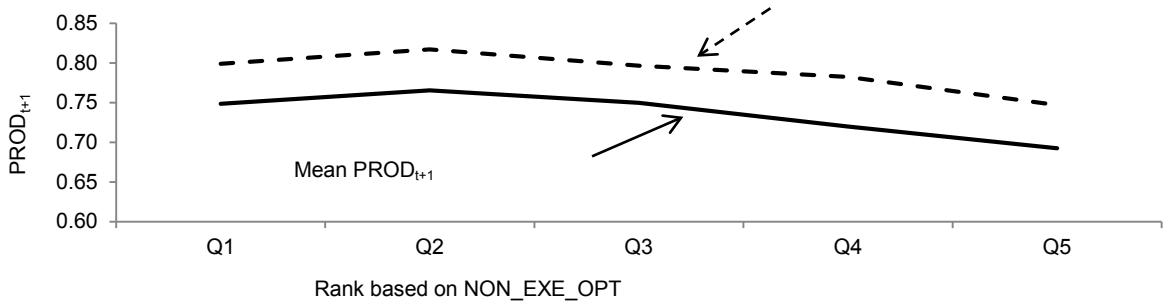
Table 2: Correlation Matrix for Regression Variables

	$PROD_{t+1}$	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
NON_EXE_OPT (1)	-0.254***									
CEO_OPT (2)	-0.206***	0.337***								
CONSTRAINT (3)	-0.161***	0.103***	0.124***							
BURDEN (4)	-0.024**	-0.015	0.082***	0.031***						
SIZE (5)	0.487***	-0.223***	-0.340***	-0.142***	0.081***					
PE (6)	0.052***	-0.005	-0.023**	0.003	-0.068***	-0.001				
LEV (7)	0.087***	-0.099***	0.026**	0.189***	0.398***	0.247***	-0.070***			
AGE (8)	0.303***	-0.285***	-0.223***	-0.197***	0.033***	0.447***	-0.035***	0.118***		
ROA (9)	0.381***	-0.203***	-0.180***	-0.224***	-0.169***	0.129***	0.159***	-0.204***	0.093***	
INFO (10)	-0.1239***	0.0268***	0.1827***	0.0548***	0.0825***	-0.3305***	-0.0208**	0.0942***	-0.1415***	-0.0915***

*This table lists the correlation of regression variables. T-statistics are provided in parentheses. * , ** , *** denote significance at 10%, 5% and 1% level, respectively.*

In Table 2, we present the correlation matrix for our main variables in the regression models. Because of space limitation, we do not include COMPET and NEW_ECON in the correlation table. The correlation coefficient between broad-based options (NON_EXE_OPT) and productivity ($PROD_{t+1}$) is negative and significant. Consistent with our hypothesis, this relationship suggests that the costs associated with higher level of NON_EXE_OPT may outweigh the expected benefits thereon, leading to diminished productivity. To further examine this relationship, we first classify observations into deciles based on annual amounts of our broad-based stock options measure. Next, we determine the median $PROD_{t+1}$ for each decile, and plot the relationship between the ranks and the mean (median) productivity.

Figure 1: Relation between Rank in Broad-Based Stock Options and Future Productivity



This figure shows the relationship between broad-based stock options and future productivity.

Figure 1 shows that the relationship between the rank of broad-based stock options and productivity is negative. The results in the correlation matrix and figure 1 provide preliminary results supporting our hypothesis that more broad-stock options are associated with lower future productivity. Table 2 also shows that CEO stock option is negatively related to productivity. Since the correlation table suggests that bigger firms have higher productivity but have less CEO option, the negative relation between CEO option and firm productivity can be driven by the firm size effect. Consistent with the results in Core and Guay (2001), we find that firms facing higher cash constraints tend to grant more broad-based stock options as a means to conserve resources. The positive correlation coefficients between $PROD_{t+1}$ and SIZE, PE, and ROA are consistent with the results in prior studies, and suggest that bigger, growth, and profitable firms are generally more productive. Stock price informativeness has a negative relation with firm productivity, which can also be driven by the size effect (larger firms have lower INFO but higher PROD).

As the correlation table shows that other variables are related to productivity, we now use multivariate regressions to test our hypotheses. Table 3 presents the regression results. The dependent variable ($PROD_{t+1}$) shows the annual performance of each firm relative to the benchmark that is constructed using the observed input-output relationship in the industry-year. We include year and industry fixed effects to address the autocorrelation and industry clusters. The first two columns in Table 3 show the relationship between $PROD_{t+1}$ and control variables, including executive and CEO option grants. Consistent with the correlation table, we find firm size, growth opportunities, industry competition, and firm profitability are positively associated with future productivity. Firm age, however, is negatively related to future productivity in our sample.

Table 3: Broad-Based Stock Options on Future Productivity

	$Prod_{t+1}$	**$Prod_{t+1}$**	**$Prod_{t+1}$**	**$Prod_{t+1}$**	**$Prod_{t+1}$**
	(1)	(2)	(3)	(4)	(5)
BROAD_OPT			-0.0091***	-0.0098**	-0.0101***
			(-2.73)	(-2.57)	(-2.95)
SIZE	0.0593***	0.0598***	0.0589***	0.0598***	0.0594***
	(41.90)	(37.80)	(43.18)	(37.79)	(41.94)
PE	0.0001***	0.0001***	0.0001***	0.0001***	0.0001***
	(3.28)	(3.68)	(3.26)	(3.67)	(3.28)
LEV	-0.0084	-0.0077	-0.0084	-0.0086	-0.0094
	(-0.93)	(-0.76)	(-0.94)	(-0.85)	(-1.05)
AGE	-0.0004***	-0.0003**	-0.0005***	-0.0003***	-0.0005***
	(-4.18)	(-2.51)	(-4.61)	(-2.88)	(-4.59)
COMPET	0.9126***	0.7835***	0.9354***	0.7880***	0.9188***
	(3.47)	(2.81)	(3.57)	(2.83)	(3.50)
ROA	0.5089***	0.5170***	0.5048***	0.5145***	0.5064***
	(40.42)	(36.36)	(40.26)	(36.10)	(40.16)
EXEC_OPT	0.0084				0.0197
	(0.54)				(1.23)
CEO_OPT		0.0119		0.0271	
		(0.36)		(0.82)	
INTERCEPT	0.4084***	0.3942***	0.4163***	0.3984***	0.4119***
	(38.89)	(33.69)	(41.90)	(33.73)	(38.98)
N	12,067	9,501	12,067	9,501	12,067
Adj. R^2	0.518	0.527	0.518	0.527	0.518
Industry fixed effect	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes

*This table shows the relationship between broad-based stock options and future productivity. T-statistics are provided in parentheses. *, **, *** denote significance at 10%, 5% and 1% level, respectively.*

We show the results of our tests on the relation between broad-based stock options and future productivity after controlling for other factors in Columns (3) to (5). To intensify the statistical significance of the tests, we mainly focus on the dichotomy variable of broad-based stock options (BROAD_OPT). In column (3) of Table 3, we find that the coefficient of BROAD_OPT is negative and significant (t= -2.73), suggesting that the relative productivity of firms with higher broad-based stock options is lower than that of other firms. Since Table 2 shows that CEO option grants are positively correlated with broad-based stock options but is negatively correlated with productivity, the negative relationship between BROAD_OPT and $PROD_{t+1}$ documented above could be primarily due to the impact of executive or CEO option grants on $PROD_{t+1}$. To address concerns that the extent of executive or CEO options may affect the relationship between BROAD_OPT and $PROD_{t+1}$, we run the regression model after including EXEC_OPT and CEO_OPT. Column (4) of Table 3 shows that the coefficient of BROAD_OPT is still negative and significant (t-stat= -2.57) after controlling for CEO option grants. Similarly, we find negative and significant coefficient (t-stat=-2.95) when we include EXEC_OPT in column (5). Collectively, the results in Table 3 provide evidence that the future one-year productivity of firms that grant more broad-based stock options is lower than that of other firms. In untabulated results, we also test the relationship between BROAD_OPT and three year ahead PROD. Our results are similar to the relationship indicated in Table 3. The coefficients of other independent variables in Table 3 are significant in the expected direction except

for AGE. Our second hypothesis predicts that the relation between BROAD_OPT and $PROD_{t+1}$ is likely to be affected by the firm's industry practice and financial constraints. More specifically, we note that New Economy firms are characterized by higher needs for R&D and other expenditures. To the extent that broad-based options represent additional compensation which involve resource diversion, their adverse effect on productivity is expected to be exacerbated in these industries. In contrast, broad-based stock options necessitated by financial constraints save the cash flows out of the firm and thus are less likely to lead to resource diversion. Therefore, we expect the relation between BROAD_OPT and $PROD_{t+1}$ to be less negative for financially constraint firms.

Table 4 shows how BROAD_OPT influences $PROD_{t+1}$ for firms facing interest burden and cash constraints. We include an indicator variable BURDEN that takes the value of 1 when a firm's interest burden is greater than the industry median, and 0 otherwise. Column (1) shows that the coefficient of BROAD_OPT is negative and significant (t-statistic=-4.50), which is consistent with the result we presented in Table 3. The coefficient of the interaction term (BROAD_OPT × BURDEN) in the same regression, however, is positive and significant (t-statistic=5.33). These results are consistent with our prediction that while broad-based stock options are in general negatively related to future productivity, this negative relationship is attenuated when such grants are necessitated by interest burden. In unreported tests, we compare coefficients of BROAD_OPT for firms facing higher interest burden with that for firms not facing interest burden. The test shows that the former is significantly higher (F-statistic=12.63; p-value = 0.02). In Column (2), we use the specific percentage of broad-based stock option (NON_EXE_OPT), the results do not change.

Table 4: The Impact of Broad-Based Options for Firms with Financial Constraint or Interest Burden

	$Prod_{t+1}$	**$Prod_{t+1}$**	**$Prod_{t+1}$**	**$Prod_{t+1}$**
	(1)	(2)	(3)	(4)
BROAD_OPT	-0.0185***		-0.0116***	
	(-4.50)		(-2.78)	
BROAD_OPT × BURDEN	0.0482***			
	(5.33)			
NON_EXE_OPT		-0.0314***		-0.0276***
		(-3.52)		(-2.98)
NON_EXE_OPT × BURDEN		0.1073***		
		(4.81)		
BROAD_OPT × CONSTRAINT			0.0164*	
			(1.93)	
NON_EXE_OPT × CONSTRAINT				0.0595***
				(3.32)
SIZE	0.0601***	0.0601***	0.0590***	0.0591***
	(38.04)	(38.00)	(37.25)	(37.29)
PE	0.0001***	0.0001***	0.0001***	0.0001***
	(3.62)	(3.65)	(3.88)	(3.86)
LEV	-0.0000	0.0004	0.0038	0.0039
	(-0.00)	(0.04)	(0.37)	(0.38)
AGE	-0.0004***	-0.0003***	-0.0004***	-0.0004***
	(-3.00)	(-2.73)	(-3.61)	(-3.52)
COMPET	0.7351***	0.7537***	0.7873***	0.7865***
	(2.64)	(2.71)	(2.83)	(2.83)
ROA	0.5108***	0.5097***	0.5051***	0.5049***
	(35.81)	(35.41)	(34.95)	(34.63)
CEO_OPT	0.0417	0.0504	-0.0117	0.0020
	(1.12)	(1.32)	(-0.30)	(0.05)
CEO_OPT × BURDEN	-0.0532	-0.0662	0.1385**	0.0901
	(-0.70)	(-0.87)	(1.97)	(1.24)
BURDEN	-0.0247***	-0.0297***	-0.0370***	-0.0426***
	(-4.23)	(-4.62)	(-6.14)	(-6.86)
INTERCEPT	0.3984***	0.3975***	0.4100***	0.4105***
	(33.61)	(33.51)	(34.36)	(34.34)
N	9,501	9,501	9,501	9,501
ADJ. R^2	0.529	0.529	0.529	0.530
Industry fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes

*This table shows the impact of broad-based options on future productivity for firms facing financial constraint or interest burden. T-statistics are provided in parentheses. * , ** , *** denote significance at 10%, 5% and 1% level, respectively.*

In the next two columns, we test how cash constraint (CONSTRAINT) affects the relation between BROAD_OPT and $PROD_{t+1}$. The indicator variable CONSTRAINT takes the value of 1 when a firm's cash constraint is greater than the industry median, and 0 otherwise. Column (3) of the Panel shows that while the coefficient of BROAD_OPT is negative and significant (t-statistic= -2.78), the interaction term (BROAD_OPT × CONSTRIANT) is positive and significant (t-statistic= 1.93). Again, these results are consistent with our prediction that while broad-based stock options are in general negatively related to future productivity, this negative relationship is attenuated when such grants are necessitated by cash constraint. When we use the NON_EXE_OPT to measure specific broad-based option percentage, the results stay qualitatively the same. Taken together, Table 4 provides evidence supporting our hypothesis that BROAD_OPT necessitated by the firms' financial constraints enhances future productivity.

In our second hypothesis, we predict that the prevalent use of broad-based stock options in New Economy industries exacerbates the negative relation between BROAD_OPT and $PROD_{t+1.}$ In Table 5, we examine the relationship between BROAD_OPT and $PROD_{t+1}$ after classifying our sample into two subsamples: one group has firms in NEW_ECON industries and the other group does not. In the first two columns of Table 5, we run a separate regression in each subsample. Column (1) shows that, when firms are not in NEW_ECON industries, the relation between BROAD_OPT and $PROD_{t+1}$ is not statistically significant. In contrast, the coefficient of BROAD_OPT is negative and significant (t-statistic = -4.70) when the firm is in NEW_ECON industries as shown in Column (2). These results are consistent with the observation that broad-based stock options are granted indiscriminately to almost all employees in these industries. As we discussed before, such programs are less likely to have incentive effect and are more likely to be add-on compensations and divert away resources needed for investment, the collective effect being diminished productivity. Another way to test the influence of broad-based stock options to future productivity in NEW_ECON firms is shown in the last three columns in Table 5.

In particular, we examine how CONSTRAINT and BURDEN moderate the relationship between BROAD_OPT and $PROD_{t+1}$ in NEW_ECON firms. Results show that the coefficient of BROAD_OPT is less negative for these firms when they are faced with financial constraints (i.e., the coefficient of BROAD_OPT × NEW_ECON × CONSTRAINT is positive and significant: t-stat = 2.96). However, the coefficient of the interaction term for BROAD_OPT × NEW_ECON × BURDEN is not significant. Overall, the results in Table 5 provide evidence that the pronounced negative relation between broad-based stock option grants and productivity for new economy firms is attenuated when these programs are necessitated by the firms' financial condition. To test the hypothesis that stock price informativeness attenuates the negative relation between broad-based stock options and future productivity, we conduct the tests as shown in Table 6. First, we split the sample into two subsamples according to the level of stock price informativeness. Since the previous correlation table shows that INFO is negatively related to SIZE, we define each subsample according to the median stock price non-synchronicity in every firm size decile. Columns (1) and (2) show that only in the low stock price informativeness subsample, BROAD_OPT decreases $PROD_{t+1}$ (t-stat= -4.70). In the high stock price informativeness subsample, however, BROAD_OPT increases $PROD_{t+1}$ (t-stat = 1.85). These results suggest option grants are more likely to solicit effort from rank-and-file employees when the employees' performance is more in line with their compensation as guaranteed by informative stock prices. We get similar results using the percentage of broad-based stock options in columns (3) and (4).

Table 5: The Impact of Broad-Based Options for Firms in the New Economy

	NEW_ECON=0	**NEW_ECON=1**	**Whole Sample**		
	$PROD_{t+1}$	$PROD_{t+1}$	$PROD_{t+1}$	$PROD_{t+1}$	$PROD_{t+1}$
	(1)	(2)	(3)	(4)	(5)
BROAD_OPT	-0.0119	-0.0636***	-0.0093**	-0.0060	-0.0182***
	(-1.14)	(-4.70)	(-2.03)	(-1.15)	(-3.61)
BROAD_OPT × NEW_ECON			-0.0115	-0.0207*	-0.0075
			(-1.06)	(-1.83)	(-0.67)
BROAD_OPT × CONSTRAINT × NEW_ECON				0.0443***	
				(2.96)	
BROAD_OPT × CONSTRAINT				-0.0073	
				(-0.69)	
CONSTRAINT				-0.0220***	
				(-3.23)	
BROAD_OPT × BURDEN × NEW_ECON					-0.0057
					(-0.31)
BROAD_OPT × BURDEN					0.0480***
					(4.18)
BURDEN					-0.0317***
					(-4.83)
CEO_OPT × CONSTRAINT				0.1389*	
				(1.74)	
CEO_OPT × BURDEN					0.0014
					(0.02)
CEO_OPT			0.1119***	0.0704	0.1155***
			(2.99)	(1.62)	(2.75)
NEW_ECOM			-0.1023***	-0.1030***	-0.1033***
			(-11.36)	(-11.45)	(-11.49)
SIZE	0.0568***	0.0620***	0.0602***	0.0598***	0.0606***
	(32.85)	(18.87)	(34.43)	(34.11)	(34.68)
PE	0.0000	0.0002***	0.0001**	0.0001**	0.0001**
	(1.13)	(3.72)	(2.24)	(2.27)	(2.17)
LEV	-0.0042	-0.1127***	-0.0089	-0.0011	0.0027
	(-0.39)	(-4.59)	(-0.79)	(-0.10)	(0.22)
AGE	0.0004***	-0.0009**	0.0005***	0.0005***	0.0005***
	(3.29)	(-2.09)	(3.91)	(3.52)	(3.80)
COMPET	-0.3919	2.3713***	-0.2426	-0.2613	-0.3066
	(-1.24)	(3.24)	(-0.80)	(-0.86)	(-1.01)
ROA	0.5735***	0.2058***	0.5710***	0.5695***	0.5657***
	(33.62)	(10.49)	(35.68)	(35.02)	(35.29)
INTERCEPT	0.3343***	0.2380***	0.2943***	0.3004***	0.2951***
	(30.47)	(10.92)	(25.30)	(25.45)	(25.26)
N	9,848	2,219	9,501	9,501	9,501
ADJ. R^2	0.306	0.363	0.395	0.396	0.397
Year fixed effect	Yes	Yes	Yes	Yes	Yes

*This table shows the impact of broad-based stock options on future productivity in new economy firms relative to other firms. T-statistics are provided in parentheses. * , ** , *** denote significance at 10%, 5% and 1% level, respectively.*

In columns (5) and (6) of Table 6, we include the whole sample and test the interaction term of broad-based option grants and stock price informativeness. We find broad-based option grants still generally have a negative influence on future productivity. However, when stock prices are more informative of the value of firm fundamentals, this negative relation decreases (the coefficients of the interaction term are positive and significant). Overall, the results in Table 6 support our third hypothesis.

Table 6: Stock Price Informativeness on the Impact of Broad-Based Options on Future Productivity

	LOW_INFO	HIGH_INFO	LOW_INFO	HIGH_INFO	Whole Sample	
	$PROD_{t+1}$	$PROD_{t+1}$	$PROD_{t+1}$	$PROD_{t+1}$	$PROD_{t+1}$	$PROD_{t+1}$
	(1)	(2)	(3)	(4)	(5)	(6)
BROAD_OPT	-0.0261***	0.0099*			-0.0239***	
	(-4.70)	(1.85)			(-4.63)	
BROAD_OPT × HIGH_INFO					0.0311***	
					(4.63)	
HIGH_INFO					0.0020	
					(0.45)	
NON_EXE_OPT			-0.0483***	0.0263**		-0.0693***
			(-3.89)	(2.20)		(-4.99)
NON_EXE_OPT × INFO						0.0248***
						(5.22)
INFO						-0.0030*
						(-1.69)
CEO_OPT	-0.0071	0.0048	0.0166	-0.0041	0.0105	0.0093
	(-0.13)	(0.11)	(0.30)	(-0.09)	(0.31)	(0.27)
SIZE	0.0601***	0.0590***	0.0602***	0.0589***	0.0601***	0.0612***
	(26.40)	(26.09)	(26.44)	(26.06)	(37.42)	(36.13)
PE	0.0001***	0.0001	0.0001***	0.0001	0.0001***	0.0001***
	(3.18)	(1.29)	(3.30)	(1.29)	(3.50)	(3.51)
LEV	-0.0326**	0.0031	-0.0325**	0.0042	-0.0125	-0.0098
	(-2.11)	(0.22)	(-2.10)	(0.29)	(-1.19)	(-0.93)
AGE	-0.0005***	-0.0002	-0.0004**	-0.0002	-0.0004***	-0.0004***
	(-2.69)	(-1.43)	(-2.50)	(-1.43)	(-3.11)	(-3.18)
COMPET	0.7657*	0.5482	0.7722**	0.5332	0.7233***	0.6212**
	(1.95)	(1.37)	(1.97)	(1.34)	(2.58)	(2.20)
ROA	0.4903***	0.5537***	0.4847***	0.5581***	0.5263***	0.5259***
	(25.44)	(25.00)	(24.83)	(25.01)	(36.28)	(35.79)
INTERCEPT	0.4022***	0.3700***	0.4012***	0.3694***	0.3872***	0.3858***
	(16.97)	(13.75)	(16.91)	(13.73)	(22.06)	(20.71)
N	9,501	9,501	9,501	9,501	9,501	9,501
ADJ. R^2	0.5549	0.5134	0.5543	0.5136	0.5298	0.5295
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes

*This table shows the effect of stock price informativeness on the relation between broad-based stock options and firm productivity. T-statistics are provided in parentheses. * , ** , *** denote significance at 10%, 5% and 1% level, respectively.*

Additional Tests

The possible endogeneity is a serious issue for the kind of our analysis. On possible form of endogeneity is reverse causality in which firms with lower productivity tend to adopt broad-based stock options. Following Sesil and Lin (2011), we run the regressions of (2a) and (2b) by including lag variables in the form of $BROAD\_OPT_{t+2}$ as an additional control variable. The coefficient on $BROAD\_OPT_{t+2}$ is not significant while the coefficient of BROAD_OPT keeps negatively significant, suggesting our results are not driven by reverse causality. Another possible form of endogeneity in this study is that the observed negative relation is indeed caused by the relation between BROAD_OPT and other control variables. To address this concern, we conduct a two-step procedure. In the 1st stage, BROAD_OPT is regressed on control variables in the regression (2a); in the 2nd stage, we use the 1st stage residual to substitute BROAD_OPT in the regression (2b) with an additional control of $BROAD\_OPT_{t+2}$. In this way, the residual used in the regressions is not related with other control variables and the reverse causality is controlled. The results show nearly no change. Therefore, our results stay robust to endogeneity issues.

As we discussed before, one of the drawbacks of broad-based stock options is that, as rewards are shared among a large number of participants based on a broad performance measure, an individual employee is likely to free ride off other members by holding back his effort (Alchian and Demsez, 1972; Weitzman and Kruse, 1990). If this is the case, we expect the broad-based stock options are less likely to cause reduced productivity when there are fewer employees. That is, when such option grants are thinly distributed. To assess the effect of employee size, we rank firms into quintiles annually based on the employee size and

then run the previous regressions (2a) and (2b) in the first and the fifth quintiles, respectively. Unreported results show that BROAD_OPT only has a negatively impact on $PROD_{t+1}$ in the fifth quintile where firms have the most number of employees. In the first quintile where firms have the smallest employee size, BROAD_OPT does not lead to lower $PROD_{t+1}$. This observation suggests that the wide distribution of broad-based stock options can be one of the reasons that such option grants bring an overall negative impact on firm productivity. If regulators recognize that broad-based stock options do not enhance productivity, recent corporate governance reforms and scrutiny may have curbed such option grants.

To test this projection, we compare the amount of broad-based stock options granted before and after the implementation of Sarbanes-Oxley Act 2002 (SOX). We find both BROAD_OPT and NON_EXE_OPT are significantly lower in post-SOX periods. Furthermore, to control for other factors related with broad-based stock option grants, we run a Probit regression using NON_EXE_OPT as the dependent variable and SOX, SIZE, LEV, AGE, CONSTRAINT, PE, and COMPET as independent variables. We define SOX=1 if the observation is after 2002, and 0 otherwise. The results show SOX has a negative and significant coefficient. This observation does not change when the dependent variable is BROAD_OPT. These results indicate enhanced corporate governance after SOX does curb the grants of broad-based options. However, when we test the effect of broad-based stock options on future productivity in periods before and after SOX, we find the negative relation holds in both periods. It suggests enhance corporate governance cannot change the negative relation between broad-based stock options and future productivity. Overall, additional test results confirms previous arguments and provide additional insights on the mechanism through which broad-based stock options are negatively associated with future productivity.

CONCLUSION

Using 12,067 firm-year observations for 1,976 U.S. firms that granted broad-based stock options during the period from 1996 to 2006, we find that the extent of broad-based stock option grants are negatively associated with future productivity. In addition, this negative relation is attenuated if firms face cash constraints or interest burden but is exacerbated if firms are in New Economy industries or if stock prices are more informative of firm fundamentals. Additional robustness tests confirm these results are not driven by endogeneity issues. The recent increase in the use of stock options to remunerate non-executive employees suggests that stock options constitute an important component of compensation packages to both executive and non-executive employees. However, while the existing research examines the impact of executive option grants, there are limited studies that focus on the performance implication of option grants to rank-and-file employees. Companies pay higher amount in options than they would pay in cash for the same service because options are risky to undiversified employees (Hall and Murphy, 2003). Prior evidence also suggests that the increase in options compensation is not matched by a corresponding downward adjustment in other forms of compensation. Furthermore, increase in the number of shares due to exercise seems to motivate managers to divert resources needed for investment in productive resources to repurchase shares so as to prevent dilution of earnings per share (Bens et al. 2002; Bhargava 2013). Our study enforces these previous findings by showing that such diversions are manifested as diminished future productivity.

Our study also contributes to the literature in the following aspects. We measure productivity using the DEA efficiency score, where relative efficiency is determined based on the empirical observation of annual inputs and output of each industry. This gives us a comprehensive measure that does not require a specific assumption about the underlying production function. In addition, the productivity metric is less susceptible to accounting manipulation than other metrics, such as ROA. Different from previous studies that focus on the existence of broad-based stock options, we examine the relationship between the extent of broad-based stock options and future productivity. Last but not the least, this paper reports that stock price informativeness intensifies the positive impact of broad-based stock options in aligning the interests between rank-and-file employees and shareholders. Collectively, this study highlights that expected incentive effect of broad-based stock options fails to compensate for the additional direct and indirect costs

associated with such compensation programs. Our study makes significant contribution to the academic literature and has important practical implications in designing efficient compensation packages.

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ACKNOWLEDGEMENT

We would like to thank the journal editors, Terrance Jalbert and Mercedes Jalbert, and two anonymous referees for their insightful comments. Any errors are our own.

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