Ultimate control and productivity

- Evidence from Taiwan's manufacturing firms

Jia-Hui Lin*

Department of International Business Management, Tainan University of Technology, Taiwan

Min-Hsien Chiang**

*Institute of international Business, National Cheng Kung University, Taiw*an

Abstract

This paper adopts the concept of ultimate control and examines the relationship with productivity (TFP). We want to find out whether a controller's type will affect productivity level and what causes the productivity difference. Our results show that family-controlled companies have lower productivity than non-family-controlled and widely-held companies. We find that the entrenchment factors - management regime, cross-holding, pyramid structure, and collateral ratio - are negatively related to productivity. On the contrary, the incentive factor of "a large shareholder, but not belonging to the controller group" is positively related to productivity. We also find that smaller boards are associated with better firm performance and independent directors and supervisors are more likely to monitor and provide expertise to firms and further increase a firm's productivity. Those factors used to enhancing controlling rights have the most significant effect on productivity in family-controlled companies, which implies the popular usage of these tools in this group, and it further causes the productivity to be lower.

Keywords: ownership structure; ultimate control; productivity

* Address correspondence to Jia-Hui Lin, Department of International Business Management, Tainan University of Technology, 529 Jhongjheng Rd., Yongkang, Tainan 71002, Taiwan. Tel: +886-6-2422609; Fax: +886-6-2530313; e-mail: t90041@mail.tut.edu.tw.

** Min-Hsien Chiang, professor of Institute of international Business, National Cheng Kung University, Taiwan, No. 1, University Road, Tainan City, 701, Taiwan. Tel: +886-6-2757575; Fax: +886-6-2376811; e-mail:mchiang@mail.ncku.edu.tw.

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I. Introduction

The importance of corporate governance has already been addressed in both research and practical aspect for many years. This may due to several scandals that have burst out since 2001, causing a huge loss to the whole economy and to individual investors. At the same time, the role of productivity is catching more and more attention, such as research conducted on different aspects - country level (Coe and Helpman, 1995), industry level (Vincenzo and Quintieri, 2001), and firm level (Hill and Snell, 1989; Palia and Lichtenberg, 1999; Schoar, 2002; Barth et al., 2005). On the firm level, some papers suggest that productivity is the more fundamental and accurate variable than the financial or accounting index (Hill and Snell, 1989; Baily and Schultze, 1990; Barth et al., 2005) and some other paper prove that productivity is positively connected with market valuation (Palia and Lichtenberg, 1999; Schoar, 2002). Therefore, this paper investigates the relationship between corporate governance with productivity rather than an accounting index.

This paper links productivity with corporate governance through the agency problem (Jensen and Meckling, 1976). The divergent interests between a shareholder and a manager are the so-called agency problem. In other words, a shareholder is long-term driven while a manager is short-term driven about the firm's operations. Hill and Snell (1989) argued that as ownership structure becomes more concentrated or when management shareholdings get higher, there will be higher R&D intensity and in turn a higher productivity level.

Unlike the method mentioned above to solve the agency problem, another view traces out a firm's ultimate controller[1] which is first proposed by La Porta et al. (1999). When defining the ultimate controller, we should combine the shares belonging to the same group of people. This method is clearer and more accurate, because it identifies the status of each stakeholder of the firm, and it aligns the divergent interest in some aspect (for example, companies with an ultimate controller and this controller also has the match proportion of cash flow rights). Using this method, we hope to investigate whether there's a productivity difference between Taiwanese manufacturing firms. Furthermore, we use some variables other than only management regime proposed by Barth et al. (2005) to explain the productivity

1. A firm has an ultimate controller if more than 20% of shares are controlled by one person or one group.

difference, including many entrenchment factors: management regime, cross-holding, pyramid structure, and collateral ratio. Yeh and Woidtke (2005) suggest that there is poor governance when the board is dominated by members who are affiliated with the controlling family but good governance when the board is dominated by members who are not affiliated with the controlling family. So we want to test if the firm performance can be affected by existing board structure or its composition. Finally, we want to test if firms with a monitoring mechanism, the agency problem will be mitigated.

We begin by using total factor productivity (TFP) as our measure of company productivity. We find that family-controlled companies have lower productivity than non-family-controlled and widely-held companies. The entrenchment factors - management regime, cross-holding, pyramid structure, and collateral ratio - are negatively related to productivity. We also find that smaller boards are associated with better firm performance and independent directors and supervisors are more likely to monitor and provide expertise to firms and further increase a firm's productivity. On the contrary, the incentive factor of "a large shareholder, but not belonging to the controller group" is positively related to productivity. Those factors used to enhancing controlling rights have the most significant effect on productivity in family-controlled companies, which implies the popular usage of these tools in this group, and it further causes the productivity to be lower.

The paper is organized as follows. Section 2 reviews the relevant literature on productivity and ownership structure. Section 3 presents the research hypothesis. Section 4 discusses the construction of data, variables, and methodology. Section 5 displays the results and gives some explanations. Finally, section 6 concludes this paper.

II. Literature Review

2.1 Firm performance

TFP is first proposed by Solow (1957), and TFP measurement is based on the following assumptions: perfect competition, constant returns of scale, and absence of the short run. Hence, it can be represented as $TFP = {Y}/{f(L,K)}$. In addition, Solow has shown that approximately 90% of the increase in real per capita output, the standard of living, is attributable to efficiency growth.

From that time onwards, TFP has been regarded as the proxy of productivity and is commonly used in the field of economics. Over the last decade, research studies have mostly focused on the country level, several authors have emphasized the role of R&D expenditure in determining the rate of growth of the whole country. In particular, Coe and

Helpman (1995) conclude that there is convincing empirical evidence that cumulative domestic R&D is an important determinant of productivity.

Research studies of productivity on the firm level are appearing more and more. This is because the effectiveness of TFP has already been proven at the country level, and some researchers want to find a variable other than Tobin's Q to represent firm value. Hill and Snell (1989) describe the influence of ownership structure on productivity differences between companies, based on a cross-sectional dataset of 122 companies. The result suggests that ownership affects a firm's posture toward diversification and investment in R&D and along with capital intensity in turn explain differences in productivity between companies.

Palia and Lichtenberg (1999) examine the relationship between managerial ownership and TFP. They argue that TFP is a good index of efficiency that accounts for the services of all of the inputs employed by the firm with proper weights. They also find that the stock market rewards companies with increases in firm value when these companies increase their level of productivity. Hence, the TFP seems to be a more fundamental variable of firm value than Tobin's Q.

Schoar (2002) uses plant-level observations and examines the relationship between diversification and productive efficiency, showing that increases in diversification are associated with a decline in the firm's overall productivity. This paper also takes the current literature a step further by linking stock market performance back to a firm's productivity. The result shows that market values correlate strongly with firm productivity, both in the dimensions of cross section and time series.

Barth et al. (2005) analyze the relationship between family ownership and productivity with a special focus on the role of owner-management. The results show that family-owned companies are less productive than non-family-owned companies. Compared to the financial index, productivity seems to be more fundamental and accurate in some aspects. Hill and Snell (1989) argue the advantage of productivity is that it constitutes a more accurate measure of efficiency than the profit ratios, because some pitfalls exist when using the profit ratio as the proxy of firm performance. First, the numerator of most profit ratios is based on pre-tax income remaining after capital costs. This is sensitive to the choice of a depreciation policy, which depends on bookkeeping convention and can materially affect the value of pre-tax income, thereby inflating or deflating a firm's profit ratio (Hay & Morris, 1979). When using productivity measurement, by adding back capital costs and employment costs, value productivity

presents a measure created by a firm that is relatively uncorrupted by choice of accounting convention. Second, differences in accounting conventions can also confound the denominator of a profit ratio. Because neither inflation nor any accounting convention affects the numbers employed, value added per employee provides a less ambiguous measure of efficiency than profit ratios. Barth et al. (2005) also argue that the accounting profit rate may be manipulated, and productivity is a more reliable measurement.

There recently has been a highlight upon corporate governance, researches are focusing on the influence of corporate governance on the financial index, like Tobin's Q. If productivity is the more fundamental variable than Tobin's Q (Baily and Schultze, 1990) and correlates with market valuation (Palia and Lichtenberg, 1999; Schoar, 2002), then examining the relationship between corporate governance and productivity should be more appropriate, and this is the point this paper wants to discuss.

2.2 Ultimate control and firm value

2.2.1 Concept of a widely-held firm

The traditional agency theory is based on Berle and Means (1932), who find that most large-sized companies were widely held in America during the 1930s, whereby ownership was dispersed and control was concentrated in the hands of managers. Recently, researchers have questioned the concept that most public companies are widely held. Under the concept of ultimate control, studies have found that most companies are dominated by large stockholders all over the world (La Porta et al., 1999; Claessens et al., 2000; Yeh et al., 2003), which indirectly overthrows the concept that most companies are widely-held.

La Porta et al. (1999) propose ultimate control, in which they examine companies in 27 of the most wealthy countries in the world,[2] finding that: under a 20% cut-off point, among all selected countries, 63.52% (76.30%) large (medium)[3] companies have an ultimate shareholder. Following this concept, Claessens et al. (2000) examine the ownership and control for 2980 listed companies in nine East Asia countries.[4] They

2. The richest countries selected are based on 1993 per capita income.

3. Large companies are the top-20 companies ranked by market capitalization of common equity at the end of 1995, while median companies are the smallest 10 companies in each country with market capitalization of common equity of at least $500 million at the end of 1995.

4. The nine countries include Hong Kong, Indonesia, Japan, South Korea, Malaysia, Philippines, Singapore, Taiwan, and Thailand.

present that 57.11% of the companies have an ultimate controller. Among these countries, 51% of the listed companies of Taiwan have an ultimate controller, and 48.2% are family-controlled companies.

Some studies have examined this issue for Taiwan in different periods, when all use the 20% cutoff point to determine whether companies have an ultimate controller or not. Yeh et al. (2003) find that 58.2% of all 251 listed companies are family-controlled companies during the research period 1997 to 1998. The results show that the ownership structure of companies in Taiwan is similar to other countries in the world.

2.2.2 The role of family in managing a business

In most studies, a family plays an important role in managing a business and dominates the largest percentage of companies' control structure. Whether family companies perform better than non-family companies or not is still debatable. Anderson and Reeb (2003) find that family companies, representing a form of undiversified ownership, perform better than non-family companies. The relation between family holdings and firm performance is non-linear and when family members serve as CEO, performance is better than under outside CEOs. However, Barth et al. (2005) present that family-owned companies are less productive than non-family-owned companies. This productivity gap is explained by differences in management regime. Family-owned companies managed by a person hired outside from the owner family are equally productive as non-family-owned companies, while family-owned companies managed by a person from the owner family are significantly less productive.

2.2.3 The influence of ultimate controller on firm value

Claessens et al. (2002) examine the relationship between shares held by the firm's largest shareholder and firm value. The results show that firm value increases with the cash-flow ownership of the largest shareholder, which is consistent with the positive incentive effect, but firm value falls when the control rights of the largest shareholder exceed its cash-flow ownership, which is consistent with the negative entrenchment effect. Lemmon and Lins (2003) examine the effect of ownership structure on value during the East Asian's financial crisis. The results show that the crisis period's stock returns of companies in which managers have high levels of control rights, but have separated their control and cash flow ownership, are 10-20 percentage points lower than those of other companies. From the previous studies, many firms use some tools to enhance control

rights, like management regime, pyramid structures,[5] and cross-holding,[6] (La Porta et al, 1999) and this situation is more serious in East Asian countries (Claessens et al., 2000).

Besides, shareholders are able to collateralize their shares in order to obtain loans from financial institutions in Taiwan. A controlling shareholder may use collateral shares to get additional shares to enhance control rights. When the share price drops, financial institutions will ask borrowers to pay back the loan or put more shares up for collateral. If shareholders are not able to achieve the demand, then their collateral shares will be sold at loss. To avoid a personal loss, a controlling shareholder may misuse the firm's resource to sustain the stock price. All these actions will deteriorate the agency problem and further decrease a firm's value.

The results of Kao et al. (2003) show that collateralized shares are significantly negatively related to accounting performance. Furthermore, they divide the sample into conglomerate companies and non-conglomerate companies. For conglomerate companies, the linkage between collateralized shares and profit ratio is still significantly negative, while the same results do not appear in non-conglomerate companies. This difference may be due to the controlling shareholder using several business transactions inside the conglomerate group to induce the money flow. Yeh et al. (2003) find that the collateral ratio is 32.82% in family-controlled companies, which is far larger than for non-family-controlled companies. They also show that when cash flow rights and cash/control rights are adjusted with the collateral ratio, then these two variables are significantly negatively related to firm value. When removing the impact of the collateral ratio, the variable becomes positively related to firm value. Therefore, the stock collateralized ratio is a measure to expropriate small shareholders' interest for the controlling shareholder.

2.2.4 The influence of board structure on firm value

Does shareholder concentration allow controlling shareholders to select board members that are more likely to monitor or provide expertise? Or does shareholder concentration allow controlling shareholders to select board members that enable them to expropriate wealth from minority shareholders? Can the independence of the board increase a firm value? Thus, a firm's board structure may be viewed as a strong indicator of the controlling shareholder's commitment to corporate governance. Controlling

5. The controlling shareholder exercises control through at least one publicly-traded company.

6. The situation in that the firm and its main shareholder own shares by each other.

shareholders may select board members that are more likely to both monitor and provide professional expertise when the positive incentive effects of ownership are high. In contrast, controlling shareholders may select board members that are less likely to monitor and more likely to support their decisions in order to entrench themselves further when the entrenchment effects of excess control outweigh the positive incentive effects of cash flow ownership (Yeh and Woidtke, 2005).

The financial performance of a firm may be affected by existing board structure or its composition. Yermack (1996) and Eisenberg et al. (1998) demonstrated that smaller boards are associated with better firm performance. That is, larger board size increases problems in communication and coordination and, then, decreases abilities of the board to control management. Chen et al. (2007) build the optimal size of the board of directors, they argue that board size is considered inappropriate when it is less than the minimum legal requirement[7] or is larger than two standard deviations from the mean. Rosenstein and Wyatt (1990) examine wealth effects surrounding outside directors appointments and find significantly positive share-price reaction, the results are consistent with the hypothesis that outside directors are chosen in the interest of shareholders.

2.2.5 Monitoring mechanism

Many studies suggest that if a firm has a monitoring mechanism, then agency problem will be mitigated. In this paper we focus on the shareholder's identity. Faccio et al. (2001) suggest that other large shareholders typically keep close and cooperate with the largest shareholder in Asian companies, while other large shareholders tend to monitor the largest shareholder in Europe. Maury and Pajuste (2004) discover that in family-controlled companies, a higher voting stake held by another family reduces firm value, whereas a higher voting stake held by another non-family owner improves firm value. These results suggest that the shareholder's identity will decide its incentives to collude with or to monitor the controlling shareholders, an effective monitoring system will increase firm value. In Taiwan the minority shareholder can ask the company's auditor to propose a lawsuit against the company's management team (or the board of directors) when necessary. In 2001, the threshold of holding percentage decreased from 5% to 3% to have such a right. The government hopes that this will further protect the rights of minority shareholders, decreasing the possibility that their rights are expropriated by the firm's largest shareholder.

7. Taiwan SEC requires all the listed firms to have at least 5 directors on board..

III. Research Hypothesis

According to the literature review of the previous section, we combine the concept of productivity, role of family, and ultimate control. The research hypotheses are summarized and developed as follows.

Barth et al. (2005) use a questionnaire to distinguish whether companies are family companies or not, and they conclude that the productivity level will be lower in family-owned companies than non-family-owned companies due to the difference of management regime. This means that the top manager positions are often controlled by the family members rather that outside professional people being the reason for lower productivity. Under the different but more objective classified rule, we would like to test the same hypothesis. Other than the only explanation of management regime, we propose some other reasons to explain the difference. Therefore, we propose Hypothesis 1.

H1 Family-controlled companies have lower productivity than non-family-controlled companies.

The lower the cash flow rights are, the less responsible the controller will be about the change of firm value, which induces a lower positive incentive effect. A larger deviation of control from cash flow rights will enhance a negative entrenchment effect (Classens et al., 2002, Lemmon and Lins, 2003). In the situation of lower cash flow rights and a larger deviation of control from cash flow rights, the controlling shareholder may prefer increasing his own benefit rather than increasing firm value. As a result, high-risk R&D investment will be avoided even if it will generate cash inflow for the firm. In turn, this firm will have a lower productivity level. We propose Hypotheses 2.1 and 2.2.

H2.1 A lower cash flow right contributes to lower productivity.

H2.2 A larger deviation of control from cash flow rights contributes to lower productivity.

From the previous studies, the popular usage of these factors is in order to enhance the control rights of the firm (La Porta et al., 1999; Claessens et al., 2000). Therefore, we adopt these variables in our sample to test whether companies existing under these situations will have higher control rights. We further link these variables with a firm's productivity.

According to Barth et al. (2005), the reason that family-owned firms have a lower productivity level is due to the management regime: family-owned firms have a larger

productivity level if they have a professional-manager rather than an owner-manager. Moreover, management regime is also a means used by a controlling shareholder to increase the control rights of the firm (La Porta et al., 1999). This approach furthers deteriorate the ownership structure and decreases the firm value like collateral shares. Moreover, cross-shareholding and pyramidal structures are deemed to be used to enhance control rights by companies' controllers and further deteriorates the ownership structure of the firms.

A controlling shareholder may use loans from financial institutions in Taiwan to get additional shares so as to enhance control rights (Kao et al., 2004; Chiang and Lin, 2006). The controller may use this tool to get more shares without enough capital to achieve the same goal through the stock market. Hence, this deteriorates the agency problem: shareholders have more shares existing in name only than the actual shares they have. The stock collateralized ratio is also a measure to expropriate small shareholders' interest for the controlling shareholder. Therefore, all these actions further decrease a firm's value. In our paper, we add these variables to test the relationship with productivity. Hence, these four variables have a negative relationship with productivity as proposed in Hypotheses 3.1 to 3.4.

H3.1 If a controller engages in management, then productivity is lower.

H3.2 If the firm is under the situation of cross-holding, then productivity is lower.

H3.3 If the firm is under the situation of a pyramid structure, then productivity is lower.

H3.4 A higher collateral ratio induces lower productivity.

A smaller board may be less encumbered with bureaucratic problems and may be more functional. Smaller boards may provide better financial reporting oversight. Yermack (1996) and Eisenberg et al. (1998) demonstrated that smaller boards are associated with better firm performance. Furthermore, independent directors and supervisors are more likely to monitor and provide expertise to firms. Rosenstein and Wyatt (1990) indicate that the appointment of an outside director is accompanied, on average, by significantly positive excess returns. Hence, we propose Hypothesis 4.1 and 4.2.

H4.1 Board size is negatively related to changes in productivity.

H4.2 Independent Board is positively related to changes in productivity.

If the firm has a shareholder that does not belong to the controllers group, then it will have higher productivity. The reason is that if a firm has a shareholder belonging other than to the ultimate controller, then the shareholder has an effective monitoring right to enforce the firm's ultimate controller exercise strategy that is beneficial to the firm, but not to that shareholder. Hence, we propose Hypothesis 5.

H5 If the firm has a shareholder that does not belong to the controllers group, then the firm has higher productivity.

IV. Data and Construction of Variables

4.1 Data

The sample companies are all listed on TSE (Taiwan Stock Exchange) in 2003. Following the concept of Palia and Litchberg (1999), who conclude that estimating production functions for other industries is difficult, we choose manufacturing companies only. Therefore, we exclude the financial-related and service industries. After combining all variables we need, we finally get a year-based, cross-sectional data of 236 companies and observations.

The ownership structure and other variables are collected from Taiwan Economics Journal (TEJ), the annual reports of each company for the year 2003, and 「Business groups in Taiwan, 2004」produced by China Credit Information Services, Ltd. The annual reports reveal the shares owned by the board of directors, the main managers of the firm, and also the 10 largest shareholders. In order to distinguish the relationship between all stakeholders of the firm, we have to refer to the research of 「Business groups in Taiwan」.

We calculate the control rights of each firm and classify all companies into the following types: widely-held (WHC), family, state, financial, corporation, foreign, and joint venture.[8] Ownership by families is aggregated to include family members with a footnote of whether there is a first- or second-rate blood relationship between them. If the main shareholder of the firm is a financial institution or corporation, then we further look into its ownership structure. We classify it the controller's type into a corporation if the owner of its juridical person is a private corporation and none of the insiders (board members, managers, and shareholders holding more than 10%) have a controlling stake in

8. We classify companies into the control type of "joint venture" only if:
(1) It is identified as a "joint venture" by China Credit Information Services (1216, 1232, 1440, 2108).
(2) There are more than two shareholders which hold more than 10% in the company (2478, 1735, 1524, 2109, 2010, 2032, 1476, 1540)

it. The situation whereby not all ownership data come from the same data source (from the annual reports of each corporation or the ownership structure data from the Business groups in Taiwan 2004) does not cause any problem, because the ownership structures tend to be stable over the period that most companies are studied here.

4.2 Definition of variables

4.2.1 Dependent variables

We begin our empirical tests by defining our productivity measure to the TFP. A good index of efficiency must account for, and give proper weight to, the services of all of the inputs employed by the firm. TFP is such an index, as it is defined as output per unit of total input, where total input is an index (weighted sum) of the individual inputs. TFP for firm i is:

$$\gamma_i = \frac{Y_i}{f(L_i, K_i)}, \qquad (1)$$

where γ_i denotes TFP, $f(\cdot)$ denotes total input, L denotes the summation of direct and indirect labor expense, and we do not use total hours worked as the variable of L (Palia and Lichtenberg, 1999), because of the insufficient disclosure of man hours. Schoar (2002) uses man hours as the proxy of L, he also re-estimates the TFP regression specifying the labor wage bill to proxy for worker quality. The results remain qualitatively the same. Term K denotes the real net stock of plant and equipment. The contribution of capital to sales is supposed to be delayed, but not the same year. Therefore, we adopt the 1-year lagged capital in calculation.

We assume $f(L_i, K_i)$ to be the familiar Cobb-Douglas functional form $L^{\alpha}K^{\beta}$, where α and β are the output elasticities of labor and capital, respectively. Substituting the Cobb-Douglas into Equation (1) and taking logarithms give us:

$$\gamma_i = \ln Y_i - \alpha \ln L_i - \beta \ln K_i . \qquad (2)$$

TFP measures in our article are obtained at the plant level by estimating a log-linear Cobb-Douglas production function for each year. We assume that the technology level is convergent at the firm level - that is, each firm has their respective weight of labor and capital. Since coefficients on capital and labor can vary by year, this specification allows for different factor intensities in different firms. It can be understood as the relative productivity rank of a firm within all the samples.

4.2.2 Independent variables

(a) Cash flow rights (CF)

According to La Porta et al. (1999), we trace out those people or groups of people who have the final influence of a firm's decision. Those people are usually the largest shareholder of the firm. The cash flow rights summarize the direct and indirect rights through multiplying the percentage of shares owned by this shareholder in the chain of control rights.

(b) Deviation of control from cash flow rights (DEV)

First of all, we have to give the definition of the control rights. According to La Porta et al. (1999), the control rights combine a shareholder's direct and indirect voting rights in the firm. The direct control is through shares registered under a shareholder, and the indirect control is the final portion held in the chain of control through the chain. Hence, we define the deviation of control from cash rights as the cash flow rights divided to control rights. For how to calculate the control rights, cash flow rights, and deviation of control from cash flow rights for each firm, we have an example in the appendix.

(c) Management (MGT)

Set 1 if a member of the controlling family is also the CEO, Honorary Chairman, Chairman, or Vice-Chairman of the Board, and 0 if they do not hold any of the mentioned positions (La Porta et al., 1999).

(d) Cross-holding (CRS)

Cross-shareholding is defined as "...if the firm both has a controlling shareholder and owns shares in its controlling shareholder or in firm that belongs to her chain of control." For the existence of cross-shareholding, we set it as 1, otherwise it is set as 0.

(e) Pyramid structure (PYRAMID)

Pyramidal structure is defined as the controlling shareholder exercising control through at least one publicly-traded company (La Porta et al., 1999). For the existence of a pyramidal structure, we set it as 1, otherwise as 0.

(f) Stock collateralized share (COLLATERAL)

The stock collateralized ratio of controlling shareholders is a measure of expropriation of small shareholders. This variable is calculated as the ratio of

collateral shares to total shares owned by the board of directors, top managers, and shareholders with more than 10% of shares to their total shareholdings.

(g) Board size (BOARD)

The board members include the board chairman, auxiliary board chairman, managing director, director and independent director.

(h) Independent board (IND BOARD)

The independent board members include independent directors and independent supervisors[9].

(i) Second largest shareholder (SEC)

For the existence of a stockholder holding more than 3% and not belonging to the controlling group of the firm, we set it as 1; otherwise set it as 0.

4.2.3 Control variables

(a) Research and development ratio (RD)

Hanel and St-Pierre (2002) examine the influence of R&D capital on a firm's profitability. The results show that R&D has a direct, positive effect on profitability, especially in industries with effective patent protection. Wang and Tsai (2003) estimate the impact of R&D on productivity within the private sector in Taiwan. The result shows that R&D investment has an average 23-25% impact on productivity growth. This is similar with the previous estimate of 21% for the U.S. (Litchtenberg and Siegel, 1991) and 27% for the UK (Wakelin, 2001), but lower than 40% in Japan. (Goto and Suzuki, 1989)

From the previous literature mentioned above, the relationship between R&D and firm value (Ex. Stock return, Tobin's Q) has been proven to be positive. Moreover, R&D has a direct and significance influence on productivity. Therefore, the impact of R&D on productivity should be positive.

(b) Market value (MV)

9. Taiwan's Corporate Law relaxed the restriction that directors and supervisors be firm shareholders at the end of 2001, and the Taiwan Stock Exchange began requiring that IPO firms listing from January 2002 on include two independent directors and one independent supervisor on the board.

This variable is calculated as the log market value of outstanding common sharesstock at the end of the year (average value of the stock for the year*total outstanding shares). This variable is related to the intangible assets of a company, reflecting a company's performance. A larger company will be regulated and monitored more by the government and public and it is hard for the controller to have larger shares of these companies (due to the constraint of fortune and risk). Therefore, a higher market value should have higher productivity.

(c) Debt ratio (DEBT)

The ratio of total debt divided by total assets is based on their respective book values. The debt ratio not only reflects the efficiency of financial leverage, but also the liquidity and the debt-paying ability of the company. According to the agency theorem, a lower debt ratio means the capital structure of the firm is healthier and the protection of the debt holder is higher, and this will induce higher firm performance. By contrast, raising funds through debt will cause tax shields (Morck et al., 1988). Therefore, a company prefers to finance through debt to some extent. By this theorem, firm value increases with the debt ratio.

(d) Growth opportunity (GROWTH)

This variable is expressed as the previous year's sales growth rate of each firm. Companies with higher growth opportunity may influence a firm's inclination to invest in R&D. We expect this variable to have a positive relationship with firm productivity, because it reflects a firm's future growth prospects and investment opportunity.

(e) Industry (IND)

Companies belonging to the so-called new economy are supposed to invest more R&D than those companies classified as in the old economy (Cui and Mak, 2002). Therefore, this variable also reflects the age of each firm - that is, companies belonging to the capital goods industry (new economy, younger companies) will be set as 1, otherwise (old economy, elder companies) set as 0.

V. Empirical Results

In this section we show our results in the following sequence. Section 5.1 presents the descriptive statistics. We next divide the sample into with or without an ultimate controller and

trace out the controller's type, and then investigate whether family-controlled firms perform worse than non-family-controlled firms in section 5.2. In section 5.3 we use positive incentive factor, negative entrenchment factor, and some other factors to enhance control rights to explain the productivity difference.

5.1 Descriptive Statistics

From equations (1) and (2), we calculate the firm specific TFP of each firm. Table 1 summarizes the mean TFP value of the following industries: consumer durables, basic industry, food, construction, textiles, and capital goods. Over half of the firms in the capital goods industry reflect the important contribution of this industry to Taiwan's economy for these years. The mean TFP value of the total sample is 1.2263, and the capital goods industry has the highest TFP value of 1.5028, whereas companies in the construction industry have the lowest TFP value of -0.1952, which implies the usage of inputs in this industry is inefficient.

Table 2 summarizes the control rights, cash flow rights, and deviation of control from cash flow rights of our results. Our paper adopts the two extreme hypotheses of the how much capital from the nominal investment companies of the firm that are 100% or 0% come from the ultimate controllers, and it is expressed as CF^{100}, CF^{0} and DEV^{100}, DEV^{0}. Claessens et al. (2000) only adopt the 100% criteria to calculate the cash flow rights and deviation of control from cash flow rights. At the same 100% criteria, the average control and cash flow rights in our sample are respectively 24.23% and 21.77%, and the cash flow rights are 87.9% of control rights. The difference between control rights and cash flow rights is 2.46%, which comes from treasury stock, non-profit driven organizations as a firm's shareholder (schools or foundations), and the usage of cross-holding and pyramid structures.

On the other hand, CF^{0} and DEV^{0} are expressed if the ultimate controller controls these nominal investment companies without paying any capital, and the profits at the year end will not attribute to them. These nominal investment companies are used to enhance the control rights like cross-holding or pyramid structures. In this situation in Table 2 the average cash flow rights are 14.40% in our sample, and the cash flow rights are about 61.6% to the control rights. The difference between control rights and cash flow rights is 9.83% higher than the percentage under the 100% condition. Compared to Yeh et al. (2003), the value of our results is a little smaller.

The next step is to decide what cut-off point we want to adopt to distinguish companies with or without a controller. We compare the mean value of productivity between companies with and without a controller. From Table 3, companies with a controller have a higher TFP

value than companies that are widely held, and this is controversial to our hypothesis under the 10% cut-off point, because we suppose that companies with a controller will have a lower productivity level due to more factors being used to deteriorate the ownership structures and severe agency problem. On the other hand, the productivity differences under the 20% and 30% cut-off points are significant and consistent with our hypothesis. Moreover, the productivity value of each control type under the 20% and 30% cut-off point are similar. Therefore, it is appropriate to adopt the 20% cut-off point as with the previous studies (La Porta et al., 1999; Claessens et al., 2000; Claessens et al., 2002; Yeh et al., 2003) to distinguish companies having a controller or not. Afterward, we will only adopt the 20% cut-off point in explanation.

The sample distribution under the 20% cut-off point is: 113 companies are widely held, and 143 companies have an ultimate controller. Firms with a controller except for family control are small, and we round up all these companies and create a new group named "non-family control". We then regress our equations based on the following categories: total sample (All, 256 firms), widely-held (WHC, 113 firms), family-controlled (Family, 116 firms), and non-family-controlled (Non-family, 27 firms).

5.2 Do family companies perform worse than non-family companies?

In the second column of Table 4 we combine the widely-held companies and non-family-controlled companies into one group and compare the TFP value between family control and these groups. The differences all reach the 10% significance level, which shows that family-controlled companies significantly performed worse than non-family-controlled companies. The results support our Hypothesis 1. They are also consistent with the results of Barth et al. (2005), but we use the more objective method and apply more factors other than management regime to explain such a difference.

In Table 5 we summarize the information of all variables used in this paper. In panel A the control rights of family-controlled and non-family-controlled companies are 34.86% and 33.33%, respectively, far larger than the 11.13% of widely-held companies. The CF^{100} and CF^{0} of widely-held companies are also significantly lower than the other two groups. In panel B the family-controlled companies have the highest percentage to use several factors to enhance control rights, whereby 77% of family companies have their family members serve as the companies' main managers. Moreover, 40% and 55% of family companies have the respective situation of cross-holding and pyramid structure of their control companies. The collateral ratio in family-controlled companies is 13.50% higher than the other companies, which is consistent with Yeh, et al. (2003).

The percentages of control factors of management regime, cross-holding, and collateral ratio in non-family-controlled types are the lowest. This can be explained in that the identity of most non-family controllers is a juristic person (government, financial institutions, widely-held companies, foreign companies). The controller of these companies rarely engages in managing the business, but plays their role to make the final decisions of the firm and to monitor the managers' actions. Most controllers serve on the company's board of directors, but not as the managers of the firm. So we can find that the numbers of board size and independent board are the highest from panel C in Table 5. But the family-controlled companies have the lowest numbers, this may be shareholder concentration allow controlling shareholders to select board members that enable them to expropriate wealth from minority shareholders

Panel D in Table 5 represents the information of control variables of each group. The R&D ratio is the highest (3.35%) in non-family-controlled companies, with the lowest value of 1.62% in family-controlled companies. These results are consistent with Wang and Tsai (2003) in that the R&D intensity of Taiwan's manufacturing industries is between 0.49% and 3.79%, and the average R&D ratio of total companies is 1.68%. The highest market value and industry dummy are 8.64 and 0.743, respectively, in widely-held companies may be attributed to the sample composition, and 84 over the total 113 firms in this group are in the so-called new economy of the "high-tech industry". On the other hand, the lowest value of industry dummy (0.440) in family-controlled companies implies that the sample composition in this group is significantly different from the widely-held group, and 65 of the 116 firms in the family-controlled group are in traditional industries opposed to the high-tech industry. These results are consistent with the high-tech industry having a noticeable development and contribution to Taiwan's economic situation in recent years.

5.3 What causes the difference of productivity?

From section 5.2 we know that family-controlled companies have a lower productivity level than non-family companies. This supports our Hypothesis 1 and is also consistent with Barth et al. (2005). In this part, we use some factors to explain what causes companies to have different productivity levels, and these factors include the positive incentive factor, negative entrenchment factor, and some other factors used to enhance control rights. The regression results are shown in Tables 6 to 9.

5.3.1 The relationship between TFP and incentive effect and entrenchment effect

First, we omit those variables used to enhance control rights and examine the influence on TFP of the incentive effect and entrenchment effect in the total sample and 3 sub-samples.

From model 1 and model 2 of Tables 6 to 9, we test Hypotheses 2.1 and 2.2.

In Table 6 the cash flow rights are not significant to support our hypothesis, where the deviation of control from cash flow rights is significant at DEV^{100}, but not at DEV^{0}. We further test Hypotheses 2.1 and 2.2 in widely-held companies from Table 7. The cash flow rights and deviation of control from cash flow rights both have a positive influence on TFP, but the previous one has a more significant relationship. In Table 8 the cash flow rights and deviation of control from cash flow rights also have a positive influence on TFP in family-controlled companies, but the negative entrenchment effect has a more significant relationship. In Table 9 the cash flow rights and deviation of control from cash flow rights have a negative effect on TFP. The results are controversial to our hypothesis.

From Tables 6 to 9, the regression results do not support Hypotheses 2.1 and 2.2 completely. We even get the overall controversial results in the non-family-controlled group. Next, we add factors used to enhance control rights with the incentive effect and entrenchment effect to see the influence on TFP. We are curious about whether these factors further affect the firm's productivity level, which is what the following section emphasizes.

5.3.2 Factors used to enhance control rights

From model 3 and model 4 of Tables 6 to 9, we test Hypotheses 3.1 to 5. In Table 6 we examine Hypotheses 3.1 to 5 of the total sample. The management regime, collateral ratio and board size are significantly negatively related to TFP. The positive and significant sign of IND BOARD means that independent directors and supervisors are more likely to monitor and provide expertise to firms and further increase a firm's productivity (Rosenstein and Wyatt, 1990).

In model 3 and model 4 of Table 7 we examine Hypotheses 3.1 to 5 of widely-held companies. The regression results support Hypotheses 4.1 and 4.2. This mean Board size is negatively related to changes in productivity and IND BOARD is positively related to changes in productivity. The relationship of other variables with TFP that we have added is inconsistent with our conjecture. These insignificant results may be due to the fact that firms inside the widely-held group are not with the controller and hold more than 20% of shares as compared to the family-controlled group and non-family-controlled group. Hence, the usage of factors to enhance control is useless and unpopular, and this reason further causes the influence of these variables on TFP to not be crucial.

Table 8 presents the results for Hypotheses 3.1 to 5 of the family-controlled companies. Cross-holding and collateral are significantly negatively related to TFP. The results support

Hypotheses 3.2 and 3.4. The positive and significant sign of SEC means that a shareholder holds more than 3% of shares, but is not related to the controller and will have an effective monitoring power and further increase the firm's productivity. The positive and significant sign of IND BOARD also means that independent directors and supervisors are more likely to monitor and provide expertise to family-controlled companies.

Table 9 shows the results for Hypotheses 3.1 to 5 of non-family-controlled companies. Because the controllers in this group act as shareholders, but do not engage in the execution of operations, therefore what they care about is how much earnings they can earn and hence they are willing to recruit professional managers to operate their firms and further increase the firms' productivity (Barth et al., 2005). Hence, the factors used to enhance control rights are rarely used as for the situation of the widely-held group, but the reason is different. This phenomenon is shown from the insignificant influence presented in Table 9.

This section concludes with a summary from Tables 6 to 9: these tables examine Hypotheses 2 to 5. The results show that there is no variable exhibiting a significant influence on TFP in the full sample and sub-samples. Furthermore, cash flow rights exhibit an opposite influence on TFP in different groups. This may be due to the sample composition, as each sub-sample has its own specific characteristics when we apply the concept of ultimate controller, and this causes the influence of the incentive and entrenchment effects on TFP, and the preference of using factors to enhance the control rights is different. Family-controlled companies account for the largest part of control type and have the lowest productivity level, which is consistent with the situation in Taiwan and our hypotheses.

VI. Conclusions

This paper investigates the relationship between control structure and productivity with the concept of ultimate control. The sample comes from manufacturing firms listed on TSE in 2003. Under the 20% cut-off point, we have divided our sample into 3 sub-samples: widely-held, family-controlled, and non-family-controlled. Family-controlled companies are the largest control type, consistent with the situation whereby family companies have been popular and important in Taiwan's economy for many years. The results also show that the family-controlled companies have a lower productivity level which conform our hypothesis.

In order to find out what causes the productivity to be different for each group, we first examine the positive incentive effect and negative entrenchment effect. These two factors are used to examine the probability for the controlling shareholder to expropriate minority shareholders (Claessens, 2002; Yeh et al., 2003). Our results exhibit a non-consistent

influence on TFP in each group. Briefly speaking, these two variables have a positive effect on TFP, but the results are not significant. The percentage of using tools to enhance control rights is also significantly higher for family-controlled companies. These tools include management regime, cross-holding, pyramid structure, and collateral ratio. When we link these tools to productivity, the regression results show that the productivity level decreases.

Furthermore, a firm's board structure also may be viewed as a strong indicator of the controlling shareholder's commitment to corporate governance in Taiwan. We find that smaller boards are associated with better firm performance and independent directors and supervisors are more likely to monitor and provide expertise to firms and further increase a firm's productivity. The results also show that a firm with a large shareholder that does not belong to the controlling shareholder's group will induce an effective monitoring function and further increase productivity. The regression results being more significant and the fitness of model being the highest in the family-controlled group prove that the interest variables have a stronger effect under this kind of ownership group. All these reasons account for the lower productivity level in family-controlled companies.

This paper links productivity with corporate governance through the agency problem. Instead of using accounting performance measures and Tobin's Q, the total factor productivity (TFP) is employed as the performance measure. It is believed that TFP is able to measure the efficiency of a firm and is relatively insensitive to accounting practices. Unlike the method before to solve the agency problem, another view traces out a firm's ultimate controller, primarily use the divergence between control and ownership as a measure of the agency conflict between majority and minority shareholders. Moreover, we also test if the firm performance can be affected by existing board structure or its composition. Board affiliation may be a reasonable proxy for the degree of agency conflicts in family-controlled firms. These findings seem have important implications for potential investors.

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Table1 TFP value of each industry

According to the classification rule of TEJ, we ruled out categories that are not belonging to the manufacturing industries. And then based on the SIC code classified by Campbell(1996). Industries are defined as follows: consumer durables (SIC 30, 36), basic industry (SIC 26, 28, 33), food and tobacco (SIC 20), construction (SIC 32), capital goods (SIC 35), textiles and trade (SIC 22).

	# of sample	TFP value
consumer durables	13	0.575417
basic industry	48	1.004722
food	14	1.213538
construction	5	-0.19519
textiles	26	0.64651
capital goods	150	1.502754
Total sample	256	1.226

Table 2 Cash Flow right and deviation of control from cash flow right in Taiwan Listed Companies

This table summarizes the control right, cash flow right, and deviation of control from cash flow right of Taiwan listed companies. Control: a shareholder's direct and indirect voting right in the firm. CF^{100}: the direct and indirect right through multiply the percentage share owned by this shareholder in the chain of control right, if the capital of nominal investment companies and other related entities 100% came from the largest shareholders. CF^{0}: the direct and indirect right through multiply the percentage share owned by this shareholder in the chain of control right, if the capital of nominal investment companies and other related entities 0% came from the largest shareholders. DEV^{100}: CF^{100}/control. DEV^{0}: CF^{0}/control.

	Mean	Sta. Dev.	Q1	Median	Q3
This study(256 manufacturing firms)					
Control	24.23%	15.33%	11.95%	21.46%	33.92%
CF^{100}	21.77%	15.40%	9.83%	18.88%	29.54%
CF^{0}	14.40%	13.88%	3.51%	9.98%	21.83%
DEV^{100}	0.879	0.215	0.826	1	1
DEV^{0}	0.616	0.380	0.230	0.716	1

Table3 TFP value under different cut-off point with or without controller

Difference is the mean value of productivity widely held corporations minus the corporations with controllers. Standard deviation in parentheses is below the productivity difference. Level of significance: 1%***; 5%**; 10%*

	Widely held	With controller	difference
10% cut-off	1.0764	1.2583	-0.1820 (-0.959)
20% cut-off	1.2866	1.0191	**0.3395** **(2.356)****
30% cut-off	1.3468	0.9613	**0.3855** **(2.501)*****

Table4 Difference matrix between family and non-family firms

The mean value of TFP in parentheses is below the group name. In second row, the TFP difference between family-control firms and other types firms (with or without controller), where t value in parentheses is below the coefficient. Level of significance: 1%***; 5%**; 10%*

	WHC and Non-family control	WHC	Non-family control
	(1.4090)	(1.4160)	(1.3799)
Family control	**-0.4031**	**-0.4101**	**-0.3741**
(1.0059)	**(-2.818)*****	**(-2.733)*****	**(-1.730)***

Table 5 Descriptive statistics of ownership structure variables

This table summarizes the variables we used in the paper. Included the independent, and control variables. The value showed in the table is the mean value of each group.

	Total sample	WHC	Family control	Non-family control
A. control right, cash flow right, and deviation				
Control	24.23%	11.13%	34.86%	33.33%
CF^{100}	21.78%	9.48%	31.60%	31.06%
CF^{0}	14.40%	6.82%	18.73%	27.55%
DEV^{100}	0.880	0.852	0.894	0.930
DEV^{0}	0.616	0.646	0.537	0.826
B. factors used to enhance control right				
MGT	0.59	0.46	0.77	0.41
CRS	0.34	0.32	0.40	0.19
PYRAMID	0.45	0.37	0.55	0.37
COLLATERAL	0.1226	0.1297	0.1350	0.0396
SEC	0.62	0.68	0.57	0.59
C. board structure				
BOARD	10.785	11.062	9.931	13.296
IND BOARD	1.035	1.195	0.810	1.333
D. control variables				
RD (%)	2.4679	3.1244	1.6237	3.3474
MV	8.37	8.64	8.07	8.56
DEBT (%)	0.4113	0.4238	0.4132	0.3504
GROWTH (%)	0.2680	0.1947	0.3697	0.1379
INDUSTRY	0.585	0.743	0.440	0.556

Table 6 Regression results on the relationship between TFP and incentive effect, factors used to enhance control right (total sample)

t-value in parentheses is below difference value Level of significance: 1%***;5%**;10%*

	A. Positive incentive effect				B. Negative entrenchment effect			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Constant	0.062 (0.117)	0.112 (0.214)	0.187 (0.351)	0.377 (0.715)	-0.861 (-1.400)	-0.004 (-0.008)	-0.373 (-0.566)	0.457 (0.832)
CF^{100}	0.084 (0.177)		0.173 (0.372)					
CF^{0}		-0.051 (-0.100)		-0.431 (-0.816)				
DEV^{100}					0.860** (2.606)		0.524 (1.460)	
DEV^{0}						0.118 (0.611)		-0.214 (-0.939)
MGT			-0.369** (-2.594)	-0.327** (-2.314)			-0.363*** (-2.653)	-0.344** (-2.494)
CRS			-0.144 (-0.964)	-0.179 (-1.186)			-0.070 (-0.445)	-0.191 (-1.251)
PYRAMID			-0.163 (-1.194)	-0.188 (-1.342)			-0.116 (-0.826)	-0.240 (-1.507)
SEC			0.217 (1.511)	0.205 (1.429)			0.235 (1.643)	0.200 (1.398)
COLLATERAL			-1.202*** (-3.344)	-1.240*** (-3.428)			-1.115*** (-3.074)	-1.269*** (-3.471)
BOARD			-0.053** (-2.336)	-0.054** (-2.381)			-0.049** (-2.115)	-0.055** (-2.416)
IND BOARD			0.220*** (3.801)	0.221*** (3.825)			0.218*** (3.772)	0.219*** (3.785)
RD	-0.009 (-0.366)	-0.009 (-0.382)	-0.031 (-1.362)	-0.032 (-1.393)	-0.012 (-0.502)	-0.011 (-0.441)	-0.033 (-1.457)	-0.029 (-1.262)
MV	0.096* (1.818)	0.095* (1.786)	0.167*** (3.169)	0.162*** (3.092)	0.118** (2.248)	0.099* (1.868)	0.171*** (3.271)	0.163*** (3.120)
DEBT	-0.004 (-0.009)	-0.022 (-0.049)	0.649 (1.449)	0.608 (1.360)	0.074 (0.167)	0.017 (0.039)	0.614 (1.382)	0.642 (1.441)
GROWTH	-0.033 (-0.874)	-0.034 (-0.883)	-0.041 (-1.134)	-0.042 (-1.169)	-0.021 (-0.544)	-0.032 (-0.832)	-0.035 (-0.975)	-0.043 (-1.196)
INDUSTRY	0.638*** (3.896)	0.633*** (3.918)	0.224 (1.334)	0.203 (1.223)	0.587*** (3.664)	0.612*** (3.708)	0.216 (1.309)	0.230 (1.381)
R2 adjusted P value	0.074 0.000	0.074 0.000	0.189 0.000	0.190 0.000	0.098 0.000	0.075 0.000	0.195 0.000	0.191 0.000

Table7 Regression results on the relationship between TFP and incentive effect, factors used to enhance control right (widely held companies)

t-value in parentheses is below difference value Level of significance: 1%***;5%**;10%*

	A. Positive incentive effect				B. Negative entrenchment effect			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Constant	-0.858 (-0.947)	-0.199 (-0.226)	-0.619 (-0.660)	0.038 (0.042)	-0.886 (-0.896)	-0.024 (-0.027)	-0.622 (-0.569)	0.474 (0.497)
CF^{100}	5.939** (2.583)		4.472* (1.919)					
CF^{0}		2.617 (1.208)		0.827 (0.327)				
DEV^{100}					0.821* (1.855)		0.589 (1.121)	
DEV^{0}						0.109 (0.372)		-0.357 (-0.882)
MGT			-0.086 (-0.369)	-0.067 (-0.283)			-0.038 (-0.161)	-0.097 (-0.404)
CRS			0.189 (0.742)	0.094 (0.365)			0.206 (0.748)	0.017 (0.065)
PYRAMID			-0.375 (-1.625)	-0.299 (-1.117)			-0.275 (-1.147)	-0.526* (-1.674)
SEC			0.149 (0.617)	0.195 (0.799)			0.211 (0.865)	0.159 (0.646)
COLLATERAL			-0.729 (-1.137)	-0.906 (-1.384)			-0.800 (-1.227)	-1.071 (-1.636)
BOARD			-0.065 (-1.357)	-0.095** (-2.033)			-0.078 (-1.596)	-0.106** (-2.295)
IND BOARD			0.331*** (3.630)	0.359*** (3.918)			0.346*** (3.773)	0.361*** (3.957)
RD	-0.220 (-0.653)	-0.034 (-0.978)	-0.043 (-1.301)	-0.050 (-1.509)	-0.037 (-1.098)	-0.036 (-1.043)	-0.053 (-1.597)	-0.046 (-1.370)
MV	0.102 (1.183)	0.073 (0.835)	0.144 (1.640)	0.140 (1.563)	0.100 (1.136)	0.066 (0.752)	0.144 (1.622)	0.146 (1.635)
DEBT	0.870 (1.156)	0.774 (1.007)	1.278 (1.624)	1.401* (1.746)	0.727 (0.955)	0.725 (0.938)	1.259 (1.560)	1.548* (1.923)
GROWTH	1.104*** (3.487)	1.194*** (3.707)	0.964*** (3.124)	1.031*** (3.292)	1.230*** (3.887)	1.243*** (3.870)	1.063*** (3.424)	1.029*** (3.311)
INDUSTRY	0.428 (1.531)	0.474* (1.660)	0.248 (0.880)	0.260 (0.907)	0.410 (1.433)	0.489* (1.696)	0.241 (0.844)	0.282 (0.985)
R2 adjusted P value	0.207 0.000	0.168 0.000	0.283 0.000	0.257 0.000	0.183 0.000	0.158 0.000	0.265 0.000	0.262 0.000

Table8 Regression results on the relationship between TFP and incentive effect, factors used to enhance control right (family control companies)

t-value in parentheses is below difference value Level of significance: 1%***;5%**;10%*

	A. Positive incentive effect				B. Negative entrenchment effect			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Constant	-0.363 (-0.560)	-0.155 (-0.245)	-0.358 (-0.535)	0.003 (0.004)	-1.572** (-2.002)	-0.116 (-0.182)	-1.374 (-1.558)	0.111 (0.165)
CF^{100}	0.731 (1.210)		0.642 (1.034)					
CF^{0}		0.248 (0.428)		-0.258 (-0.401)				
DEV^{100}					1.479*** (2.856)		1.203** (2.010)	
DEV^{0}						0.057 (0.226)		-0.239 (-0.809)
MGT			-0.153 (-0.716)	-0.093 (-0.419)			-0.183 (-0.866)	-0.051 (-0.223)
CRS			-0.340* (-1.872)	-0.395** (-2.145)			-0.221 (-1.149)	-0.417** (-2.254)
PYRAMID			0.136 (0.747)	0.074 (0.392)			0.182 (1.008)	0.052 (0.275)
SEC			0.299 (1.623)	0.282 (1.528)			0.315* (1.734)	0.289 (1.571)
COLLATERAL			-0.808* (-1.896)	-0.840* (-1.931)			-0.682 (-1.604)	-0.870** (-2.006)
BOARD			-0.025 (-0.811)	-0.026 (-0.821)			-0.013 (-0.642)	-0.029 (-0.919)
IND BOARD			0.139* (1.679)	0.138* (1.657)			0.129 (1.579)	0.138* (1.672)
RD	0.011 (0.211)	0.011 (0.220)	-0.025 (-0.481)	-0.021 (-0.392)	-0.002 (-0.050)	0.013 (0.263)	-0.031 (-0.590)	-0.021 (-0.398)
MV	0.133** (2.030)	0.132** (1.984)	0.161** (2.450)	0.154** (2.325)	0.146** (2.294)	0.129* (1.950)	0.165** (2.539)	0.153** (2.317)
DEBT	-0.417 (-0.797)	-0.428 (-0.809)	0.145 (0.258)	0.126 (0.223)	-0.282 (-0.552)	-0.435 (-0.818)	0.152 (0.273)	0.103 (0.182)
GROWTH	-0.051 (-1.567)	-0.055* (-1.686)	-0.056* (-1.774)	-0.060* (-1.894)	-0.030 (-0.920)	-0.055* (-1.689)	-0.042 (-1.300)	-0.062* (-1.947)
INDUSTRY	0.551*** (2.632)	0.523** (2.494)	0.266 (1.199)	0.227 (1.023)	0.473** (2.329)	0.516** (2.396)	0.251 (1.154)	0.254 (1.147)
R2 adjusted	0.112	0.102	0.185	0.178	0.163	0.101	0.208	0.182
P value	0.004	0.007	0.001	0.001	0.000	0.007	0.000	0.001

Table9 Regression results on the relationship between TFP and incentive effect, factors used to enhance control right (non-family control companies)

t-value in parentheses is below difference value Level of significance: 1%***;5%**;10%*

	A. Positive incentive effect				B. Negative entrenchment effect			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Constant	3.082* (1.971)	3.010* (1.907)	1.518 (0.603)	1.584 (0.627)	3.400* (1.740)	3.198* (1.827)	2.205 (0.862)	2.470 (0.952)
CF^{100}	-2.306 (-1.049)		-0.549 (-0.189)					
CF^{0}		-1.761 (-0.866)		-0.875 (-0.270)				
DEV^{100}					-0.380 (-0.295)		-1.512 (-0.845)	
DEV^{0}						-0.167 (-0.183)		-1.780 (-0.981)
MGT			-0.898 (-1.490)	-0.877 (-1.438)			-0.844 (-1.486)	-0.769 (-1.331)
CRS			-0.139 (-0.170)	-0.179 (-0.213)			0.038 (0.048)	-0.120 (-0.155)
PYRAMID			0.052 (0.082)	-0.016 (-0.022)			-0.305 (-0.407)	-0.689 (-0.702)
SEC			0.245 (0.372)	0.232 (0.353)			0.338 (0.539)	0.319 (0.516)
COLLATERAL			-3.413 (-0.789)	-3.292 (-0.760)			-5.351 (-1.200)	-5.774 (-1.284)
BOARD			0.031 (0.411)	0.026 (0.328)			0.046 (0.612)	0.028 (0.377)
IND BOARD			-0.125 (-0.510)	-0.121 (-0.495)			-0.096 (-0.403)	-0.106 (-0.453)
RD	0.041 (0.897)	0.039 (0.827)	0.008 (0.137)	0.007 (0.120)	0.044 (0.921)	0.042 (0.887)	0.009 (0.171)	-0.001 (-0.022)
MV	-0.222 (-1.166)	-0.246 (-1.304)	-0.083 (-0.312)	-0.067 (-0.243)	-0.315* (-1.834)	-0.318* (-1.853)	-0.017 (-0.064)	0.026 (0.094)
DEBT	0.997 (0.627)	0.942 (0.587)	0.689 (0.322)	0.607 (0.283)	0.971 (0.594)	0.976 (0.596)	0.650 (0.312)	0.119 (0.056)
GROWTH	1.218 (1.086)	1.344 (1.209)	0.789 (0.537)	0.760 (0.517)	1.657 (1.565)	1.680 (1.590)	0.299 (0.194)	0.253 (0.167)
INDUSTRY	0.471 (0.957)	0.564 (1.157)	0.869 (1.012)	0.865 (1.021)	0.564 (1.139)	0.585 (1.143)	0.749 (0.897)	0.894 (1.109)
R2 adjusted	0.184	0.170	0.030	0.033	0.142	0.140	0.078	0.095
P value	0.118	0.133	0.457	0.453	0.168	0.171	0.391	0.368

Appendix: The example of calculating the control right, cash flow right and deviation of control from cash flow right

Suppose there exist 3 listed companies, and the shares hold by each entity is listed below in the chart. And we can calculate the control right, cash flow right and deviation of control from cash flow right for each firm.

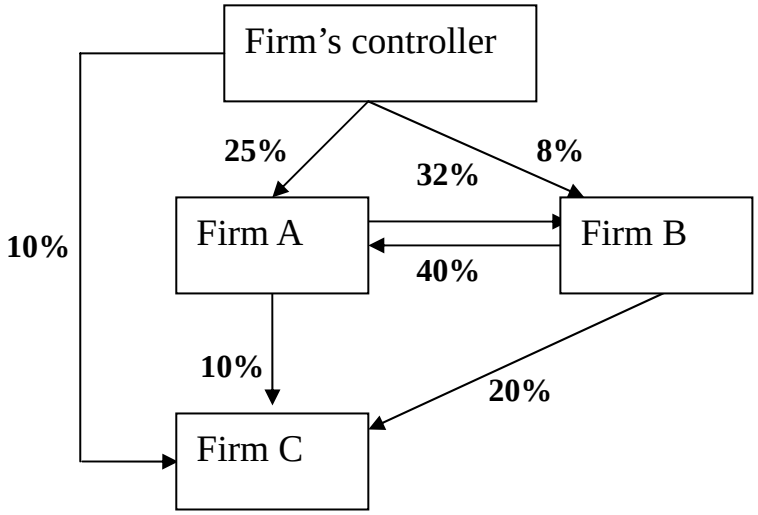

Figure 1 The example of calculating the control right, cash flow right and deviation

$CONTROL_A$=direct holding＋indirect holding (minimum value of chain of control)

=direct holding＋cross holding through firm B

=25%＋Min{8%,40%}=33%

CF_A=direct holding＋indirect holding (multiple value from the chain of control)

=25%＋[8%*40%]=28.2%

$DEVIATION_A$= 28.2% / 33%=0.855

$CONTROL_B$=direct holding＋cross holding through firm A

=8%＋Min{25%,32%}=33%

CF_B=8%＋[25%*32%]=16%

$DEVIATION_B$=16% / 33%=0.485

$CONTROL_C$=direct holding＋pyramid holding through firm A and firm B

=10%＋Min{25%,10%}＋Min{8%,20%}=28%

CF_C=10%＋[25%*10%]＋[8%*20%]=14.1%

$DEVIATION_C$=14.1% / 28%=0.504