# CORPORATE INNOVATION AND CORPORATE GOVERNANCE: A STUDY OF U.S. FIRMS

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**Abstract**

The paper relates corporate governance to firm's total factor productivity growth of U.S. firms from 1990 to 2004. Given technological constraints, some firms are very efficient whereas others are not and some firms have much faster rates of innovation and productivity growth than others. Are these differences due to chance or are there some factors contributing to higher total factor productivity growth? In this paper, we find evidence that firms with stronger shareholder rights have higher total factor productivity growth. By employing the governance index compiled by Gompers, Ishii, and Metrick (2003), we determine that the effect of governance on productivity varies positively with the quality of corporate governance. Furthermore, this relationship is strongest among firms which have the strongest shareholder rights.

**Keywords:** corporate governance, innovations, US firms

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## I. Introduction

American workers are currently about seven times as productive as they were a century ago. Real wages and average family income are also roughly seven times higher than the corresponding levels in 1900. This increase in labor productivity has not been simply the result of endowing labor with more capital; it has also been the outcome of improved technology and efficiency. In Paul Samuelson's (1999) words, "it is the result of inspiration as well as perspiration" (pp. 28). This "inspiration" is often measured by total factor productivity (TFP) and is calculated using a residual – the difference between the growth rates of an index of output and an index of input.

The importance of TFP cannot be over emphasized. In his pioneering paper, Solow (1957) finds that some 80 percent of the rise in output per worker in the United States over the preceding half-century was explained by this mysterious residual which he called the *measure of our ignorance*. Since then many researchers have confirmed that sustained high economic growth is consistent with high values of this Solow residual or TFP. The novel thing about TFP is that it can be applied to compare economies, industries, and on a micro level, firms. In this paper we use the concept of TFP at the firm level as 'Corporate Innovation'.

Though 'innovation' is often measured from the U.S. Patent and Trademark office data (for eg., see Aghion et al., 2008) we would like to separate it from the term 'corporate innovation' which includes non-capital and non-labor productivity factors like marketing efforts, brand equity, the quality of its management, etc. which may contribute either positively or negatively to a firm's performance. Such factors can substantially differentiate two firms with similar levels of capital and labor, and lead to very different levels of economic profit. Bartelsman and Doms (2000) point out that managerial ability; management/ownership changes, technology, human capital, and regulation are all factors that have been discussed in recent literature that influence productivity growth. The direct effect on the productivity growth of the firm emanates from the fact that managers make the choice of the firm's inputs, outputs, and technology. Lucas (1978) models labor productivity being the same across firms in equilibrium, due to diminishing returns to managerial skill. In contrast, according to Jovanovic's (1982) model, better managers have high efficiency parameters and higher productivity. However, it is difficult to come up with an objective measure of manager quality and performance (Bartelsman and Doms, 2000).

A growing body of literature has talked about how the corporate governance system influences managerial performance. If a firm has strong shareholder rights and minimal takeover defenses then, a managers could be risk-averse and may only select low return-low risk projects. In such case, innovation may actually carry a risk for the managers. If things go wrong, the board could fire the managers. This might create a natural aversion to take risky projects. At the same time, if the company is not being innovative and is unable to generate high returns on projects, the market valuation of the firm is likely to decline in the future and which could also result in firing of the managers or the firm becoming more susceptible to takeovers. In such case, the managers of a firm having strong shareholder rights might actually be more efficient lest they might lose their job.[1] The justification for takeover threats (i.e. less anti-takeover provisions) is often seen as the strongest form of managerial discipline (Jensen, 1986). Lower agency costs due to stronger shareholder rights (GIM, 2003) could create an environment that may foster managerial efficacy.

On the other extreme, there are firms where the shareholders have very few rights. If there are stiff anti-takeover provisions, so that the firm is impregnable to outside takeovers, managers feel more secure. In such case, such managers may engage in risky behavior because the fear of being "taken" over by some firm is small. Managers would be willing to take more risks, and therefore, be innovative, which may translate into better future growth prospects, operating performance, and increased long term value of the firm. At the same time, with increased job security, managers may put in less effort, shirk, appropriate a part of the cash flows as high executive compensations, or invest in inefficient projects (Williamson, 1964). With weak shareholder rights, it is difficult or costly to replace managers, so managers may be more willing and able to extract private benefits (Jensen, 1986).

The recent empirical evidence supports the latter stream of reasoning (Blanchard, et al., 1994;, Lang, et al., 1991; Harford, et al., 2008). Those firms which have weak shareholder rights tend to make more acquisitions for empire building purposes, which destroy firm value (Masulis, et al., 2007). Similarly, Dittmar and Mahrt-Smith (2007) argue that poorly governed firms dissipate excess cash quickly in ways that significantly reduce operating performance. They also find that negative impact of large cash holdings on future operating performance is eliminated if the firm is well governed.

The recent literature, including Gompers, Ishii, and Metrick (GIM, 2003), Bebchuk and Cohen (2005), and Cremers and Nair (2005), has found that firms having better corporate governance have higher long-term stock returns, firm value, and operating performance. We add to this literature by suggesting that a part of a firm's TFP growth or corporate innovation can be attributed to a better corporate governance system. We find robust evidence that the firms with stronger shareholder rights have higher rates of growth in TFP, even after controlling for factors such as the effect of intangibles, the scale effect due to size, age of the firm and industry. The results are robust for the sample period from 1990-2004. This paper also contributes to the literature on sources of productivity growth by including corporate governance as a factor contributing to the growth in total factor productivity. To our knowledge, this is the first paper which uses the broad based and widely used governance index $G$, compiled by GIM (2003) to provide evidence on the relationship between shareholder rights and productivity growth.

## II. Data and Methodology

### *A. Governance Data*

Following GIM (2003), the recently developed and widely used governance index measures is used to measure the strength of shareholder rights.[2] GIM's governance index $G$ is created on the basis of how many restrictive governance provisions are imposed on shareholder rights; the more restrictive the governance, the weaker the shareholder rights. Their primary data source is the Investor Responsibility Research Center (IRRC), which publishes detailed listings of corporate-governance provisions for individual U.S. firms in Corporate Takeover Defenses volumes (Rosenbaum, 1990, 1993, 1995, 1998, 2000, 2002 and 2004). The governance index is constructed as follows. For every firm, GIM adds one point for every provision that restricts shareholder rights and correspondingly increases managerial power; thus, the higher the score, the weaker the shareholder rights. According to GIM, the firms with weak shareholder rights are more likely to experience a wider divergence of ownership and control. Additionally, such firms are also more likely to have high agency costs and hence, poor corporate governance.

Each volume of Corporate Takeover Defenses includes about 1400 to 1500 firms, with some changes in the list of included firms from volume to volume. Since the IRRC does not publish volumes for every year, missing years are filled by assuming that the governance provisions reported in any given year were also in place in two years preceding the volume's publication. In the event that there was a gap in reporting, for example, if a firm is reported in 1990 and again in 1998, the years 1991-1993 are filled assuming it did not change its governance value from 1990. For years 1995-1997 the value from 1998 is used. This procedure is consistent with all the major studies involving the $G$ index. Using different filling methods do not change the results qualitatively. This is due to the fact that that the $G$ index is relatively sticky, as about 45% of the firms had some changes in its $G$ level in the 15 years comprising the sample (1990-2004).

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[1] Typically when there is a hostile takeover, many of the target company's middle level and senior level managers are laid off.

[2] We thank Andrew Metrick for making this data publicly available. The data is directly obtained from Metrick's website at http://finance.wharton.upenn.edu/~metrick/data.htm

A simple linear transformation of the $G$ index is *CORPG = 24-* $G$. The $G$ index is based on 24 corporate governance provisions. A firm can have a maximum $G$ value of 24 (which would essentially make the firm fascist). In the sample employed in this paper, the *CORPG* has a maximum value of 22 (there are no firms having zero, or one $G$ index value) and a minimum value of 6 (which corresponds to value of 18 in the $G$ index). Higher values of *CORPG* correspond to better shareholder rights.

### B. Empirical Cobb-Douglas Model for Total Factor Productivity

The starting point of our empirical model of productivity growth is a Cobb-Douglas production function with two factor inputs. This specification, partly based on Nickell (1996), explicitly models the sources of total factor productivity. Specifically, the *level* of total factor productivity as a function of the firm's past corporate governance is modeled. In particular, it is assumed that firm's production function is given by[3]

$$Y_{it} = \Phi_{it} K_{it}^{\beta_{k,i}} L_{it}^{\beta_{l,i}} H_{it}^{\beta_{c,i}} \quad (1)$$

where $Y_{it}$ is value added, measured as sales minus the cost of goods sold, $\Phi_{it}$ is a measure of total factor productivity, $K_{it}$ is the tangible capital stock, $L_{it}$ is the labor input, and $H_{it}$ is the stock of intangible capital for firm $i$ in year $t$. Since value added, defined as total sales less materials costs, is used as an output measure, this specification implicitly allows for materials as the fourth input.

The issue though is accounting for the different growth rates of labor and capital for firms in different industries. In other words, it would be naïve to assume that the factor inputs of labor and tangible and intangible capital have similar coefficients across industries. Just using industry dummies does not solve the problem as it is not able to isolate the effect of individual factor inputs. Instead, an alternative formulation that is able to capture the industry specific component on the factor inputs of labor, tangible, and intangible capital is employed.

For a firm belonging to a particular industry, the coefficient on tangible capital $\beta_{k,i}$ is treated as $\beta_{k,i} = \beta_k + \beta_{k,j(i)}$, to capture the industry adjusted coefficient on tangible capital and the coefficient on intangible capital is treated as $\beta_{h,i} = \beta_h + \beta_{h,j(i)}$ to capture the industry adjusted coefficient on intangible capital. Similarly, the industry adjusted coefficient on labor $\beta_{l,i}$ is calculated as $\beta_{l,i} = \beta_l + \beta_{l,j(i)}$ where $j(i)$ denotes the industry of firm $i$. The regression terms for labor, tangible, and intangible capital factor inputs for firm $i$ belonging to industry $j(i)$ are given by

$$\beta_l l_{i,t} + \beta_{l,j(i)}\left(l_{i,t} \times IND_{j(i)}\right),$$
$$\beta_k k_{i,t} + \beta_{k,j(i)}\left(k_{i,t} \times IND_{j(i)}\right),$$
$$\beta_h h_{i,t} + \beta_{h,j(i)}\left(h_{i,t} \times IND_{j(i)}\right)$$

where $IND_j$ is the dummy variable for the $j^{\text{th}}$ industry. Unlike Nickell (1996), the restriction that factor coefficients to sum to 1 is not used, i.e., constant returns to scale are not assumed. This gives the basic log-linear empirical production function with $y_{it}$, $k_{it}$, $l_{it}$, $h_{it}$ and $\phi_{it}$ denoting the logs of $Y_{it}$, $K_{it}$, $L_{it}$, $H_{it}$ and $\Phi_{it}$, respectively

$$\begin{aligned} y_{it} = \; & \phi_{it} + \beta_k k_{it} + \beta_l l_{it} + \beta_h h_{it} \\ & + \beta_{k,j(i)}(k_{it} \times IND_{j(i)}) + \beta_{l,j(i)}(l_{it} \times IND_{j(i)}) \\ & + \beta_{h,j(i)}(h_{it} \times IND_{j(i)}) + \mu_i + \upsilon_{it} \end{aligned} \quad (2)$$

Additionally, taking first differences eliminates the fixed firm effect $\mu_i$ which accounts for all unobserved company specific factors influencing the level of productivity. This gives the differenced growth version of the adjusted Cobb-Douglas production function

$$\begin{aligned} \Delta y_{it} = \; & \Delta\phi_{it} + \beta_k \Delta k_{it} + \beta_l \Delta l_{it} + \beta_h \Delta h_{it} \\ & + \beta_{k,j(i)}(\Delta k_{it} \times IND_{j(i)}) + \beta_{l,j(i)}(\Delta l_{it} \times IND_{j(i)}) \\ & + \beta_{h,j(i)}(\Delta h_{it} \times IND_{j(i)}) + \Delta\upsilon_{it} \end{aligned} \quad (3)$$

Finally, the sources of productivity growth are specified by using the level of corporate governance in year *t-1*. The level of corporate governance is proxied by *CORPG*. To control for value added growth differences between younger firms and older firms, the logarithm of a firm's age in years, which is the difference between the foundation date of the firm and the current date, is used. The coefficient on the age variable should be negative in line with the view that younger firms are likely to have a faster growth than the older firms (Evans, 1987b). An alternative measure of firm age as the log of years listed does not qualitatively alter the results.

In addition, time and industry dummies are included to account for time effects that capture shocks common to all firms and industry effects that capture shocks specific to the particular industry which a firm belongs to. Thus, total factor productivity growth is specified as

$$\Delta\phi_{it} = \lambda_1 CORPG_{it-1} + \lambda_2 \ln(Age) + Year\ Effects + Industry\ Effects$$

[3] Results do not change qualitatively if a simpler specification without intangible capital is employed.

(4)

The above model specification defined by equations (3) and (4) is used for all regression results. The Industry dummy variable from equation (4) is excluded for the firm specific fixed effects model as industry dummies will be collinear with firm fixed effects.

### C. Firm Specific Accounting Data

The inputs used to compute a firm's TFP are obtained from COMPUSTAT. In terms of data series used, a firm's gross profit or value added is defined as the difference between a firm's sales (SALES, COMPUSTAT industrial Annual data item 2) and its cost of goods sold (COGS, COMPUSTAT Annual data item 30). A firm's labor input is the number of its employees (EMP, COMPUSTAT industrial annual data item 29). The capital stock of a firm is measured using the Net Property, Plant, and Equipment (PPEN, COMPUSTAT industrial annual data item 8). PPEN is firm's net fixed assets. The book value of total assets is used to account for the size factor (ASSETS, COMPUSTAT industrial annual data item 6). Intangible is proxied by COMPUSTAT item 33 and represents the net value of intangible assets.[4] Long term liabilities (LTD, industrial annual data item 9) are taken as the value of debt. Also, EBITDA (earnings before interests, taxes, depreciation, and amortization) is taken from COMPUSTAT industrial annual data item 13) as a gross operating profit.

To capture industry wide differences across firms, we classify them into 10 industries (see Table 2) based on Fama-French (1997) classification system using SIC codes.[5] Intangible intensity (*INTANI*), defined as the ratio of intangible assets to net fixed assets (PPEN), is used as a control variable in our regressions as a robustness check. This is because the intangible-intensity varies largely among industries (Claessens and Laev, 2003). It would also account for some industry level differences in productivity. Table 2 displays the average intangible-intensity benchmarks for U.S. firms in 10 different industries. The average intangible-intensity during the sample period (1990-2004) is 128%. But there is a wide variation of intangible-intensity across industries, ranging from as low as 4% for utilities and 12% for petroleum, natural gas and coal products to as high as 267 % for the telecommunications industry and 224% for the healthcare industry. The variation concurs with notions of what constitutes relatively capital intensive versus more knowledge intensive industries.

### D. Some Measurement Issues

The capital stock in a firm is difficult to measure with time series of investments required along with composition issues. However, Bailey, et al., (1992), find that in the productivity model, the use of sophisticated measures of capital instead of crude measures based on book values of capital stock do not change the results qualitatively. For labor input, there is no way to distinguish between "blue collar" and "white collar" workers and hence the measured employed assumes the same amount of labor productivity and ignores the composition issues.

All the variables in the Cobb-Douglas model are required to be either in nominal terms or real terms for consistency. We have nominal accounting values for all our variables except labor. The COMPUSTAT item "labor and related expenses" would have served the purpose, however COMPUSTAT does not report this data regularly and the labor and related expenses data amount to less than 5% of the sample. The widely used alternative is the number of employees as a measure of labor input, which is in real terms.

Since prices do not rise equally for all goods and services, finding the real values from the nominal book values is not simple. Rises in the price of oil are likely to affect the petroleum extraction industry much more than say consumer durables. Similarly, a decline in the prices of consumer durables may not result in similar decline in prices in the food industry. To convert nominal book values into real values, each firm's output and costs must be deflated by sub-industry specific producer prices. Also applying price deflators based on industry is only acceptable under perfect competition where price per unit of quality adjusted output is identical across firms. Bartelsman and Doms (2003) suggest that persistent dispersion of productivity and costs across firms even in the same industry, disputes the empirical validity of perfect competition. Refraining from attempting to take on such a complicated endeavor, a generic and widely used consumer price index is instead used to compute the real values of the nominal variables.

The data on the consumer price index is obtained from Bureau of Labor Statistics (BLS) website[6] of the U.S. Department of labor. The broadest, most comprehensive CPI, the consumer price index for all urban consumers (CPI-U) for the U.S. city average for all items with base 1982-84=100, is used here. We calculate the real values from the nominal book values of capital, intangibles, assets, net sales and cost of goods sold by deflating each variable each year by the corresponding yearly CPI-U index.

### D. Descriptive Statistics

Table 1 presents the median, mean and standard deviation of the regression variables. The median firm age is 37 years and the mean is 58 years with a standard

[4] Intangibles are assets that have no physical existence in themselves, but represent rights to enjoy some privilege. In COMPUSTAT, this item includes blueprints or building designs, patents, copyrights, trademarks, franchises, organizational costs, client lists, computer software patent costs, licenses, and goodwill.

[5] We thank Kenneth French for making this information available on his website.

[6] http://www.bls.gov

deviation of 28 years. The governance index *G* has a median value of 9 and a mean value of 8.40 with a standard deviation of 4.59 representing almost a normal distribution. The growth in value added has a median growth rate of 5.16% and a mean growth rate of 7.93% with a standard deviation of 16.53%. This reflects a high growth rate of output for the sample period from 1990 to 2004. The tangible capital stock and labor both have median growth rates of about 3.7%. Intangible capital stocks grew at a negative rate during the sample period and the standard deviation was 13%. The largest part of intangibles is often goodwill. This was likely due to a spate of high merger and acquisition (M&A) activities in late 1980s and a relative decline of the M&A activities in the 1990s. The intangible-intensity is also highly skewed with median of 54% and a mean of 128% with a standard deviation of 60%.

Table 2 presents the mean values of some firm statistics based on the 10 industries. The industries are categorized using 10 industry classifications from SIC codes by Fama-French (1997). The growth in value added during the period 1990-2004 is highest for the healthcare industry at 18.3%. This industry also has one of the highest intangible-intensities. The energy sector, which includes petroleum, natural gas, and coal products, had the second highest growth in value added at 17.8%. The EBMARGIN defined as EBIT/SALES, where EBIT is the earnings before interest and taxes, is highest for telecommunication industry at 33%, and lowest for wholesale and retail businesses at slightly over 9%. The gross profit margin (GPM) defined as the ratio of (Sales-COGS)/Sales follows a pattern similar to growth in value added. The average size of total assets varies from $1,676 million for consumer durables to $17,481 million for telecommunications industry. The leverage defined as the ratio of long term liabilities to book value of total assets is highest for the telecommunications sector at 33%. The mean leverage of the entire sample is 20%.

## III. Results and Analysis

### A. OLS estimation with robust standard errors

The starting point of this analysis is a pooled OLS regression of the model specified by equations (3) and (4). Breusch-Pagan/Cook-Weisberg tests reveal the presence of panel heteroskedasticity which is corrected by the use of a Huber-White Sandwich estimator for robust standard errors[7]. Wooldridge (2002) autocorrelation tests for panel data show autocorrelation in the levels but no serial correlation when first differences are used. As the model is a first differenced mode, the problems associated with autocorrelation are not a concern.

Column (1) in Table 3 reports the result of a simple pooled regression with the absence of individual firm effects and cross industry dummies for capital, labor, and intangibles. The coefficient on growth rates of the input factors is positive and significant at the 1% level. The coefficient of 0.0022 on the lagged *CORPG* term is also positive and highly significant. This implies that a one point increase in CORPG will increase the value added by 1%.[8] As expected, the coefficient on firm age is negative and is significant. However, there is a positive and significant (at 10%) intercept term which possibly indicates the presence of an omitted variable. The intercept becomes insignificant when cross industry dummies of the factor inputs are included in the regression as specified by equation (3). The coefficient on lagged *CORPG* is similar to the value in column (1) and significant at the 1% level. The coefficients for the factor inputs except capital are all insignificant, though a few of individual cross industry dummies for labor and intangibles are significant. The 30 cross industry dummies for factor inputs are not presented for brevity of exposition.

The regressions in Table 3, columns (3) and (4) expand the model to incorporate temporal and per-industry heterogeneity by adding year and industry dummies to the model. Column (3) reports a fixed time effects pooled regression model which includes year dummies. This helps in controlling for a time effect that makes errors spatially correlated. The coefficient on the governance variable is positive and significant at 1%. Column (4) reports the result of a pooled OLS regression with 10 industry dummies. The coefficient on *CORPG* is significant at 5%. The last column uses both fixed time and industry effects and finds similar results. The coefficient on *CORPG* in all the five pooled OLS regressions is stable and significant. Overall, the results imply a robust positive and significant effect of corporate governance on a firm's productivity growth.

### B. Endogenously Issues

One of principal problems faced when creating an empirical model for governance studies is the problem of endogeneity. The variables that represent levels of corporate governance may be also determined simultaneously with dependent variables related to firm value and productivity. The simultaneous equations bias makes it difficult to determine the direction of causality. Corporate governance can affect productivity, but productivity can also generate a better governance structure (Hermalin and Weisbach, 2003).

[7] We also use Roger's standard errors for robustness but the significance of the coefficient of the regressors does not change.

[8] A firm that is one standard deviation better than the average firm in terms of its corporate governance measure will have a 1% higher value added than the average firm in the sample, given by the product of the standard deviation and the coefficient on *CORPG*, which is 4.59 times 0.22%.

The problem of simultaneous equation bias could be empirically treated by the use of an instrumental variables or the Arellano-Bond (1991) approach, but such an instrument for $G$ is not easily identified. GIM (2003) also report their inability to come up with a suitable instrument for $G$ to use as an instrumental variable.

Using lagged values of *CORPG*, however, may partially reduce this endogeneity problem though it does not completely rule out reverse causality. Lagged governance index also ensures that the information set at the beginning of time *t* contains the prior year value of each firm's governance index, preventing a look-ahead bias. The endogeneity problem can also be reduced if productivity growth is included rather than productivity levels simply because productivity growth is less persistent than productivity levels (Nickell, 1996).

### C. Panel Data Fixed Effect Model

An alternative solution for the endogeneity problem is the use of panel data fixed effect models. A source of endogeneity can be omitted variables related to firms, years, or industries. A combined time and firm fixed effect regression model eliminates omitted variables arising both from unobserved variables that are constant over time and unobserved variables that are constant across firms. With firm fixed effects, the regression coefficient on *CORPG* is driven by the extent of variation over time *within* each firm. Since the governance index for a firm being largely invariant over time (in our sample around 55% of the firms do not undergo a change during the sample period 1990-2004), the fixed effects regression coefficient on *CORPG* is mostly attributed to the variation of *CORPG* of the firms for which the governance index does change over time. If a firm's governance is sticky over time, that firm would not contribute to the coefficient estimation but will only introduce noise and lower test power (Chi, 2005). GIM rejects the use of panel data fixed effect in the sense of firm fixed effects with time-varying coefficients for the above-mentioned reason. Another problem with firm-fixed effects is that including all our firm dummies significantly reduces the degrees of freedom.

Hausman (1978) test suggests picking fixed effects over random effects. Though, both fixed and random effects regression results are presented to check for robustness. The GLS random effects results are discussed in the robustness section. Column (1) in Table 4 corresponds to the total sample. This sample is then divided over two sub-samples called *DEM* and *DICT* that correspond to the levels of lagged $G \leq 5$ and $13 \leq G \leq 24$, respectively.[9] Note that there are no firms with $G$ above 18 in the sample. With higher levels of *CORPG* corresponding to better corporate governance, the sub-samples *DEM* and *DICT* correspond to democratic and dictator firms in the previous year since they are based on lagged $G$ values. Columns (2) and (3) of Table 4 correspond to sub-samples *DEM* and *DICT* respectively. In each column, regressions are for the growth of firm value added on firm's capital, labor and intangibles growth, and lagged corporate governance index *CORPG* with the log age of firms used as a control variable.

Regressors also include industry specific capital, labor, and intangibles components that are not reported in the table for brevity of exposition. For all firms and dictator sub-samples, the coefficient on lagged *CORPG* is positive but marginally significant at the 10% level. The coefficient on *CORPG* for all firms is higher in magnitude though lower in significance than the previous pooled OLS results in Table 3. Notice, that the t-values are lower than those reported in the pooled OLS models. This is because in the fixed effects model, only the time-series variation of governance is captured. For the democratic sub-sample, the coefficient on *CORPG* is 0.0054 which implies that a one point increase in *CORPG*, all else equal, have 2.47% higher value added[10]. For the dictator sub-sample, the coefficient on the governance variable is negative but insignificant. The results for the entire sample and for the democratic sub-sample are quite strong considering the fact that for a sizeable number of firms in the sample the corporate governance index does not change over time. Hence, the fixed effect regression only captures changes in *CORPG* for firms which undergo a change in its $G$ index.

### D. Robustness section

A series of robustness checks is included in this subsection. The results indicate that the empirical findings documented in the previous subsection are robust to different econometric model specifications, additional control variables, and yearly analysis.

#### D.1 Year-by-Year Regression

In the unlikely event that the results were influenced by the effect of a single year or few years, OLS regressions on the model specified by equations (3) and (4) are conducted for each year starting from 1990 to 2004. All regressions use the Huber-White sandwich estimator, which is robust to the presence of generic heteroskedasticity. Table 5 shows that in 14 out of 15 years in the sample, the coefficient of

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[9] We modify the GIM (2003) classification for Dictator firms by including firms from $G \geq 13$ instead of $G \geq 14$. This allows us to add about 500 firm years to the sample which makes our dictator sub-sample less skewed in number of observations in comparison to the democratic sub-sample. Our results do not change qualitatively if the GIM (2003) classification is used though.

[10] A firm that is one standard deviation better than the average firm in terms of its corporate governance measure will have a 2.47% higher value added than the average firm in the sample, given by the product of the standard deviation and the coefficient on *CORPG*, that is 4.59 times 0.54%.

*CORPG* remains positive. In eight of the fifteen years it is positive and significant. The only year it is negative is 1997, but it is insignificant. The coefficient on *CORPG* is relatively stable throughout the years.

### D.2 Generalized Least Squares Random–Effects Model

It is possible that the level of governance effects firm productivity not only in the time series but also in the cross section. A random effect model captures both the time-series and the cross sectional variations while modeling the error terms differently for each firm, and therefore generates more efficient estimates than a fixed effects model does. However, a Hausman (1978) specification test indicates that a fixed effects model is more efficient as there may be omitted variables present. Random effects regression results are also presented; as such specification is widely used in finance research[11]. The justifications for reporting the random effects model are as follows. First, the omitted variable may have nothing to do with the governance level. Second, as governance levels tend to be sticky over time, the fixed effects regression may not reveal the true picture. Third, fixed effects may work best when there are relatively fewer firms and more time periods, as each dummy variable removes one degree of freedom from the model. There are close to 2,000 firms with an average of only 9 yearly observations.

Table 6 reports the result of GLS random effects regressions. Column (1) indicates that lagged *CORPG* is positive and significant at 1% for the entire sample. For democratic firms represented by sub-sample *DEM*, the coefficient of lagged *CORPG* has a higher positive number and significance at the 1% level. This implies that the effect of the governance variable on productivity growth is the strongest for the democratic sub-sample. The coefficient on age is negative and significant at 5% for both the entire sample and democratic sub-sample. Column (3) shows the results of dictator firms represented by sub-sample *DICT*. The coefficient of lagged *CORPG* is negative but insignificant.

### D.3 Additional Control Variables

There is a stream of literature[12] which includes lagged output as a control variable in the empirical Cobb-Douglas production function. In particular, it is assumed that firm $i$ 's production function is given by the standard Cobb-Douglas formulation (1) and (2). Following Nickell (1996), lagged output is included in the empirical production function. This expansion takes into account potential persistence in output levels. This gives the basic log-linear empirical production function, with $y_{it}$, $k_{it}$, $l_{it}$, $h_{it}$ and $\phi_{it}$ denoting the logs of $Y_{it}$, $K_{it}$, $L_{it}$, $H_{it}$ and $\Phi_{it}$, respectively

$$y_{it} = \phi_{it} + \beta_o y_{it-1} + \beta_k k_{it} + \beta_l l_{it} + \beta_h h_{it} + \beta_{k,j(i)}(k_{it} \times IND_{j(i)}) + \beta_{l,j(i)}(l_{it} \times IND_{j(i)}) + \beta_{h,j(i)}(h_{it} \times IND_{j(i)}) + \mu_i + \upsilon_{it} \quad (2')$$

Secondly, taking first differences eliminates the fixed firm effect $\mu_i$ which accounts for all unobserved company-specific factors influencing the level of productivity. The differenced growth version of the adjusted Cobb-Douglas production function is thus obtained

$$\Delta y_{it} = \Delta\phi_{it} + \beta_o \Delta y_{it-1} + \beta_k \Delta k_{it} + \beta_l \Delta l_{it} + \beta_h \Delta h_{it} + \beta_{k,j(i)}(\Delta k_{it} \times IND_{j(i)}) + \beta_{l,j(i)}(\Delta l_{it} \times IND_{j(i)}) + \beta_{h,j(i)}(\Delta h_{it} \times IND_{j(i)}) + \Delta\upsilon_{it} \quad (3')$$

where $\Delta y_{t-1}$ controls for any growth or momentum effect that may obscure results of the regressions.

The inclusion of dynamics in the form of a lagged dependent variable captures the fact that, whenever there is a change in factor inputs of production, it takes some time for output to reach its new long run level. For example, if new capital goods are purchased, it may take a considerable amount of time for the new machines to be fully operational. Autonomous shocks to effort (such as increasing the speed of the production line) may induce a rise in output and a possible fall in employment. In fact, including $\Delta y_{t-1}$ puts a downward bias on the right-hand side exogenous variables, so the results should be stronger if there is still a significant relationship between governance and productivity growth after controlling for potential persistence in output.

To control for growth effects related to firm size but unrelated to corporate governance, lagged log total assets is included. This is expected to make the coefficient on assets negative as small firms tend to grow faster than large firms (Hall, 1987). Also, intangible-intensity *INTANI* is included as a control variable. The modified equation including additional control variables is given by

$$\Delta\phi_{it} = \lambda_1 CORPG_{i,t-1} + \lambda_2 \ln(Age) + \lambda_3 \ln ASSETS_{i,t-1} + \lambda_4 INTANI_{i,t-1} + Year\ Effects + Industry\ Effects \quad (4')$$

Table 7 reports pooled OLS results with Huber-White sandwich estimators. Column (1) shows OLS

[11] Statistically, fixed effects are always a reasonable thing to do with panel data (they always give consistent results) but they may not be the most efficient model to run. Random effects will give better p-values as they are a more efficient estimator, so random effects should be employed if it is statistically justifiable to do so.

[12] For example, see Nickell (1996) and Köke and Renneboog, (2005).

regression results without the cross industry dummies. All of the regressors except the lagged log assets are significant. Comparing these results with the results in Table 3, the coefficient on *CORPG* is still positive and significant though has declined from 0.0022 to 0.0019. The coefficient on log lagged assets is negative as expected. Intangible-intensity is positively related to growth in value added. The coefficient on *CORPG* is fairly stable and significant, though the magnitude of the coefficient and the level of significance has decreased after the inclusion of additional control variables.

### *D.3.1 Panel Data Fixed Effect and GLS Random Effects Model*

How the coefficient on *CORPG* behaves in the presence of additional control variables for the entire sample and the sub-samples of *DEM* and *DICT* is particularly relevant. Column (1) of Table 8 reports the result of a fixed effects model for all firms. The coefficient on *CORPG* is positive but has declined from 0.0031 to 0.0024. For the random effects model in column (2), the coefficient on *CORPG* is 0.0023 and significant at 5%. For the democratic sub-sample, the fixed effect model generates a coefficient of 0.0042 but is now insignificant, as is seen in column (1) of Table 9. The corresponding coefficient for the dictator sub-sample in column (1) of Table 10 is negative as before and also insignificant. Column (2) in Table 9 shows that the result for the DEM firms on CORPG for the random effects model is positive and significant, whereas for the *DICT* firms it is negative but insignificant.

In general, the inclusion of additional control variables does not change the sign of the coefficient on the governance variable, though the magnitude and the significance declines.

## IV. Conclusions

This paper shows that a firm's growth of total factor productivity is positively related to the quality of governance *CORPG* which proxies the strength of shareholder rights for a firm. The effect varies positively with the quality of governance, and is strongest among firms which have the strongest shareholder rights. As the governance quality becomes poorer, the strength of the effect declines. At very low levels of *CORPG*, corresponding to the weakest shareholder rights, the effect on productivity growth is less clear, and in some of the results there is a negative relationship between the level of governance and productivity growth. One possible explanation could be the much smaller size of dictator firms in the sample results in low power for testing.

To summarize, some firms are very efficient whereas others are not and some firms have much faster rates of innovation and productivity growth than others though they use similar factor inputs. There are some factors which contribute to higher total factor productivity growth that may determine this difference among firms. This paper provides evidence that the quality of corporate governance in a firm is a likely source of productivity growth. The channels through which it influences productivity growth are not directly investigated. However, it is suggested that good governance can have a positive influence on a manager's ability, which in turn contributes to productivity growth.

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## Appendices

**Table 1.** Variable Description and Summary Statistics

| Variable Name | Variable Description | Median, Mean (Std. Dev.) |
|---|---|---|
| $\ln(AGE)_{it}$ | Log of Age (in years) of firm *i*, defined as the difference between the current year, *t*, and the date of formation. | 37 years<br>58 years<br>(28 years) |
| $G$ | Governance index measure of a firm as constructed in GIM (2003). Higher values of $G$ denote weaker shareholder rights. | 9<br>8.40<br>(4.59) |
| $CORPG_{it}$ | A Corporate Governance measure formed as a simple linear transformation of the $G$ index. Higher values of *CORPG* signify stronger shareholder rights. | 15<br>15.60<br>(4.59) |
| $\Delta y_{it}$ | Growth rate of value added or the gross profit of firm *i* in year *t*, defined as the difference in the log values of gross profit, $Y_{it}$ and $Y_{it-1}$. | 5.16%<br>7.93%<br>(16.53%) |
| $\Delta k_{it}$ | Growth rate of the net capital stock of firm *i* in year *t*, defined as difference in the log values of net capital stock, $K_{it}$ and $K_{it-1}$. | 3.65%<br>6.34%<br>(15.77%) |
| $\Delta l_{it}$ | Growth rate of labor of firm *i* in year *t*, defined as the difference in the log values of number of employees, $L_{it}$ and $L_{it-1}$. | 3.7%<br>5.65%<br>(11.4%) |
| $\Delta h_{it}$ | Growth rate of intangibles of firm *i* in year *t*, defined as the difference in the log values of intangibles, $H_{it}$ and $H_{it-1}$ | -1.86%<br>-3.07%<br>(13.07%) |
| $\ln(ASSETS)_{it}$ | Log of the Book value of Total Assets of firm *i* in year *t*. | $5389 million<br>$45,746 million<br>($24, 284 million) |
| $INTANI_{it}$ | Intangible intensity of firm *i* in year t. Defined as the ratio of Book value of Intangibles to the Book value of Net Fixed Assets for firm *i* in year *t*. | 54%<br>128%<br>(60.66%) |

*Note:* The median, mean and standard deviation for age and assets are given without the logs. The assets are in the unit of millions of dollars. The industry groups are discussed in Table 2.

**Table 2.** Means and standard errors of selected variables based on industry

| | *G* | $\Delta y$ | *EBMARGIN* ( EBIT/Sales) | *GPM (Gross Profit/Sales)* | *ROE* | *ASSETS $ millions)* | *INTANG* | *LEV* |
|---|---|---|---|---|---|---|---|---|
| Consumer Non-Durables | 9 | 8.39% | 16.77% | 43.17% | 24.40% | 3925 | 1.37 | 0.22 |
| | | *0.6%* | *3%* | *4%* | *5.9%* | *288.020* | *0.065* | *0.006* |
| Consumer Durables | 10 | 10.43% | 12.22% | 31.63% | 12.38% | 1676 | 1.10 | 0.23 |
| | | *2.1%* | *4%* | *6%* | *0.09%* | *167.908* | *0.178* | *0.012* |
| Manufacturing | 9 | 7.46% | 14.63% | 32.36% | 14.61% | 3519 | 0.64 | 0.23 |
| | | *0.5%* | *0.1%* | *3%* | *1.0%* | *133.926* | *0.022* | *0.004* |
| Energy, Oil, Gas, and Coal Extraction | 9 | 17.84% | 27.09% | 36.07% | 8.78% | 7720 | 0.12 | 0.23 |
| | | *2.5%* | *1.0%* | *1.0%* | *0 .5%* | *909.157* | *0.031* | *0.007* |
| Hitech- software and Electronic Equipment | 7 | 14.70% | 16.51% | 42.52% | 13.18% | 2594 | 1.06 | 0.14 |
| | | *0.9%* | *0.3%* | *0.5%* | *1.7%* | *207.931* | *0.062* | *0.006* |
| Telecommuni-cations | 8 | 16.34% | 32.80% | 48.03% | 6.92% | 17481 | 2.67 | 0.33 |
| | | *1.5%* | *6%* | *9%* | *1.4%* | *1890.681* | *0.223* | *0.013* |
| Wholesale, Retail, and Some Services | 8 | 14.58% | 9.24% | 29.17% | 12.33% | 3051 | 0.92 | 0.19 |
| | | *0.5%* | *0.1%* | *0.4%* | *0.6%* | *192.697* | *0.097* | *0.004* |
| Healthcare, and Drugs | 8 | 18.29% | 22.58% | 54.89% | 15.82% | 3712 | 2.24 | 0.15 |
| | | *0.9%* | *3%* | *7%* | *1.4%* | *308.749* | *0.194* | *0.005* |
| Utilities | 9 | 9.31% | 24.21% | 24.67% | 10.28% | 12131 | 0.04 | 0.32 |
| | | *1.8%* | *5%* | *5%* | *0.4%* | *655.830* | *0.003* | *0.004* |
| Others | 8 | 15.50% | 19.41% | 35.53% | 14.61% | 13962 | 2.11 | 0.18 |
| | | *0.6%* | *2%* | *3%* | *1.2%* | *1233.527* | *0.093* | *0.003* |
| Total Sample | 9 | 12.3% | 18.89% | 38.2% | 15.05% | 5389 | 1.28 | 0.20 |

For governance index $G$ , the numbers are for median values of $G$ for each industry

**Table 3.** OLS regression with Robust Standard Errors

The panel data encompasses all firms which have a governance index value created by GIM (2003) for 1990-2004. The dependent variable is $\Delta y_t$ or growth in value added. The regression result corresponds to the empirical Cobb-Douglas production function discussed in the paper. The regressors include the growth rate of tangible capital stock $\Delta k_t$, growth rate of labor $\Delta l_t$, and the growth rate of intangible capital stock $\Delta h_t$. $\Delta k_t IND_i$, $\Delta l_t IND_i$ and $\Delta h_t IND_i$ give the cross–industry dummies associated with tangible capital, labor, and intangible capital respectively. The measure of corporate governance is given by $CORPG$ where higher values of $CORPG$ signify stronger shareholder rights in a company. *Ln (Age)* is the logarithm of firm age in years. Robust standard errors are due to Huber-White sandwich estimators. ***,**,* denote significance at 1%, 5% and 10% respectively.

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | OLS | OLS | Fixed Time Effects | Fixed Industry Effects | Fixed Time and Industry Effects |
| $\Delta k_t$ | 0.228*** | 0.0346 | 0.4338*** | 0.0091 | 0.4505*** |
| | (0.0244) | (0.1159) | (0.1097) | (0.1437) | (0.1148) |
| $\Delta l_t$ | 0.3544*** | 0.5654** | 0.5688** | 0.5642** | 0.204* |
| | (0.0342) | (0.1899) | (0.1921) | (0.1897) | (0.0981) |
| $\Delta h_t$ | 0.0244*** | -0.035 | -0.0148 | -0.0508 | -0.015 |
| | (0.0056) | (0.346) | (0.045) | (0.3546) | (0.0449) |
| $CORPG_{i,t-1}$ | 0.0022*** | 0.0024*** | 0.0024*** | 0.0023** | 0.0022** |
| | (0.0007) | (0.0007) | (0.0007) | (0.0007) | (0.0007) |
| *Ln(Age)* | -0.0124*** | -0.0112*** | -0.012*** | -0.0083* | -0.0092** |
| | (0.0032) | (0.0033) | (0.0034) | (0.0035) | (0.0035) |
| *Intercept* | 0.0483* | 0.0345 | 0.021 | 0.0111 | 0.0035 |
| | (0.0174) | (0.0206) | (0.0238) | (0.0283) | (0.0289) |
| $\Delta k_t IND_i$, $\Delta l_t IND_i$, $\Delta h_t IND_i$ | no | yes | yes | yes | yes |
| *R-Squared* | 0.2174 | 0.2276 | 0.2404 | 0.2304 | 0.2432 |
| *No. of Firm Years* | 11122 | 10530 | 10530 | 10530 | 10530 |

**Table 4.** Fixed –Effects regression

The panel data fixed effect regression encompasses all firms which have a governance index value created by GIM (2003) for 1990-2004. The dependent variable is $\Delta y_t$ or growth in value added. The regression result corresponds to the empirical Cobb-Douglas production function discussed in the paper. The regressors include the growth rate of tangible capital stock $\Delta k_t$, growth rate of labor $\Delta l_t$, and the growth rate of intangible capital stock $\Delta h_t$. $\Delta k_t IND_i$, $\Delta l_t IND_i$ and $\Delta h_t IND_i$ give the cross–industry dummies associated with tangible capital, labor, and intangible capital respectively. The measure of corporate governance is given by *CORPG* where higher values of *CORPG* signify stronger shareholder rights in a company. Ln(Age)is the logarithm of firm age in years. ***,**,* denote significance at 1%, 5% and 10% respectively.

| | (1) | (2) | (3) |
|---|---|---|---|
| | ALL | DEM | DICT |
| $\Delta k_t$ | 0.3581 | 0.3689 | 0.4929 |
| | (0.1920) | (0.6178) | (0.8093) |
| $\Delta l_t$ | 0.3458** | 0.2637 | 0.0606 |
| | (0.1325) | (0.4046) | (0.9139) |
| $\Delta h_t$ | -0.2702 | -0.1313 | 0.0127 |
| | (0.3826) | (0.0908) | (0.1961) |
| $CORPG_{i,t-1}$ | 0.0031* | 0.0054* | -0.0118 |
| | (0.0014) | (0.0025) | (0.0152) |
| *Ln(Age)* | -0.0274* | -0.0174 | -0.0567 |
| | (0.0138) | (0.0251) | (0.072) |
| *Intercept* | 0.0799 | 0.005 | 0.3809 |
| | (0.0608) | (0.1463) | (0.333) |
| $\Delta k_t IND_i$, $\Delta l_t IND_i$, $\Delta h_t IND_i$ | yes | yes | yes |
| *R-Squared (within)* | 0.1838 | 0.1545 | 0.2138 |
| *R-Squared (between)* | 0.2579 | 0.3645 | 0.1674 |
| *R-Squared (overall)* | 0.2235 | 0.2268 | 0.2303 |
| *No. of firm years* | 10530 | 3023 | 1010 |

**Table 5.** Year-by-Year Regressions

The data is comprised of all firms which have a governance index value created by GIM (2003) from 1990-2004. The dependent variable is $\Delta y_t$ or growth in value added. The regression result corresponds to the empirical Cobb-Douglas production function discussed in the paper. The regressors include the growth rate of tangible capital stock $\Delta k_t$, growth rate of labor $\Delta l_t$, and the growth rate of intangible capital stock $\Delta h_t$. $\Delta k_t IND_i$, $\Delta l_t IND_i$ and $\Delta h_t IND_i$ give the cross–industry dummies associated with tangible capital, labor, and intangible capital respectively. The measure of corporate governance is given by *CORPG* where higher values of *CORPG* signify stronger shareholder rights in a company. Ln(Age)is the logarithm of firm age in years. For brevity of exposition, only the coefficient on lagged *CORPG* is tabulated. Robust standard errors are due to Huber-White sandwich estimators. ***,**,* denote significance at 1%, 5% and 10% respectively.

| year | 1990 | 1991 | 1992 | 1993 | 1994 |
|---|---|---|---|---|---|
| $CORPG_{i,t-1}$ | 0.00329 | 0.00265 | 0.00263 | 0.00231* | 0.00028* |
| | (0.0024) | (0.0016) | (0.0014) | (0.0011) | (0.0001) |
| *R-Squared* | 0.2183 | 0.1913 | 0.2720 | 0.2794 | 0.2181 |
| No. of Observations | 387 | 799 | 860 | 928 | 1004 |

| year | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|
| $CORPG_{i,t-1}$ | 0.00145 | 0.00274* | -0.00046 | 0.00404** | 0.00681*** |
| | (0.0009) | (0.0013) | (0.0368) | (0.0015) | (0.0016) |
| *R-Squared* | 0.2113 | 0.2859 | 0.3506 | 0.3577 | 0.2968 |
| No. of Observations | 1085 | 1159 | 1266 | 1399 | 1504 |

| year | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|
| $CORPG_{i,t-1}$ | 0.00401** | 0.00118 | 0.00153* | 0.00154* | 0.00099 |
| | (0.0015) | (0.0006) | (0.0007) | (0.0007) | (0.0007) |
| *R-Squared* | 0.3174 | 0.3069 | 0.1816 | 0.1778 | 0.1786 |
| No. of Observations | 1596 | 1703 | 1880 | 2135 | 2245 |

**Table 6.** GLS Random –Effects regression

The panel data generalized least squares random effects regression encompasses all firms which have a governance index value created by GIM (2003) from 1990-2004. The dependent variable is $\Delta y_t$ or growth in value added. The regression result corresponds to the empirical Cobb-Douglas production function discussed in the paper. The regressors include the growth rate of tangible capital stock, $\Delta k_t$, growth rate of labor $\Delta l_t$, and the growth rate of intangible capital stock $\Delta h_t$. $\Delta k_t IND_i$, $\Delta l_t IND_i$ and $\Delta h_t IND_i$ give the cross–industry dummies associated with tangible capital, labor, and intangible capital respectively. The measure of corporate governance is given by $CORPG$ where higher values of $CORPG$ signify stronger shareholder rights in a company. Ln(Age)is the logarithm of firm age in years. Random effects use the Swamy-Aurora estimator for computing standard errors. ***,**,* denote significance at 1%, 5% and 10% respectively.

| | (1) | (2) | (3) |
|---|---|---|---|
| | ALL | DEM | DICT |
| $\Delta k_t$ | -0.0129 | 0.7073 | 0.3915 |
| | (0.1454) | (0.5389) | (0.7685) |
| $\Delta l_t$ | 0.0283 | 0.201 | -0.2636 |
| | (0.1248) | (0.3285) | (0.7931) |
| $\Delta h_t$ | 0.0015 | 0.0032 | -0.0642 |
| | (0.3458) | (0.0674) | (0.1791) |
| $CORPG_{i,t-1}$ | 0.0028*** | 0.0069*** | -0.0182 |
| | (0.0008) | (0.002) | (0.0116) |
| *Ln(Age)* | -0.0124** | -0.0167** | 0.0198 |
| | (0.0042) | (0.0054) | (0.0206) |
| *Intercept* | 0.0343 | -0.0281 | 0.1395 |
| | (0.0237) | (0.0489) | (0.1482) |
| $\Delta k_t IND_i$, $\Delta l_t IND_i$, $\Delta h_t IND_i$ | yes | yes | yes |
| *R-Squared (within)* | 0.1832 | 0.1472 | 0.2182 |
| *R-Squared (between)* | 0.2773 | 0.4588 | 0.0456 |
| *R-Squared (overall)* | 0.2274 | 0.2426 | 0.1915 |
| *No. of firm years* | 10530 | 3023 | 1010 |

**Table 7.** OLS regression with robust standard errors and Control variables

The data is comprised of all firms which have a governance index value created by GIM (2003) from 1990-2004. The dependent variable is $\Delta y_t$ or growth in value added. The regression results correspond to the empirical Cobb-Douglas production function discussed in the paper. The regressors include the growth rate of tangible capital stock $\Delta k_t$, growth rate of labor $\Delta l_t$, and the growth rate of intangible capital stock $\Delta h_t$. $\Delta k_t IND_i$, $\Delta l_t IND_i$ and $\Delta h_t IND_i$ give the cross–industry dummies associated with tangible capital, labor, and intangible capital respectively. The measure of corporate governance is given by $CORPG$ where higher values of $CORPG$ signify stronger shareholder rights in a company. The control variables are lagged value of log total assets $\ln ASSETS_{i,t-1}$, lagged intangible intensity $INTANI_{i,t-1}$, defined as the ratio of intangibles to net fixed assets, lagged growth in value added, $\Delta y_{i,t-1}$, and Ln(Age), the logarithm of firm age in years. Robust standard errors are due to Huber-White sandwich estimators. ***,**,* denote significance at 1%, 5% and 10% respectively.

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | OLS | OLS | Fixed Time Effects | Fixed Industry Effects | Fixed Time and Industry Effects |
| $\Delta k_t$ | 0.2526*** | 0.1129 | 0.4402*** | 0.1024 | 0.4585*** |
| | (0.0258) | (0.1034) | (0.1147) | (0.1086) | (0.1193) |
| $\Delta l_t$ | 0.3428*** | 0.5062** | 0.5088** | 0.5031** | 0.5052* |
| | (0.0342) | (0.1942) | (0.1968) | (0.1938) | (0.1964) |
| $\Delta h_t$ | 0.0246*** | -1.4897** | -0.0127 | -1.5026** | -0.0131 |
| | (0.0056) | (0.4629) | (0.0441) | (0.4621) | (0.0441) |
| $CORPG_{i,t-1}$ | 0.0019** | 0.0019* | 0.0016* | 0.0017* | 0.0015* |
| | (0.0007) | (0.0007) | (0.0007) | (0.0007) | (0.0007) |
| $\ln ASSETS_{i,t-1}$ | -0.0033 | -0.0042* | -0.0037 | -0.0054** | -0.0048* |
| | (0.0018) | (0.0021) | (0.0021) | (0.0021) | (0.002) |
| $INTANI_{i,t-1}$ | 0.0023** | 0.0021* | 0.0022* | 0.0019* | 0.002* |
| | (0.0008) | (0.0009) | (0.0009) | (0.0009) | (0.0009) |
| $\Delta y_{i,t-1}$ | -0.0636* | -0.0641* | -0.0677* | -0.0681* | -0.0719* |
| | (0.0285) | (0.0291) | (0.0297) | (0.0292) | (0.0298) |
| *Ln(Age)* | -0.0108** | -0.0092* | -0.0107** | -0.0058 | -0.0074* |
| | (0.0035) | (0.0037) | (0.0037) | (0.0038) | (0.0038) |
| *Intercept* | 0.0799 | 0.04 | 0.0952 | 0.0259 | 0.084 |
| | (0.024) | (0.0273) | (0.0304) | (0.0335) | (0.0353) |
| $\Delta k_t IND_i$, $\Delta l_t IND_i$, $\Delta h_t IND_i$ | no | yes | yes | yes | yes |
| *R-Squared* | 0.2319*** | 0.2437 | 0.2558** | 0.2461 | 0.2582* |
| *Number of Obs.* | 10584 | 10011 | 10011 | 10011 | 10011 |

**Table 8.** ALL firms with control variables

The panel data fixed effects regression and GLS random effects regression encompasses all firms which have a governance index value created by GIM (2003) from 1990-2004. The dependent variable is $\Delta y_t$ or growth in value added. The regression result corresponds to the empirical Cobb-Douglas production function discussed in the paper. The regressors include the growth rate of tangible capital stock $\Delta k_t$, growth rate of labor $\Delta l_t$, and the growth rate of intangible capital stock $\Delta h_t$. $\Delta k_t IND_i$, $\Delta l_t IND_i$ and $\Delta h_t IND_i$ give the cross–industry dummies associated with tangible capital, labor, and intangible capital respectively. The measure of corporate governance is given by $CORPG$ where higher values of $CORPG$ signify stronger shareholder rights in a company. The control variables are lagged values of log total assets $\ln ASSETS_{i,t-1}$, lagged intangible intensity $INTANI_{i,t-1}$, defined as the ratio of intangibles to Net fixed assets, lagged growth in value added, $\Delta y_{i,t-1}$, and Ln(Age), the logarithm of firm age in years. ***,**,* denote significance at 1%, 5% and 10% respectively.

| | (1) (Fixed Effects) | (2) (Random Effects) |
|---|---|---|
| $\Delta k_t$ | -0.1234 | 0.0877 |
| | (0.182) | (0.1419) |
| $\Delta l_t$ | 0.0544 | 0.0395 |
| | (0.1263) | (0.121) |
| $\Delta h_t$ | -0.9377 | -0.0429 |
| | (0.491) | (0.3458) |
| $CORPG_{i,t-1}$ | 0.0024* | 0.0023** |
| | (0.001) | (0.0008) |
| $\ln ASSETS_{i,t-1}$ | -0.0389*** | -0.0059** |
| | (0.0068) | (0.0023) |
| $INTANI_{i,t-1}$ | 0.0027* | 0.0021** |
| | (0.0011) | (0.0007) |
| $\Delta y_{i,t-1}$ | -0.1292*** | -0.0843*** |
| | (0.0094) | (0.0086) |
| *Ln(Age)* | -0.0029 | -0.01* |
| | (0.0159) | (0.0041) |
| *Intercept* | 0.3352* | 0.0544 |
| | (0.1581) | (0.0314) |
| $\Delta k_t IND_i$, $\Delta l_t IND_i$, $\Delta h_t IND_i$ | yes | yes |
| *R-Squared (within)* | 0.2138 | 0.2081 |
| *R-Squared (between)* | 0.1676 | 0.2829 |
| *R-Squared (overall)* | 0.2099 | 0.2429 |
| *No. of firm years* | 10011 | 10011 |

**Table 9.** Democratic firms with control variables

The panel data fixed effects regression and GLS random effects regression encompasses all firms which belong to the democratic portfolio characterized by $G$ values of 5 or less based on a governance index value created based on firm anti-takeover amendments and charter provisions from the Investor Responsibility Research Center (IRRC). See GIM (2003) for a detailed explanation of this governance index. Democracies are defined as firms with 5 or fewer charter provisions having $G$ values of 5 or less. The dependent value is $\Delta y_t$ or growth in value added. The regression results correspond to the empirical Cobb-Douglas production function discussed in the paper. The regressors include the growth rate of tangible capital stock $\Delta k_t$, growth rate of labor $\Delta l_t$, and the growth rate of intangible capital stock $\Delta h_t$. $\Delta k_t IND_i$, $\Delta l_t IND_i$ and $\Delta h_t IND_i$ give the cross–industry dummies associated with tangible capital, labor, and intangible capital respectively. The measure of corporate governance is given by $CORPG$ where higher values of $CORPG$ signify stronger shareholder rights in a company. The control variables are lagged value of log total assets $\ln ASSETS_{i,t-1}$, lagged intangible intensity $INTANI_{i,t-1}$, defined as the ratio of intangibles to net fixed assets, lagged growth in value added $\Delta y_{i,t-1}$ and Ln(Age), the logarithm of firm age in years. ***,**,* denote significance at 1%, 5% and 10% respectively.

| | (1) | (2) |
|---|---|---|
| | (Fixed Effects) | (Random Effects) |
| $\Delta k_t$ | 0.1009 | 0.5685 |
| | (0.8838) | (0.3894) |
| $\Delta l_t$ | 0.2456 | 0.1589 |
| | (0.3851) | (0.3095) |
| $\Delta h_t$ | -0.1295 | 0.0042 |
| | (0.0869) | (0.0125) |
| $CORPG_{i,t-1}$ | 0.0042 | 0.0058** |
| | (0.0032) | (0.0021) |
| $\ln ASSETS_{i,t-1}$ | -0.0361** | -0.0073* |
| | (0.0134) | (0.0033) |
| $INTANI_{i,t-1}$ | 0.0031 | 0.0017 |
| | (0.0017) | (0.001) |
| $\Delta y_{i,t-1}$ | -0.1190*** | -0.0032 |
| | (0.0168) | (0.0144) |
| *Ln(Age)* | 0.0071 | -0.0112 |
| | (0.0292) | (0.0057) |
| *Intercept* | 0.2569 | 0.0156 |
| | (0.1821) | (0.0628) |
| $\Delta k_t IND_i$, $\Delta l_t IND_i$, $\Delta h_t IND_i$ | yes | yes |
| *R-Squared (within)* | 0.1808 | 0.2068 |
| *R-Squared (between)* | 0.5746 | 0.2045 |
| *R-Squared (overall)* | 0.2846 | 0.1950 |
| *No. of firm years* | 2924 | 2924 |

**Table 10.** Dictator Firms with Control Variables

The panel data fixed effects regression and GLS random effects regression encompass all firms which belong to the dictator portfolio characterized by $G$ values of 13 or more based on a governance index value created based on of firm anti-takeover amendments and charter provisions from the Investor Responsibility Research Center (IRRC). See GIM (2003) for a detailed explanation of this governance index. Dictators are defined as firms with 13 or more restrictive charter provisions. The dependent value is $\Delta y_t$ or growth in value added. The regression results correspond to the empirical Cobb-Douglas production function discussed in the paper. The regressors include the growth rate of tangible capital stock $\Delta k_t$, growth rate of labor $\Delta l_t$, and the rate of growth of intangible capital stock $\Delta h_t$. $\Delta k_t IND_i$, $\Delta l_t IND_i$ and $\Delta h_t IND_i$ give the cross-industry dummies associated with tangible capital, labor, and intangible capital respectively. The measure of corporate governance is given by *CORPG* where higher values of *CORPG* signify stronger shareholder rights in a company. The control variables are lagged value of log total assets $\ln ASSETS_{i,t-1}$, lagged intangible intensity $INTANI_{i,t-1}$, defined as the ratio of intangibles to net fixed assets, lagged growth in value added $\Delta y_{i,t-1}$ and Ln(Age), the logarithm of firm age in years. ***,**,* denote significance at 1%, 5% and 10% respectively.

| | (1) | (2) |
|---|---|---|
| | (Fixed Effects) | (Random Effects) |
| $\Delta k_t$ | -0.2209 | -0.3517 |
| | (1.3019) | (1.2659) |
| $\Delta l_t$ | -0.1278 | -0.1082 |
| | (0.9021) | (0.7482) |
| $\Delta h_t$ | 0.1886 | 0.1911 |
| | (1.6627) | (1.628) |
| $CORPG_{i,t-1}$ | -0.0019 | -0.0137 |
| | (0.016) | (0.0115) |
| $\ln ASSETS_{i,t-1}$ | -0.0318 | -0.0012 |
| | (0.0236) | (0.0086) |
| $INTANI_{i,t-1}$ | -0.2209 | -0.3517 |
| | (1.3019) | (1.2659) |
| $\Delta y_{i,t-1}$ | -0.1278** | -0.1082* |
| | (0.9021) | (0.7482) |
| *Ln(Age)* | 0.1886 | 0.1911 |
| | (1.6627) | (1.628) |
| *Intercept* | 0.0019 | -0.0137 |
| | (0.016) | (0.0115) |
| $\Delta k_t IND_i$, $\Delta l_t IND_i$, $\Delta h_t IND_i$ | yes | yes |
| *R-Squared (within)* | 0.2503 | 0.2356 |
| *R-Squared (between)* | 0.0438 | 0.2809 |
| *R-Squared (overall)* | 0.1819 | 0.2649 |
| *No. of firm years* | 969 | 969 |