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邁向一般競爭異質性理論－運用潛在群組成長模式與混合成長模型

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中 文 摘 要 ： 本研究連結策略管理之持續性競爭優勢與財務管理之企業評價模式，將持續性競爭優勢定義為企業運用策略，長期創造、獲取並留住價格的能力，並因此得以持續成長。此一看不到的潛在成長能力，反映於其長期績效。本研究首先建立潛在群組成長分析(LCGA)及混合成長模型(GMM)運用於企業之長期績效軌跡，並對生技產業進行實證研究，先以 LCGA 決定分組群數，再以 GMM 確定績效軌跡型態，結果成功將生技產業廠商分為競爭優勢及競爭劣勢軌跡兩群，繼而檢定兩群組之資源構型變數是否有差異。結果顯示，相較於競爭劣勢群組，競爭優勢軌跡群組資本投資比例顯著較高，但其成本有效性較優。本研究結論為，即使我們無法得知企業之潛在競爭因素，但觀察其績效，仍得以推論其優勢。

中文關鍵詞： 持續性競爭優勢、較優績效、價值－價格－成本模型、淨現值成長機會、潛在群組成長分析、混合成長模型

英 文 摘 要 ： This research connects the notion of sustained competitive advantage in strategic management to the firm valuation model in financial management. Sustained competitive advantage was denoted as the attained position of a firm undertaking strategies to create, capture, and retain value over an extended time, thereby propelling growth. This capability of achieving growth opportunities can be visualized by the long-term performance. In the empirical study, it adopted a latent class approach to identify the group of firms that consistently show sustained superior performance. The performance trajectories of firms are quantified using binary, annual series of financial return, which is the provision of capabilities of resource employment. We applied latent class growth analysis (LCGA) to the US pharmaceutical preparation industry (SIC code 2834) for the last decade and determined the number of heterogeneous subpopulations of performance trajectory. The growth mixture model (GMM) was subsequently used to examine the heterogeneity between groups and the variations within groups; advantage and disadvantage trajectory groups were then identified. Finally, t tests show that the advantage and disadvantage trajectory groups are heterogeneous in terms of all resource-configuration

variables. The superior performing firms in pharmaceutical industry tend to have more asset investment but are more cost effective. The resluts of this research support the proposition of equifinality: even without knowing their underlying strategic differences, firms can be grouped simply by their observed performance.

英文關鍵詞： sustained competitive advantage, superior performance, value-price-cost model, net present value of growth opportunity, latent class growth model, growth mixture model

邁向一般競爭異質性理論
—運用潛在群組成長模式與混合成長模型

TOWARD A GENERAL THEORY OF COMPETITIVE HETEROGENEITY-LATENT CLASS GROWTH ANALYSIS AND GROWTH MIXTURE MODEL

This research connects the notion of sustained competitive advantage in strategic management to the firm valuation model in financial management. Sustained competitive advantage was denoted as the attained position of a firm undertaking strategies to create, capture, and retain value over an extended time, thereby propelling growth. This capability of achieving growth opportunities can be visualized by the long-term performance. In the empirical study, it adopted a latent class approach to identify the group of firms that consistently show sustained superior performance. The performance trajectories of firms are quantified using binary, annual series of financial return, which is the provision of capabilities of resource employment. We applied latent class growth analysis (LCGA) to the US pharmaceutical preparation industry (SIC code 2834) for the last decade and determined the number of heterogeneous subpopulations of performance trajectory. The growth mixture model (GMM) was subsequently used to examine the heterogeneity between groups and the variations within groups; advantage and disadvantage trajectory groups were then identified. Finally, t tests show that the advantage and disadvantage trajectory groups are heterogeneous in terms of all resource-configuration variables. The superior performing firms in pharmaceutical industry tend to have more asset investment but are more cost effective. The resluts of this research support the proposition of equifinality: even without knowing their underlying strategic differences, firms can be grouped simply by their observed performance.

Keywords: sustained competitive advantage, superior performance, value-price-cost model, net present value of growth opportunity, latent class growth model, growth mixture model

1. INTRODUCTION

1.1 Research background

There is no way to predict the price of stocks and bonds over the next few days or weeks. But it is quite possible to foresee the broad course of these prices over longer periods, such as the next three to five years. These surprising and contradictory finding were made and analyzed by the 2013 Laureates, Eugene Fama, Lars Peter Hansen and Robert Shiller.

Is the value of a firm predictable from a series of historical performance indicators? This is the core question of financial and strategy research. From the perspective of financial research, the answer is clear. According to the above-quoted statement, while the short-term market price of an

asset is an unpredictable random walk (Fama, 1969), it still has an intrinsic value based on future cash flows that makes the prediction of a long-term price possible (Shiller, 1981). Such a prediction can be made using a series of historical performance indicators. This technique is used in finance as well as in strategy management research, though with different focuses.

Financial theories and valuation models are built on investor behavior, or equivalently on the interactions of demand and supply for underlying assets in the financial market. Strategy scholars do not predict value directly1, even though value creation is the core of strategic management (Collis and Montgomery, 1998: 5). Rather, the primary goals of strategic management research are explaining firm performance and the determinants of strategic choices (Grant, 1996: 110). This literature connects the value created by a firm to a latent construct of sustained competitive advantage (e.g., Porter, 1985: 2; Barney, 1991: 102), and posits that sustained competitive advantage leads to superior performance (e.g., Porter, 1985: 65; Barney, 2002: 9), that is, above normal financial (or economic) profit is taken for granted as the consequence of sustained competitive advantage (Ghemawat and Rivkin, 1999: 49; Besanko et al., 2007: 346). Although sustained competitive advantage does not depend upon calendar time (Barney, 1991: 102), empirical studies use long-term series of performance data taken from accounting books to detect persistent superior performance, which is taken as evidence for sustained competitive advantage (e.g., Henderson, Raynor, and Ahmed, 2012; McGahan and Porter, 1997, 2003; Powell, 2003; Powell and Lloyd, 2005; Powell and Reinhardt, 2010; Ruefli and Wiggins, 2003; Wiggins and Reufli, 2002, 2005).

1.2 Research Purpose

This report aims to identify examine performance heterogeneity under with the value-price-cost (VPC) framework (Hoopse, Madsen, and Walker, 2003). We posit that financial indicators reflect a firm's effective application of a bundle of resources on a yearly basis, while sustained competitive advantage is the outcome of the process of a firm undertaking value creating strategies that allow the firm to capture the residual value from whatever it sources, retained the residual value, and continue to do so over a long time. By capturing the long term growth path of year-to-year financial performance, one can infer the presence or absence of sustained competitive advantage, and at the same time, this growth path can be used to determine the intrinsic value of a firm. Hence, on the one hand, a latent growth path of strong financial performance implies the presence of sustained competitive advantage, and on the other hand this growth path also determines the intrinsic value of a firm. This research broadens the VPC framework from the product level to the firm level, and avoids these limitations by modeling latent growth patterns in time series of

[1] The concepts of value creation (Adner and Zemsky, 2006) and value capture (Lippman and Rumelt, 2003a, 2003b; MacDonald and Ryall, 2004) focus on the observed cash flows that determine value. They have been used successfully to explain the dynamics of competition (e.g., Chatain and Zemski, 2011; Costal and Cool, 2013). However, they rely on a game model that is complex and hard to operate when there are hundreds of players in the industry or performance is tracked over a long time.

financial return, to capture the resource employment by the sample firms.

1.3 Research Framework

The present value of growth opportunity model (PVGO) is used in finance to predict stock/firm value. PVGO decomposes the long-term value of a firm into the value of its assets in place and the value of its growth opportunities (Miller and Modigliani, 1961). The value of a growth opportunity is in turn determined by hidden assumptions regarding the firm's persistent competitive advantage (Myers, 1984: 130). In this research, we replace the value of assets in place with the profit rate (π), and replace the value of growth opportunities with the long-term growth rate (g). Sustained competitive advantage is incorporated into the model as the determinant of g, so is predicted by the performance trajectory over time.

In the VPC framework, value is measured as the surplus between consumers' maximum willingness to pay and the firm's supply cost (Besanko *et al.*, 2007: 354-355). The VPC model suggests that the firm producing the largest surplus between value and cost has an advantage over its rivals, regardless of the appropriation between the firm and the buyers. The key variables of the model are therefore value (V), the benefits perceived by the consumers for using a product/service; market price (P), the willingness of a marginal buyer to pay for the product/service; and cost (C), the value of the resources employed to produce the product/service and provide it to the market. All buying consumers must enjoy V higher than P. The difference between V and P is the consumer surplus (CS); the difference between P and C is the producers' surplus (PS). The firm (and by extension its shareholders) receives positive profits only when PS is positive. Therefore, the value created by the managers is V–C = CS+PS.

This framework has proved useful in cross-section case studies for single products. It is more difficult to use in a setting where each firm has multiple products or businesses, or to examine performance differences across industries and over time. Yet the VPC framework can be used to examine performance heterogeneity among firms over time by using V to denote the aggregated value of all products/services created by a firm. In this context, V signifies the willingness of an acquiring investor to pay for the firm given its expected future cash flows, P is the transaction price, and C is the cost of creating the expected cash flows.

To infer sustained competitive advantage, we first adopted a group-based, multi-parametric approach to capture the heterogeneity of firms' performance trajectories in a specific industry. This approach lets us identify the long-term superior performing firms from the grouping results where competitive heterogeneity among groups is latent and unobservable. The approaches we use are latent class growth analysis (LCGA) and growth mixture model (GMM). LCGA (Nagin, 1999, 2005) and GMM (Muthén & Asparaouhov, 2006) are widely used in social and psychological science but are relatively new to management research. Instead of examining how dependent and independent variables are related, LCGA and GMM, which are person-centered approaches, aim to

classify individuals into distinct groups based on individual response patterns so that individuals within a group are more similar than individuals between groups. They model the probability of membership in the observed distinct (performance) trajectory groups where the grouping variable is unavailable or unknown (Jung and Wickrama, 2008; Nagin, 2001, 2005; Nagin and Tremblay, 1999). GMM is a flexible grouping approach, which allows for differences in growth parameters across unobserved subpopulations. It allows for different groups of individual growth trajectories (latent trajectory classes) to vary around different means (categorical latent variables), with the same or different forms (Jung and Wickrama, 2008). LCGA is a special type of GMM whereby the variances of the growth factors within each class are assumed to be zero.

LCGA are less complex, more clearly identify classes, and are less computationally burdensome than GMM. Therefore, it is helpful to begin the model building process with a LCGA before proceeding with GMMs (Jung & Wickrama, 2007). We apply LCGA to the pharmaceutical industry and successfully identify two subgroups with distinct latent performance trajectories. Growth mixture model was then used to examine the heterogeneity between the two trajectory groups.

This final report is structured as follows. The second section connects sustained competitive advantage to the persistence of financial performance with the net present value of growth opportunity (NPVGO). The third section reviews methodologies used in prior studies to identify competitive advantage or persistent performance. The fourth section introduces the research methodologies, LCGA and GMM, applied to identifying long-term trajectory of performance. Section five applies the methodologies to the pharmaceutical industry and identified two heterogeneous groups: advantage- and disadvantage-trajectory performance groups. T tests were subsequently used to examine the resource heterogeneous between the two groups. Section six gives discussion and conclusions.

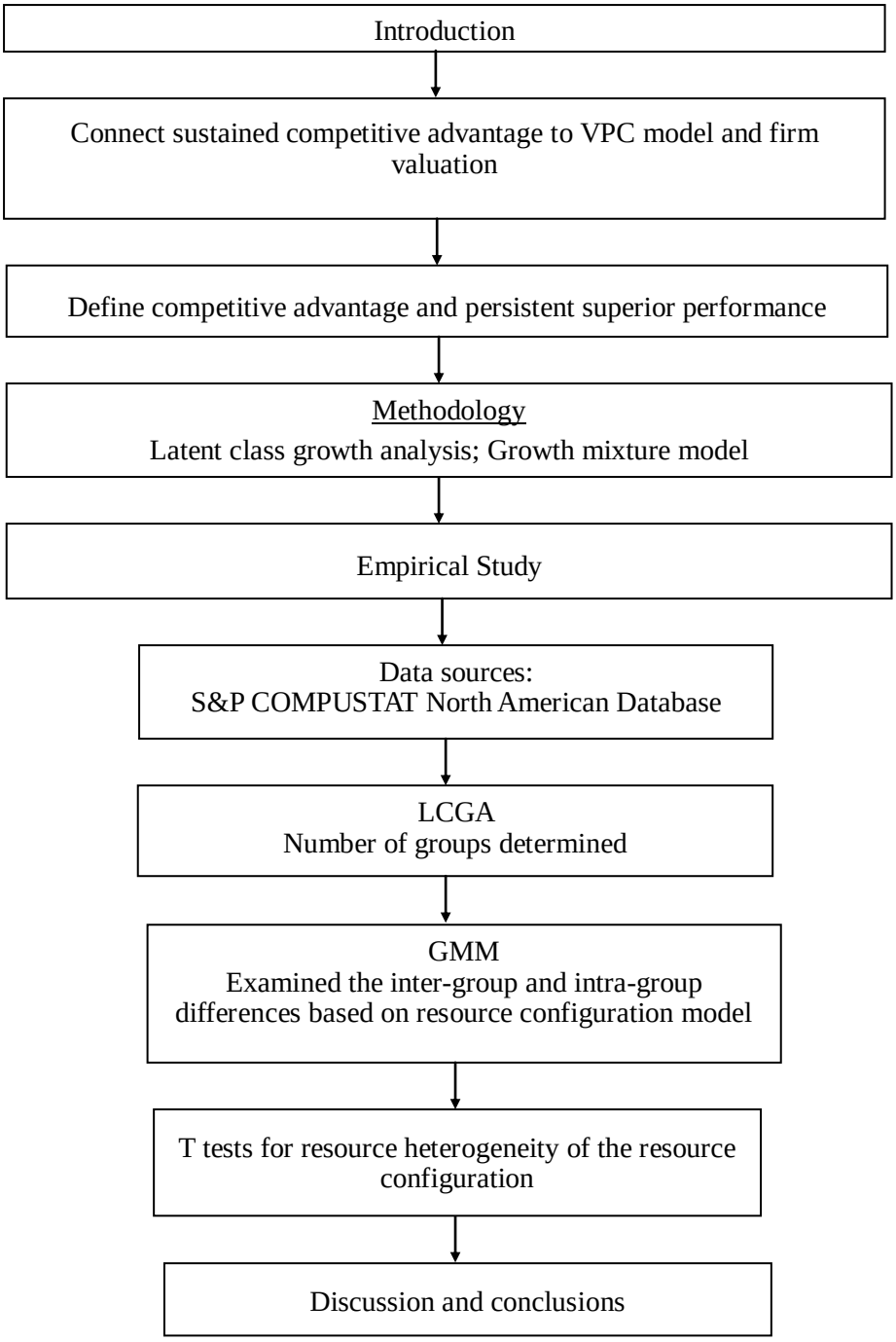


Figure 1 The Research Framework

2. BRIDGING PERSISTENT PERFORMANCE TO VALUE WITH SUSTAINED COMPETITIVE ADVANTAGE

Sustained competitive advantage is the bridge that links firm value to persistent performance. Given a causal (or probabilistic) relationship between sustained competitive advantage and superior performance, it follows that evaluation of the firm's historical performance can identify the presence or absence of sustained competitive advantage. Furthermore, given the positive connection between value and sustained competitive advantage, the finding that a firm enjoys sustained competitive advantage can be a determinant of its value. The PVGO model can be used to express this relationship.

The PVGO model decomposes long-term value into two terms: a static value generated by the firm's operations at time t, and a dynamic value representing future growth opportunities (GO) (Myers and Turnbull, 1977). The value of GO depends both on financial factors such as ongoing investment in new projects (Myers, 1984), and organizational factors such as capabilities and competitive advantage (Hazhir, 2012). The static value is measured using current financial profits, and represents the rewards from employing assets in place. The value of GO depends on latent factors such as permanent competitive advantage (Myers, 1984).

The profits at time t and the value of GO can both be expressed in unit terms (π_t and go_t) by dividing them by the amount of resources employed (such as total assets, equity, and sales). That is:

$$iv_i \pi_i + go_t, t = 1, \ldots, T, \tag{1}$$

where iv denotes the (unit) intrinsic value and T is the total number of time points. The static firm value equates to the realized profit rate at time t (π_t), which is unpredictable over the short term as it follows a random-walk process (Fama, 1970). Strategy scholars (e.g., Denrell, Fang, and Zhao, 2013) suggest that π_t is a linear combination of the entry status (π_0), the profit rate of the previous period, and the capabilities.

The term got in Equation (1) can be obtained from the long-term growth rate ($\bar{g}$) by $go_t = (1+\bar{g})\pi_t$. $\bar{g}$ is heterogeneous among firms (Kogan and Papanikolaou, 2010), and it is higher for firms with sustained competitive advantage than those without. From the probabilistic view (Powell, 2000; 2001; 2002; Tang and Liou, 2010), those firms with profit rates higher than a hurdle level ($\pi_t > \bar{\pi}$) are more likely to have competitive advantage at time t. We name this yearly status temporary competitive advantage (TCAt) to distinguish it from sustained competitive advantage (SCA), which is a series of temporary advantages (Eisenhardt and Martin, 2000; D'Aveni, 1994; Morrow et al., 2007). SCA may be defined by placing conditions on the trajectory of TCA as follows:

$$\bar{g} = h(SCA) = h(f(TCA_0, TCA_1, \ldots, TCA_{T-1}, TCA_T)), \tag{2}$$

where h relates SCA and $\bar{g}$, and f indicates that SCA is determined by $TCA_0, TCA_1, \cdots, TCA_{T-1}$, and TCA_T. Based on longitudinal performance data, we can assess sustained competitive advantage by an appropriate time series methodology. We adopt the latent class growth model, a special type of growth mixture model (Muthén, 2004: 349). By Equations (1) and (2), firms with higher $\bar{g}$ are associated with higher intrinsic value, given their entry status, cumulative advantage, and capabilities. Therefore, firms can be differentiated in terms of SCA, a dynamic index describing the change of TCA over time, rather than in terms of TCAt measured at specific time points.

3. COMPETITIVE ADVANTAGE AND PERSISTENCE OF PROFIT

A firm that outperforms its rivals in an industry is said to have superior performance, and is seen as most likely to have competitive advantage (Powell, 2000, 2001, 2002; Tang and Liou, 2010), or TCA as defined above. If such a firm continues to enjoy superior performance over a long period of time, it is said to have persistent superior performance. This is seen as an effective evidence of having sustained competitive advantage. Yet there is no universally accepted definition of "persistent superior performance". This ambiguity has encouraged strategy scholars to develop many different methodologies for testing their theories and identifying long-term outperformers. Table 1 lists some of the different definitions and methodologies used in prior studies.

Some empirical studies define "competitive advantage" as the "abnormal returns enjoyed by a firm"; others define it as the returns of a firm superior to those of its rivals or to the industry average. Sustained competitive advantage has been operationally defined as "the tendency of abnormally high or low profits to continue in subsequent periods" (McGahan and Porter, 2003). Thus, "persistent superior performance" includes two qualities: superiority and sustainability. Whatever methods are used to measure sustained superior performance must quantify and satisfy both elements (McGahan and Porter, 2003). While superior performance is measured using yearly data, sustainability is usually examined by statistical methodologies with longitudinal data.

3.1 The Probabilistic View of the Causality between Competitive Advantage and Performance

Aiming at developing tools capable of prescribing a particular course of action for practitioners, mainstream of strategic management deploys inductive logic to infer principles, theoretical claims, and/or "takeaway" from particular cases and other empirical evidence. However, the popularity of this approach does not ensure that the generalizations procured from induction are universally tested or even broadly supported. Porter's (1980; 1985) proposition of generic competitive strategies and the VRIO (value, rare, imitable, and organization) argument (Barney, 1997) of the resource-based view (RBV) are indicated individually as a *truism* or *tautology* for they are not empirically falsifiable (Priem and Butler, 2001a; 2001b; Tang and Liou, 2010).

Table 1. Definitions of superior and persistent performance, methodologies, and grouping approaches in previous studies

Performance indicators	1. Net profit margin = net income after taxes / sales (Carey, 1974); gross profit margin = (sales – COGS)/sales (Devinney, Yip and Johnson, 2010) 2. Return on assets (ROA): gross/net-of-tax profits plus interest / total assets (Mueller, 1977; 1986); net income after taxes / tangible assets (Carey, 1974); return on total assets before (or after) taxes (Geroski and Jacquemin, 1988; articles collected in Mueller, 1990; Roberts, 1999; Wiggins and Ruefli, 2002; Devinney, Yip and Johnson, 2010; Henderson, Raynor and Ahmed, 2012) ; operating income / total assets (Schmalensee, 1985); operating income / assets held by business segment (MaGahan and Porter, 1999; Choi and Wang, 2007); operating income / identifiable assets (Ruefli and Wiggins, 2003) 3. Return on equity (ROE) = net income after taxes / common equity (Carey, 1974; Goddard *et al*., 2011); EBIT/shareholders' equity (Devinney, Yip and Johnson, 2010) 4. Excess value = (market value – book value)/sales (Connolly and Schwartz, 1985) 5. Expected return on investment (ROI) = riskfree rate + beta × (market return – riskfree rate) (Jacobsen, 1988) (CAPM model) 6. Return on sales; rate of profit on sales (ROS) (Kessides, 1990; Bentzen *et al*., 2005; Devinney, Yip and Johnson, 2010) 7. Profit rate = (firm profit – sample average)/sample average (Schohl, 1990) 8. Profit rate = value added – depreciation – wages/capital + wages (Droucopoulos and Lianos, 1993) 9. Profit rate = (value of output – wages – raw material cost – interest) / gross fixed assets 10. Return on capital employed (ROC): Goddard and Wilson, 1996; Devinney, Yip and Johnson; Devinney, Yip and Johnson, 2010 (EBIT/total assets – current liabilities) 11. Tobin's q: market value of equity and debt securities / book value of equity (Wiggins and Ruefli, 2002; Devinney, Yip and Johnson, 2010); market value of stock / book value of assets (McGahan and Porter, 1999; Choi and Wang, 2007; Henderson, Raynor and Ahmed, 2012) 12. Cash flow from operations to operating revenue; change in market value; total shareholder return; Earnings before interest and taxes (EBIT); sales growth (Devinney, Yip and Johnson, 2010) 13. No specific indication on calculations: profit rate (Cubbin and Geroski, 1987; 1990); ROA (Waring, 1996; Powell and Reinhardt, 2010); ROE (Denrell, *et al*., 2013); total profit, return on equity, return on assets, 1-year yield to investors, and 10-year yield to investors in Fortune 500 (Powell, 2003)
Superior performance	1. Above industry average in the given year (Waring, 1996; Wiggins and Ruefli, 2002; 2005; Ruefli and Wiggin, 2003; Denrell, *et al*., 2013) or in the selected year(s) (McGana and Porter, 1999; 2003; Choi and Wang, 2007) 2. Above the long-term average of the specific industry (Cubbin and Geroski, 1987; Schohl, 1990; Roberts, 1999; Goddard et al., 2011) or above the mean across industries (Mueller, 1986) 3. Deviation of return from its expected return (Jacobsen, 1988) 4. Positive lagged normalized profit (Roberts, 1999)Profitability Ranking (Powell and Reinhardt, 2010; Henderson, Raynor and Ahmed, 2012)

Table 1. (Continued)

Persistent performance	1. Persistent rents or above-average returns (Mueller, 1977; 1986; 1990; McGahan and Porter, 1997; 1999; 2003) 2. Consistency of staying in the above-modal performance stratum over time (Wiggins and Ruefli, 2002; 2005; Ruefli and Wiggins, 2003) 3. Consistency of profitability ranking: Carey, 1974; Powell and Reinhardt, 2010 (Spearman's distance); Henderson, Raynor and Ahmed, 2012 4. Consistency of winning: Powell, 2003 (Gini coefficient); Powell and Lloyd, 2005 (Gini, Entropy, Herfindahl, Pearson, Likelihood) 5. Multiple measures of performance frontier: Devinney, Yip and Johnson, 2010. 6. Distinguishing superiority generated by capabilities from luck and cumulative advantage (Denrell, Fang and Zhao, 2013)
Methodology	1. Autoregressive models (Mueller, 1977; 1986; Cubbin and Geroski, 1987; 1990; Connolly and Schwartz, 1985; Jacobsen, 1988; Goddard and Wilson, 1996; Waring, 1996; Geroski and Jacquemin, 1988; McGahan and Porter, 1999; Roberts, 1999; Choi and Wang, 2009; Goddard et al., 2011; articles collected in Mueller (ed.), 1990) 2. Rank (ordinal) approaches (Powell, 2003; Powell and Lloyd, 2005; Powell and Reinhardt, 2010; Henderson, Raynor and Ahmed, 2012 with Markov Chain process) 3. Bayesian approach with lag information (Denrell, *et al*., 2013) 4. Stratifying approach (Wiggins and Ruefli, 2002; 2005; Ruefli and Wiggins, 2003) 5. Full information maximum likelihood (Cubbin and Geroski, 1987) 6. Panel unit root tests (Bentzen *et al*., 2005) 7. Structural equation modeling (Bou and Satorra, 2007) 8. Data envelope analysis (Devinney, Yip and Johnson, 2010) 9. Trend analysis: polynomial time trends (Mueller, 1986); Structural time series (Cable and Jackson, 2008)
Grouping approach	1. Rank and divide firms into n groups by profitability rate (quantiles- Mueller, 1986; percentiles- McGahan and Porter, 1999; Powell and Reinhardt, 2010; Henderson, Raynor and Ahmed, 2012; Powell, 2003; Powell and Lloyd, 2005; Roberts, 1999; Choi and Wang, 2007 (lagged)); 2. Non-parametric approach- Kolmogorov-Smirnov iterative technique (Wiggins and Ruefli, 2002; 2005; Ruefli and Wiggin, 2003)

Powell (2001: 881) disputed the RBV by proposing the counterfactual condition of *competitive disadvantage*. He suggested transforming the deterministic, unidirectional proposition *sustainable competitive advantages create sustained superior performance* into a probabilistic inference: *sustainable competitive advantage is more probable in firms that have already achieved sustained superior performance*. Following the Bayesian process, which periodically updates its propositions or hypotheses in the face of empirical evidence, Powell laid out a syllogistic structure describing the relationships between competitive advantage, competitive disadvantage, and superior performance.

Similar to Powell's (2001) Bayesian process, Tang and Liou (2010) added an auxiliary or bridge hypothesis to help define the causal relationship between sustainable competitive advantage and sustainable superior performance. They indicated that the firm's unique configuration of resources (Miller, 1986; Siggelkow, 2002) that mediates between heterogeneous sources and competitive advantages, creating superior performance. Any primary sources of competitive advantage (a unique business process such as lean production, customer relationships, etc.) are considered embedded in and inseparable from the organization itself, along with its business units and functional departments. The RBV assumes that the process of managing these resource bundles, variously termed configuration, strategic fit (Siggelkow, 2001; Levinthal, 1997), or causal ambiguity (Reed and DeFillippi, 1990; Rivkin, 2001), cannot be comprehended or imitated by outsiders. Yet, Tang and Liou suggested that we can infer the sources of the competitive advantage by decomposing the realized superior performance indicators such as operating revenue, market share, stock prices, and 10-K reports, which can be thoroughly assessed by the public.

Tang and Liou (2010) use the Bayesian conditional equation (3) to rationalize the causal relationship between sustained competitive advantage and the performance.

$$P(\boldsymbol{\theta}|\mathbf{Y}) = \frac{P(\mathbf{Y}|\boldsymbol{\theta})P(\boldsymbol{\theta})}{P(\mathbf{Y}|\boldsymbol{\theta})P(\boldsymbol{\theta})+P(\mathbf{Y}|\sim\boldsymbol{\theta})P(\sim\boldsymbol{\theta})} = \frac{P(\mathbf{Y}|\boldsymbol{\theta})P(\boldsymbol{\theta})}{P(\mathbf{Y})} \tag{3}$$

Whereas $\boldsymbol{\theta}$ represents an exhaustive set of mutually incompatible competitive advantage hypotheses or theories, and $\mathbf{Y}$ represents a collective set of empirical performance indicators.

Given that heterogeneous performance deductively entails different configurations, they subsequently extended the posterior probability $P(\boldsymbol{\theta}|\mathbf{Y})$ in equation (3) to the general conditional $P(\boldsymbol{\theta},\psi|\mathbf{Y})$, where ψ is an auxiliary equifinality proposition representing a mixture of heterogeneous resource bundles $\boldsymbol{x}$ and their associated weights λ, $\psi=(x,\lambda)$. The causal series can be extracted by the Bayesian discriminant model (Sivia 1996), which assumes that the population of firms is composed of two unaffiliated factions: those with competitive advantage and those without (i.e., having competitive disadvantage).

$$\boldsymbol{P}(\theta|\boldsymbol{Y})+\boldsymbol{P}(\sim\theta|\boldsymbol{Y})=1 \tag{4}$$

$$P(\boldsymbol{\theta}, \psi|\mathbf{Y}) = P(\boldsymbol{\theta}|\psi, \mathbf{Y}) \times P(\psi|\mathbf{Y}) \quad (5)$$

The probabilities of the competitive advantage hypotheses $\boldsymbol{\theta}$ are straightforward. Statistical inference of competitive advantages (and competitive disadvantages) comes from inductive reasoning based on the unobserved configurations of heterogeneous resource bundles ψ and the empirical evidence of superior performance $\boldsymbol{Y}$.

To determine sources of competitive advantage that in turn causes superior financial performance, Tang and Liou used financial data to conduct the inferences of competitive advantage. Firstly, they selected the return on invested capital (ROIC) to measure a firm's sustainable superior performance and/or value creation. Secondly, the firm's resource bundles x, such as advertising and accounts receivable, are treated as driving elements of ROIC. Thirdly, the configuration weights λ represent dynamic linkages such as operating efficiency and capital leverage that interconnect resource bundles. Lastly, the identified four-dimension configuration of interconnected resource bundles including customer relationships, intellectual property, and fixed asset management that might lead to sustainable competitive advantage.

3.2 Superior Performance

Depending on their specific research objectives, prior studies variously define superior performance as: (1) profits above the annual average for a specific industry or segment, either in a single year (Waring, 1996; Wiggins and Ruefli, 2002; 2005; Ruefli and Wiggin, 2003; Denrell, Fang, and Zhao, 2013) or over selected years (McGana and Porter, 1999; 2003; Choi and Wang, 2007); (2) profits above a long-term average for a specific industry (Cubbin and Geroski, 1987; Schohl, 1990; Roberts, 1999; Goddard *et al*., 2011) or across industries (Mueller, 1977, 1990); (3) positive lagged normalized profits (Roberts, 1999); (4) deviation of the realized return from a firm's expected return (Jacobsen, 1988); and (5) being in a predefined percentile based on profitability ranking (Powell and Reinhardt, 2010; Henderson *et al*, 2012). Because we wish to observe trends in firm performance over consecutive years during the study period, we define annual superior performance using the first definition: realized profits above the industry average in the corresponding year

3.3 Persistent Superior Performance

The fourth row of Table 1 lists methodologies for identifying persistent superior performance used in the literature. Among parametric studies, a vast number use an autoregressive model to examine the persistence of profits within and across industries (Choi and Wang, 2009; Connolly and Schwartz, 1985; Cubbin and Geroski, 1987; 1990; Geroski and Jacquemin, 1988; Goddard and Wilson, 1996; Goddard *et al*., 2011; Jacobsen, 1988; McGahan and Porter, 1999; Mueller, 1977, 1986; articles collected in Mueller (ed.), 1990; Roberts, 1999; Waring, 1996). With an autoregressive model, sustained performance refers to the persistence of profits, which are commonly defined as persistent rents or abnormal returns over time (Mueller, 1977, 1986, 1990;

McGahan and Porter, 1999; 2003). The autoregressive model investigates the year-to-year movements of annual profits. This line of research aims to examine the loss of abnormal profits over time across industries as well as identify the effects of the industry and firm-specific factors. As a complementary analysis, the firms are often grouped by performance (in quantiles) so that sustained superiority can be compared between the highest and lowest performance groups. The ordinal importance of factors that influence persistence is inconclusive, but all these studies agree that *only a few firms show persistent superior financial performance in the long run*.

A limitation of the autoregressive model in examining sustained superior performance is that the cardinal data are not directly comparable across time periods, and the model requires assumptions about the true form of the unobserved performance distribution (Powell and Reinhardt, 2010). In addition, competitive advantage is essentially a property of outliers (Wiggins and Reufli, 2002), while the autoregressive model is based on the population mean. The autoregressive model statistically neutralizes the differences between firms and fails to account for their unique characteristics (Hansen, Perry, and Reese, 2004). As a consequence, research results based on a normal distribution of performance might be misleading (Henderson, Raynor, and Ahmed, 2013).

In addition, the autoregressive model estimates just one growth pattern to describe the entire population. This approach oversimplifies the diversity of growth patterns found in real industries that describe continuity and change among members of different subpopulations with heterogeneous performance (Jung and Wickrama, 2008).

Rather than testing the trend of abnormal profits, Wiggins and Reufli (2002; 2005) and Reufli and Wiggins (2003) use a non-parametric approach to stratify firms into several groups with significant differences in annual performance. Persistence is then quantified by measuring the frequency of transitions among the ordered performance strata across years. Alternative approaches to measuring the consistency of profit ranking over time include the Gini coefficient (Powell, 2003), the Entropy, Herfindahl, Pearson, and Likelihood indicators (Powell and Lloyd, 2005), and the Spearman distance (Powell and Reinhardt, 2010). Note that all these indicators measure the persistence of performance at the industry level instead of identifying individual outperformers. In addition, they are estimated by the number of wins and ignore the sequence of wins throughout the sample period.

Recent studies are concerned about the effectiveness of financial indicators as evidence of firm performance driven by capabilities (Denrell, 2004; Denrell, Fang, and Zhao, 2013; Henderson, Raynor, and Ahmed, 2012). Denrell, Fang, and Zhao apply a Bayesian approach associated with the Markov chain process to distinguish financial performance driven by capabilities from performance driven by luck and accumulative advantage. Henderson, Raynor, and Ahmed record the frequency of a firm being superior (that is, ranked in the top 10th percentile) across its observed life. This track record is compared with an expected frequency benchmark built by the Markov chain process on a rank-based percentile performance space. Thus, an observed long-term superiority is considered to be real (not solely a result of market randomness) if the firm's

frequency of superiority is higher than the benchmark. Denrell, Fang, and Zhao (2013) and Henderson, Raynor, and Ahmed (2012) conclude that yearly performance indicators can be generated from luck or cumulative advantage, not just from capabilities. They also suggest that with appropriate methodologies, financial indicators are useful for identifying firms with capabilities or sustained advantage.

Unlike cardinal approaches, ordinal (rank-based) approaches to investigating persistent profits do not require the researcher to know the underlying distribution of the performance indicator. However, these approaches do not specify the time sequence of shifts in ranking or wins, which is essential to recognize growing outperformers.

Consider, for example, two competitive firms A and B, both of which have 10 observed years of life and have achieved performance superior to their peers in all years. We recognize that both firms have superior performance and are the most likely in their sector to have sustained competitive advantage (Hansen, Perry, and Reese, 2004; Powell, 2000; 2001; 2002; Tang and Liou, 2010). If both firms only achieved superior performance six times in the past ten years, they are still regarded as outperformers if the benchmark frequency is less than six years. However, if Firm A achieved superior performance from year 5 to year 10 while Firm B achieved superior performance from year 1 to year 6, Firm A is thought to be more competitive than Firm B since the former has an upward trend. Therefore, to recognize whether a firm is more competitive than others in the long run, we need not only the frequency of outperformance but also the growth trajectory of the firm's performance relative to others. The LACG with logit model described in the next section captures the time-ordering performance trajectory of firms.

4. METHODOLOGY

4.1 LCGA

For a heterogeneous population (like the firms in an industry), it is appropriate to assume that distinct groups of individuals pursue qualitatively different trajectories (Muthen, 2004; Nagin and Land, 1993). LCGA is a statistical methodology originally developed by Nagin and Land (1993) in criminology, and later adopted by other social science researchers for longitudinal data analysis (Bushway and Weisburd, 2006). LCGA models the developmental paths corresponding to individual characteristics and behaviors in a heterogeneous population (e.g., McLeod and Fettes, 2007; Sturgis and Sullivan, 2008; Syed and Seiffge-Krenke, 2013; Van den Akker et al., 2013; see Nagin and Odgers, 2010 for an overview).

LCGA is a multiple-group approach based on semi-parametric group-based trajectory analysis (Jones, Nagin, and Roeder, 2001). Combining cluster analysis and latent trajectory analysis, this approach groups individuals in a way that the individual response trajectories within groups are homogeneous but those of different groups are heterogeneous (Jung and Wickrama, 2008; Sturgis and Sullivan, 2008). LCGA fits each group with a different model and assigns different parameter

values across unobservable subpopulations (Jung and Wickrama, 2008). It is particularly useful to identify and model the probability of membership in distinct trajectory groups where grouping variables are unobservable (Jung and Wickrama, 2008; Nagin, 2001, 2005; Nagin and Tremblay, 2001).

For competitive advantage analysis, LCGA can identify groups of firms with homogenous growth trajectories based on observable financial indicators (observable consequence variables). The group trajectory representing within-group members' long-term performance pattern is driven by unobservable antecedents such as organizational typologies (Miles and Snow, 1978; Mintzberg, 1979), generic strategies (Porter, 1980), heterogeneous resources (Barney, 1991), organizational configurations (Ketchen, Thomas, and Snow, 1993), and/or dynamic capabilities (Teece, Pissano, and Shuen, 1997).

4.1.1 The LCGA of performance trajectory

LCGA is used to group individual growth parameters rather than observed outcomes (Jones, Nagin, and Roeder, 2001). It identifies *K* latent classes (the latent trajectory groups) with distinct developmental trajectories depicted with different growth parameters (Sturgis and Sullivan, 2008). The growth trajectory identified for each group is based on the vector $Y_i = (y_{i1}, y_{i2}, \cdots, y_{iT}), i = 1, \ldots, n,$ describing the longitudinal sequence of firm *i*'s performance over *T* points in time for *n* firms. In our case, the elements of *Y* are binary values indicating the presence or absence of superior performance in a given period. LCGA assumes that there are *K* unobserved trajectory subpopulations of firms within an industry, differing in parameter values. The maximum likelihood method is used to estimate these unknown parameter vectors that determine the shapes of the trajectories (Jones, Nagin, and Roeder, 2001; Jones and Nagin, 2007; Haviland, Jones, and Nagin, 2011). The form of the likelihood function can be selected to conform to three types of data: count data, psychometric scale data, or binary data. For binary data, which we use in the present study, the likelihood function is based on the Bernoulli distribution.

LCGA allows one to incorporate variables other than time, including both time-dependent covariates and time-invariant predictors (Jones, Nagin, and Roeder, 2001). In the present study, we include lagged performance (Bollen and Curran, 2004; 2006, Sec. 7.5) and the annual economic growth rate, both time-varying variables, in order to partial out the effects of cumulative advantage and environmental changes. The adjusted latent trajectories of the firms better reflect their dynamic capabilities. We use the binary logit model to fit the dichotomous data (superior performance or otherwise) resulting from the 'above the industry average' criterion. Specifically, letting Y_{ijk} be the binary performance response (1 = superior; 0 otherwise) for firm *i* at time *t* in group *k*, we have

$$\Pr(Y_{itk} = 1) = p_{itk} = \frac{\exp\left(\beta_{0k} + \beta_{1k} Time + \beta_{2k} Time^2 + \ldots + \delta_{1k} Y_{i,t-1} + \delta_{2k} ecog_t\right)}{1 + \exp\left(\beta_{0k} + \beta_{1k} Time + \beta_{2k} Time^2 + \ldots + \delta_{1k} Y_{i,t-1} + \delta_{2k} ecog_t\right)}, \quad (6)$$

where β_{0k}, β_{1k}, and β_{2k} denote the latent intercept, latent linear trajectory, and latent quadratic trajectory for group *k* respectively. The observable variable $ecog_t$ is the economic growth rate at time *t*. The parameters δ_{1k} and δ_{2k} are the random coefficients associated with $Y_{t\text{-}1}$ and $ecog_t$ for group *k*. The degree of the polynomial logit model is determined by trying different models and choosing the degree that best fits the data. The ellipsis in the formula represents these higher-order terms.

Grouping is based on the adjusted latent trajectories of the firms (reflecting their dynamic capabilities). Moreover, the entry status (luck), a time-invariant variable, is included to examine and to delineate its effect on the groups formed by using the multinomial logit model given by

$$\Pr\left(C_i = k \middle| ENTRY_i = entry_i\right) = \frac{\exp\left(\theta_k + \lambda_k entry_i\right)}{\sum_{k=1}^{K} \exp\left(\theta_k + \lambda_k entry_i\right)} \tag{7}$$

where $C_i = k$ means that firm *i* belongs to group *k*. θ_1 and λ_1 are taken to be zero for identifiability (Jones, Nagin, and Roeder, 2001).

4.1.2 Longitudinal missing data and model selection

Since entries and exits of firms are common in the free market, attrition and truncation of the performance series are unavoidable in the longitudinal data. Firms that delisted because of bankruptcy, mergers, acquisitions, or going private disappear from the dataset partway through the study period, while newly listed firms are added to the dataset. For example, in the pharmaceutical industry, there are a total of 446 listed companies from 2004 to 2013. Only 237 of these were active in 2004, and the number of active firms rose to 236 in 2013. The variation of the number of companies reveals that entry and exit were common in the pharmaceutical industry.

It is reasonable to suggest that the attrition rate varies across groups, since financial ratios are effective indicators of pre-bankruptcy (Altman, 1968). The attrition rate affects group sizes over time as well as the parameter estimates in population-level projections (Haviland, Jones, and Nagin, 2011). In LCGA, all periods with missing performance values are retained; the missing data are regarded as random. Economists refer to this approach as exogenous selection (Little and Rubin, 1987). It is reasonable to include subjects with missing longitudinal data in the analysis of competitive advantage, because these firms account for a significant portion of activity in the industry and ought not to be ignored (McGahan and Porter, 2003).

To conduct LCGA, we need to determine the number of trajectory groups and the shapes of the trajectories. SAS Proc Traj software allows estimation of up to a fourth-order polynomial. As for the number of trajectory groups, no "correct" solution is available. However, it can be determined by statistical and/or theoretical criteria (Greenbaum et al., 2004; Muthén, 2004; Nagin, 2005). The trajectory procedure in SAS (Jones, Nagin, and Roeder, 2001) uses the Bayesian information criterion (BIC) to determine the model. The model with the smallest BIC is the one that best fits the data and is therefore considered the best model.

4.2 GMM

The growth mixture modeling approach is a useful method for fully capturing information about inter-individual differences in intra-individual change (the trajectory) taking into account unobserved heterogeneity (different groups) within a larger population (Muthén, 2004). A trajectory defines the developmental course of a behavior/measure (e.g., employment of resources or capabilities) over time. Trajectories, however, are not deterministic functions of time. External events may deflect a trajectory. For example, the impact of strategies or the employment of resources and capabilities on trajectories of competitive advantage might vary in different industries.

Mixture models have been used for modeling unobserved heterogeneity in a population. Consider the two-level growth model, for time point *t* and individual *i*:

Level 1 growth model (the trajectory):

$$\boldsymbol{Y_{ti}} = \boldsymbol{\beta_{0i}} + \boldsymbol{\beta_{1i}}\left(\boldsymbol{TIME}\right)_{\boldsymbol{ti}} + \sum_{\boldsymbol{j}=1}^{\boldsymbol{J}} \boldsymbol{\beta_{tji}} \boldsymbol{a_{tji}} + \boldsymbol{v_{ij}}\,, \text{ where } \boldsymbol{v_{it}} = \boldsymbol{N}\left(0, \boldsymbol{\sigma}^2\right) \tag{8}$$

Level 2 growth factor (variation among individuals):

$$\begin{aligned} \boldsymbol{\beta_{0i}} &= \boldsymbol{\pi_{00}} + \textstyle\sum \boldsymbol{\pi_{0i}} \boldsymbol{x_i} + \boldsymbol{\mu_{0i}} \\ \boldsymbol{\beta_{1i}} &= \boldsymbol{\pi_{10}} + \textstyle\sum \boldsymbol{\pi_{1i}} \boldsymbol{x_i} + \boldsymbol{\mu_{1i}} \\ \boldsymbol{\beta_{2i}} &= \boldsymbol{\pi_{20}} + \textstyle\sum \boldsymbol{\pi_{2i}} \boldsymbol{x_i} + \boldsymbol{\mu_{2i}} \end{aligned} \text{ , where } \begin{pmatrix} \boldsymbol{\pi_{0i}} \\ \boldsymbol{\pi_{1i}} \\ \boldsymbol{\pi_{2i}} \\ \vdots \\ \boldsymbol{\pi_{Ji}} \end{pmatrix} \sim \boldsymbol{N}\left[\begin{pmatrix} 0 \\ 0 \\ 0 \\ \vdots \\ 0 \end{pmatrix} \times \begin{pmatrix} \boldsymbol{\tau_{00}}\, \boldsymbol{\tau_{01}} \boldsymbol{\tau_{02}} \ldots \boldsymbol{\tau_{0J}} \\ \boldsymbol{\tau_{10}}\, \boldsymbol{\tau_{11}} \boldsymbol{\tau_{12}} \ldots \boldsymbol{\tau_{1J}} \\ \boldsymbol{\tau_{20}} \boldsymbol{\tau_{21}} \boldsymbol{\tau_{22}} \ldots \boldsymbol{\tau_{2J}} \\ \vdots \\ \boldsymbol{\tau_{J0}} \boldsymbol{\tau_{J1}} \boldsymbol{\tau_{J2}} \ldots \boldsymbol{\tau_{JJ}} \end{pmatrix} \right] \tag{9}$$

…

where

Y_{ti} = the outcome of individual company over time (e.g., financial performance)

TIME = time-related variable (time scores) (e.g., 2003-2007)

a_{jti} = the j^{th} time-varying covariate (e.g., resource and capability related financial indicators)

x_i = time-invariant covariate (e.g., industry type, governance institution)

β_{0i}, β_{1i} and β_{2i} are random intercepts and slopes varying across individuals. The residuals v_{ij}, μ_{0i}, μ_{1i}, and μ_{2i} are assumed normally distributed with zero mean and uncorrelated with *Time*, *a* and *v*. The Level 2 residuals μ_{0i}, μ_{1i}, and μ_{2i} are possibly correlated but uncorrelated with *v*. The variances of *v* are typically assumed equal across time and uncorrelated across time. However, these restrictions on residuals can be relaxed. The model may alternatively be expressed as a mixed linear model relating *y* directly to a_1, a_2, and *x* by inserting (8) into (7). Analogous to a two-level regression, when either a_{ti} or β_{2ti} varies across *i*, there is variance heteroscedasticity for *y* given covariates and therefore not a single covariance matrix for model testing.

The combined form is

$$\boldsymbol{Y_{ti}} = [\boldsymbol{\pi}_{00} + \boldsymbol{\pi}_{10}(\boldsymbol{TIME})_{\boldsymbol{ti}}] + [\boldsymbol{\mu}_{0i} + \boldsymbol{\mu}_{1i}(\boldsymbol{TIME})_{\boldsymbol{ti}} + \boldsymbol{v}_{ij}] \quad (10)$$

The multilevel, random effects model presented above can be seen as a latent variable model, where the random effects β_{0i}, β_{1i} and β_{2i} are latent variables. The latent variables β_{1i} and β_{2i} are called growth factors and are of key interest in growth model.

Model (1) and (2) have two contradictory assumptions. On one hand, it allows individual differences in development over time because the growth intercept β_{0i} and growth slope β_{1i} vary across individuals, resulting in individually varying trajectories for Y_{ti} over time. The heterogeneity is captured by random effects (i.e., continuous latent variables). On the other hand, it assumes that all individuals are drawn from a single population with common population parameters. Growth mixture modeling relaxes the single population assumption to allow for parameter differences across unobserved subpopulations. This is accomplished using latent trajectory classes (i.e., categorical latent variables). This implies that instead of considering individual variation around a single mean growth curve, the growth mixture model allows different classes of individuals to vary around different mean growth curves. The combined use of continuous and categorical latent variables provides a very flexible analysis framework (Muthén, 2004).

5. EMPIRICAL STUDY

Our sample firms are pharmaceutical companies. We identify these firms in the Compustat North America Database by SIC code 2834, which includes firms engaged in manufacturing, fabricating, or processing drugs in pharmaceutical preparations for human or veterinary use. Products of this industry consist of pharmaceutical products promoted to the dental, medical, or veterinary professions, and to the public. There are 466 such companies in the Compustat database from 2004 to 2013. This period also covers at least two phases of the industry business cycle, if the five-year period depicted by McGahan and Porter (1999) and Rumelt (1991) is accurate. We deleted firms that have less than five-year operations and received 238 series of firm observations in total.

5.1 Identify Performance Trajectory Groups with LCGA

Superior performance of a specific year was defined as ROA rank at the top 20th percentile in the industry. SAS proc traj provided by Professor Bobby Jones was used to derive the performance trajectory groups. The model comparison tests suggested that adding classes more than two performed worse. The BIC indicator signified that the two class model was the best and should be further explored. The results of model fits are shown in Figure 2 and Table 2. Figure 2(a) shows the performance trajectories (dynamic capabilities) identified by the best LCGA model. ROA identifies two trajectory groups (Table 1), of which group 1 fit an upward linear pattern (0.379***) while group 2 showed a downward growth trend (– 0.134**). Group 2 (19%) achieved superior performance 5 times out of an average of 10 observed years (Table 3), and also has higher ROAs

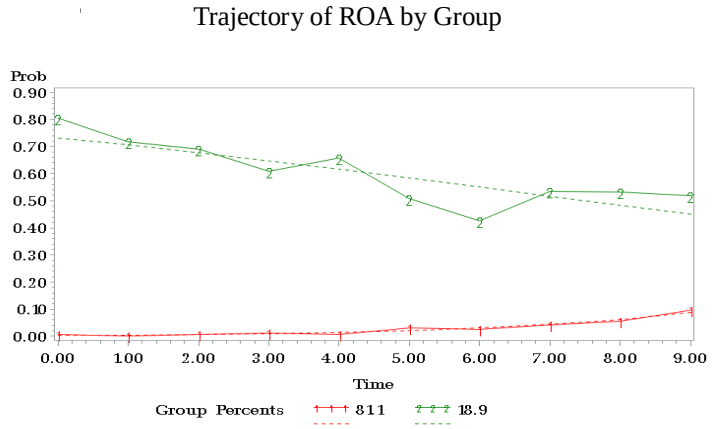
over time. In contrast, firms classified in Group 1 (89%) never achieved superior performance; in terms of ROA, they operated on the axis of errors (Powell and Arregle, 2007).

Give the pre-assumption of zero variance within classes LCGA model might probably be poor because past research have found substantial variability among firm performance. The GMM described next might be a better statistical representation of the hypothesized model of persistent path of performance.

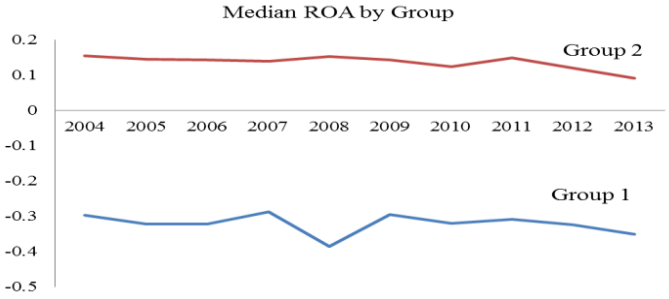
Table 2. Results of model fitting with LCGA and group performance

	Group 1	Group 2
Model fit		
Intercept	– 5.744***	1.005***
Linear	0.379**	– 0.134**
Group performance		
Group percent	78%	22%
Times above average/Year counts	0 / 9	5 / 10

***p<0.001, **p<0.01; *p<0.05.



(a) Predicted trajectory of performance with LCGA



(b) Original ROA pattern

(c)

Figure 2. Latent groups based on growth trajectories

5.2 Identify Performance Trajectory Groups with GMM

GMM estimates the unique variances of intercept and slope for each class of performance where the within-class variances are allowed to be freely estimated. Models were estimated in Mplus version 7.31 (Muthén & Muthén, 1998-2014). This research followed the procedure in Uher et al. (2010) to determine the model with the best fit. First, the Lo-Mendell-Rubin (LMR) likelihood ratio test of model showed that the additional class significantly improves fit over a model with fewer classes (Lo et al. 2001). The *p* value (0.02<0.05) indicated that the two-class model was superior to one-class model. For the decision on the number of classes in the final model, the LM-test was confirmed by the more accurate and computationally demanding parametric bootstrapped likelihood ratio test with 100 draws (McLachlan & Peel 2000; Nylund et al. 2007). Finally, the entropy value, which 0 corresponds to randomness and 1 to a perfect classification (Celeux & Soromenho 1996), was calculated for models with more than one class, to quantify the uncertainty of classification of subjects into latent classes. In addition, the entropy value, which valued 0 is corresponding to randomness and 1 to a perfect classification (Celeux & Soromenho 1996), was 0.95 for the linear model and 0.80 for the quadratic model, indicating that the linear model had a better model fit than the quadratic model.

Group 1 shows higher return on assets than Group. Therefore, Group 1 is named advantage trajectory group while Group 2 is disadvantage trajectory group.

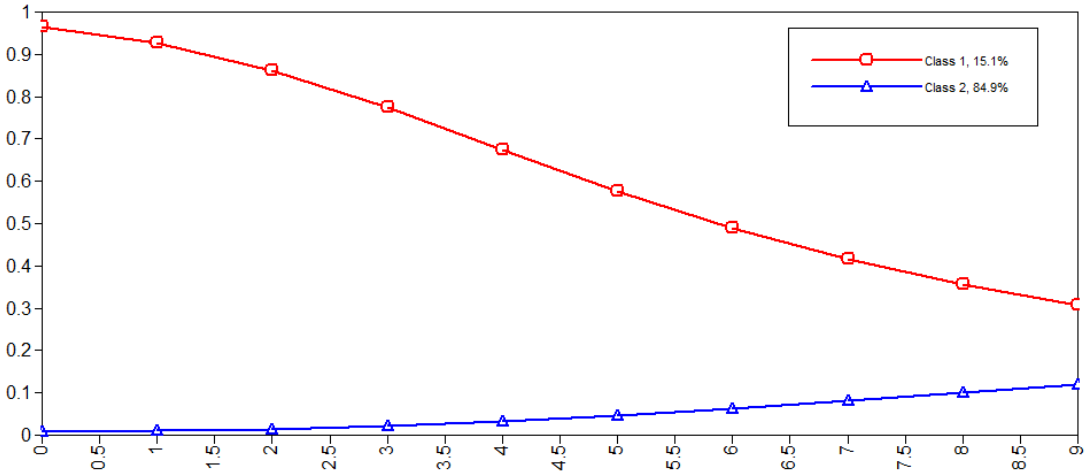


Figure 3. Probabilities of class membership of long-term performance with GMM linear model

5.3 Heterogeneity in resource configurations between groups

This research examined whether there was heterogeneity in resource configurations between the two groups identified above. The resource configuration is measured by six financial ratios suggested by Tang and Liou (2010) including three expense related items (indicating operating efficiency) and three turnover ratios (signifying asset management). The return on assets and the equity multiplier, which represents the financial leverage of the firms, were also examined. The

measurements of these variables are listed below.

Ratio of selling, general and administrative expenses to sales (SG&A expenses/sales)

Ratio of research and development expenditure to sales (R&D expenditure/sales)

Ratio of cost of goods sold to sales (COGS/sales)

Accounts payable turnover ratio (APT=sales/accounts payable)

Accounts receivable turnover ratio (ART=sales/accounts receivable)

Fixed asset turnover ratio (FAT=sales/fixed assets)

Equity multiplier (EM=total assets/equity)

Table 3 presents the descriptive statistics of these variables for the two groups identified in previous section. Table 4 lists the top 10 pharmaceutical companies in terms of the median ROA during 2004-2013 together with the resource-configuration variables.

Table 3. Descriptive statistics

Variable	N	Mean	Standard Deviation	Minimum	Maximum
			Group 1		
ROA	35	0.06	0.48	–2.53	0.43
SG&A	32	0.33	0.16	0.10	0.76
R&D	33	0.10	0.08	0.00	0.35
COGS	35	0.36	0.22	0.10	0.92
APT	35	36.50	73.23	2.49	446.33
ART	34	18.77	34.81	1.20	141.23
EM	34	2.17	1.58	1.10	10.19
			Group 2		
ROA	203	–0.59	1.29	–11.56	0.36
SG&A	136	11.89	58.26	0.04	428.29
R&D	194	27.87	188.21	0.00	2449.90
COGS	198	24.95	214.24	0.00	2948.83
APT	203	12.50	18.87	0.00	148.36
ART	191	18.73	59.04	0.00	561.44
EM	198	2.19	2.64	1.04	29.21

Table 4. Top 10 pharmaceutical firms in terms of median return on assets for 2004-2013

Company	Number of superior performing years	Number of observing years	ROA	SG&A/ sales	R&D/sales	COGS/ sales	APT	ART	FAT	EM	SCA
Usana Health Science	10	10	0.430	0.64	0.01	0.21	69.66	74.64	3.23	1.55	6.07
United-Guardian	10	10	0.273	0.17	0.04	0.39	65.03	9.15	15.15	1.12	2.55
Novo Nordisk	10	10	0.260	0.33	0.15	0.17	21.28	5.81	2.78	1.53	9.13
Biostar	4	6	0.244	0.45	0.03	0.32	15.22	2.50	10.46	1.14	3.97
AstraZeneca	10	10	0.222	0.33	0.16	0.13	7.70	3.86	7.08	2.34	10.30
Nu Skin	10	10	0.210	0.70	0.01	0.15	53.11	59.00	7.73	2.03	7.16
GlaxoSmithKline	9	10	0.208	0.31	0.14	0.19	18.65	4.63	4.33	4.52	10.70
Balchem	10	10	0.207	0.10	0.01	0.67	25.74	7.81	4.09	1.22	5.42
Tianyin	5	7	0.206	0.23	0.01	0.55	17.25	6.89	3.94	1.12	4.16
Roche Hoding	10	10	0.196	0.23	0.19	0.22	37.87	4.68	4.21	2.64	10.74
Skystar Bio	6	7	0.193	0.16	0.02	0.45	50.42	6.20	3.08	1.18	3.52
Reliv International	6	10	0.187	0.76	0.01	0.18	30.72	139.05	3.21	1.69	4.51
China Pharmaceutical	4	7	0.184	0.12	0.03	0.57	19.18	1.20	16.65	1.10	4.00
Eli Lilly	10	10	0.183	0.31	0.22	0.16	21.01	5.71	3.37	2.30	9.96
Johnson&Johson	9	10	0.182	0.32	0.12	0.25	11.06	6.36	6.16	1.84	11.03

Table 5 shows that the median return on assets of Group 1 (0.06) for the last decade was significantly higher than that of Group2 (-0.59). In addition, all resource-configuration variables significantly distinguish these two groups.

On average, Group 1 shows more cost effective than Group 2. These two groups had similar median FAT and EM but were different in APT and FAT. The APT of Group 1 (36.5x) was significantly higher than Group 2 (12.50x) by 24x, indicating that Group 1 had a longer operating cycle than Group 2 by half month (365 days/24=15 days). With longer operating cycles, Group 1 required more working capital to finance its services activities before they could recover the cost from customers. In addition, the fixed assets turnover ratio of Group 2 was higher than Group 1, signifying that Group 2 employed fewer tangible assets than Group 1. In summary, in the pharmaceutical industry, the superior performing firms, those in Group 1, invested more in tangible assets but operate effectively.

Table 5. T Test for resource heterogeneity between the two groups

	Group	ROA	SG&A/Sales	R&D/Sales	COGS/Sales
Expense related items	Group 1	0.06	0.32	0.10	0.36
	Group 2	-0.59	11.89	27.87	24.95
		APT	ART	FAT	EM
Turnover ratios	Group 1	36.50	18.77	11.60	2.17
	Group 2	12.50	18.73	92.14	2.19

All t tests of the predicted variables presented $p<0.001$.

6. DISCUSSION AND CONCLUSIONS

Mainstream strategic management research attributes the persistence of superior performance to sustained competitive advantage, the sources of which lie in industrial structure (Porter, 1985) or firm-specific factors such as idiosyncratic and immobile resources (Barney, 1991), knowledge management (Grant, 1996), and capabilities (Teece, Pisano, and Shuen, 1997). Notwithstanding the diverse views of scholars regarding these sources, all suggestions share the characteristic of invisibility. Investigation of long-term observed outcomes, especially annual financial performance, is a feasible solution to investigate the latent sources of sustained competitive advantage. Empirical studies in this field have connected sustained competitive advantage to financial metrics, with performance as the interface. This research strengthens the connection between sustained competitive advantage and observed long-term value, in order to better serve the major objective of strategic management research.

The proposition that competitive advantage determines the value created by a firm is not unique to strategy research; it also appears in financial studies. Financial scholars indicate that the value of GO depends on the permanent competitive advantage created as a result of strategy planning

(Myers, 1984:130), and provides a basis to explain the heterogeneity within an industry (Kogan and Papanikolaou, 2010: 532). In dynamic competition, the financial literature attributes sustained high stock returns during periods of environmental turmoil to invisible factors such as business model (Fahlenbrach, Prilmeier, and Stulz, 2012), entrepreneurship (Gompers et al., 2010), and other managerial explanations (Rouse and Daellenbach, 1999; Spanos and Lioukas, 2001).

Myers (1984: 130) states that 'Finance theory and strategic planning could be viewed as two cultures looking at the same problem.' Sustained competitive advantage is about the ability of a firm to create future value. The future value will be generated from a firm's decisions and activities on new investment projects that bring products/services to the marketplace. These physical projects must both satisfy consumers' needs and generate positive net present value (NPV) to the firm. Although strategy theory refers to the value created in terms of consumers' willingness to pay, the value captured by the firm could be a minimum measurement of competitive advantage. Just as financial analysts evaluate whether the firm's investment projects meet positive-NPV criterion, managers should always check the valuation results with a strategic analysis before decision making (Myers, 1984: 130). To extend the valuation of individual investment projects to growth opportunities of the entire firm, strategic management factors such as sustained competitive advantage should be incorporated into the valuation model.

In the PVGO model, the status of sustained competitive should be determined before a firm can be evaluated. Strategy theory provides a theoretical background to infer the status of sustained competitive advantage by observing the long-term persistence of superior financial performance. Prior studies use performance changes between consecutive years to examine persistence. According to the proposition that sustained competitive advantage correlates with persistent superior performance, firms that present smaller variation of financial performance are more sustained than others. Ironically, greater growth opportunities are usually associated with more volatile performance (Bartram, Brown, and Stulz, 2012). Examining the variation of annual performance changes therefore might not identify firms with great opportunities to grow, especially in emerging industries.

Instead of using performance changes between two years, this research uses latent class technique to distinguish heterogeneous subpopulations of performance trajectories in pharmaceutical industry for the period of 2004-2013. LCGA with logit model suggested two groups of performance trajectories, which are heterogeneous between groups given the assumption of zero valuation within groups. GMM relaxed the assumption of zero variation within group and confirmed the two groups of performance trajectory model. The T tests showed that the firms with superior performance were more intensive in asset investments but were more cost effective.

The results of this research verify that although one may not be privy to the strategies of a firm or the sources of superior performance, so long as the firm continues to effectively manage resources and create value it will display persistent financial superior performance. This implication supports the proposition of equifinality: even without knowing their underlying strategic differences, firms can be grouped simply by their observed performance (von Bertalanffy,

1968; Katz and Kahn, 1978).

There are research constraints with this research. Some variables related to marketing activities such as selling expenses and advertising expenses are not available in financial database. In addition. The data collected from Compustat, which provide financial information of the list companies. Private companies were excluded because of data shortage.

7. CONTRIBUTIONS

7.1 To academic research

This research introduces the newly developed latent class approach, LCGA and GMM to the strategy filed. The latent class approach models the probability of membership in the observed distinct (performance) trajectory groups where the grouping variable (competitive heterogeneity) is unavailable or unknown (Jung and Wickrama, 2008; Nagin, 1999; Nagin and Tremblay, 2005). It provides an appropriate procedure to capture information about interindividual differences in intraindividual change (Nagin, 1999). Unlike the previous study that identify superior performance based on a single year or by the number of wins without ordering at the time zone, the latent class approach identifies the group of firms which show superior-performance trajectory over a long time.

In addition, although the purpose of the research is not to answer the question whether strategic group exist or not (Barney and Hoskinsson, 1990) as Wiggin and Ruefli (1995) did, the results of the research may imply the existence of equifinality, that is, without knowing the strategic factors behind, firms can be grouped simply by the observed performance. These similar achievements may source from different initial conditions and by a variety of different paths (von Bertalanffy, 1968; Katz and Kahn, 1978). To summarize, the research will tackle weakness of the methodologies used in the previous studies and helps toward a general theory of competitive heterogeneity step by step.

7.2 To practitioners

This research examined the competitive heterogeneity and identifies resource configuration of superior firms in the pharmaceutical industry. These outcomes have important implications for industry practitioners in strategic positioning and the investors in stock picking.

7.3 To participants

Participants will learn about mainstreams of strategic management research. Participants can also learn how to use the S&P COMPUSTAT and SAS program to conduct international business research.

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附件四

國科會補助專題研究計畫項下出席國際學術會議心得報告

日期:104 年 7 月 6 日

計畫編號	MOST 103－ 2410 － H － 263 － 009 －		
計畫名稱	邁向一般競爭異質性理論－運用潛在群組成長模式與混合成長模型		
出國人員 姓名	劉芬美	服務機構 及職稱	致理技術學院
會議時間	104 年 6 月 29 日至 104 年 7 月 2 日	會議地點	韓國首爾
會議名稱	(中文) 2015 商業與管理世界研討會 (英文) World Conference on Business and Management (WCBM) 2015		
發表論文 題目	(中文) 捷運系統對房價軌跡之影響 (英文) The Effects of Metro System on the Trajectory of Housing Prices		

一、參加會議經過

本研討會於 2014 年 6 月 20 日-7 月 2 日於韓國首爾舉行，本計畫主持人之論文安排於 6 月 30 日上午 10:30-12:00 場次進行口頭發表，其餘時間則參與其他學者之發表，並參與學術交流活動。研討會主辦單位為此研討會籌備三年，原報告人次超過三百人，但因 MERSE 的陰影，許多學者未出席會議，實際出席者約近一百人。

二、與會心得

本研討會包括來自世界二十餘國之學者與會，涵蓋領域包括財務會計、行銷及一般管理，

三、考察參觀活動(無是項活動者略)

四、建議

多鼓勵學者參加此類國際學術活動，累積經驗，除讓語言表達上更順暢外，並加強肢體語言的訓練，簡報時更具說服力。

五、攜回資料名稱及內容

1.接受及邀請函

2.會議議程

3.發表論文集

4.簡報資料

六、其他

March 27, 2015

Dear. Fen-May Liou:

Your paper submitted for consideration for the *World Conference on Business and Management (WCBM) 2015* has been reviewed. Each competitive paper was blind reviewed by at least two referees and the final decision was based on their recommendations.

Congratulations! I am pleased to inform you that your paper (Paper # WCBM2015-1071) entitled "The Effects of Mass Rapid Transit System on the Trajectory of Housing Price in Taipei" has been accepted for the World Conference on Business and Management (WCBM) 2015 to be held in Seoul, South Korea from 29th June to 2nd July, 2015.

Please prepare a completed paper and submit before **May 10th, 2015.** Note that at least one author must register. Registration is now available through P&GBA website (www.pngba.org) by clicking on "conference". Please kindly notify your co-author(s), if applicable.

The WCBM 2015 organizing committee also provides a competitive paper award competition. If you would like your paper to be considered, you must send a completed paper to me before May 10th, 2015, if you have not done so already.

Also, we need scholars who can present papers as well as who can serve as country co-chairs or session chair for the conference. If you can participate as country co-chairs or session chair, please send us a resume or a personal profile. After evaluation, we will send you an invitation letter. As a country or session chair, you will get to pay student rate ($250) instead of regular rate ($550), which saves a total of $300 if you make an early registration by April 30.

In addition, if you could promote this conference in your country and set a session (collect at least 4 papers & make 4 people to register conference), we can waive full of your registration fee.

Since we prepared various events for the WCBM 2015, we want you to enjoy the conference and cherish the great memory of it. Please check attached file for hotel & travel information. For more details, visit our website www.pngba.org. If you have any questions upon any subjects, please contact us via email pngba@pngba.org

Thank you and we look forward to seeing you in Seoul.

Sincerely,

Jeong-Gil Choi, Ph. D.
WCBM 2015 Executive Chair
President, People and Global Business Association (P&GBA)
Professor, Kyung Hee University

Enclosure: Reviewer's comments

General Program Schedule

Monday, June 29th at Courtyard by Marriott Seoul Times Square

		Optional Tour
1:00 PM – 6:00:PM	4th Fl. Lobby	**Registration**
6:00 PM – 8:00 PM	Urban BBQ (15th Fl.)	**Welcoming Reception** ***(Courtesy of P&GBA and KNTC)***

Tuesday, June 30th at Courtyard by Marriott Seoul Times Square

8:00 AM – 6:00 PM	4th Fl. Lobby	**Registration**
10:00 AM - 10:30 AM	Room #6	Plenary Session (Introduction & Greeting)
10:30 AM – 10:45 AM	4th Fl. Lobby	**Coffee Break** ***(Courtesy of P&GBA)***
10:45 AM – 12:15 AM	Room #1	IT Management / Service Science and Others
	Room #2	Economics / Marketing and Consumer Behaviors
	Room #3	Management and Decision Science
12:15 PM – 1: 30 PM	Momo Café	**Lunch** ***(Courtesy of P&GBA and Seoul City)***
1:30 PM – 3:00 PM	Room #1	Operation Management and Research
	Room #2	Strategic and Change Management
	Room #3	Tourism and Hospitality Management
3:00 PM – 3:15 PM	4th Fl. Lobby	**Coffee Break** ***(Courtesy of P&GBA)***
3:15 PM – 4:45 PM	Room #1	Economics / Management and Decision Science
	Room #2	Finance
	Room #3	Open Lecture
	Room #4	Management and Decision Science Strategic and Change Management
5:00 PM-		**Dinner on your own & Optional Tour**

Wednesday, July 1st at Courtyard by Marriott Seoul Times Square

8:00 AM – 6:00 PM	4th Fl. Lobby	**Registration**
9:00 AM – 10:30 AM	Room #2	Accounting
	Room #3	Finance
	Room #4	Finance/ Health Care Management
	Room #6	Junior Academic Competition
	4th Lobby	Poster Session
10:30 AM – 10:45 AM	4th Fl. Lobby	**Coffee Break** ***(Courtesy of P&GBA)***
10: 45 AM– 12: 15PM	Room #2	Finance
	Room #3	Marketing and Consumer Behaviors
	Room #4	Finance / Operation Management and Research
	Room #6	Junior Academic Competition
	4th Fl. Lobby	Poster Session
12:15 PM – 1:30 PM	Momo Café	**Lunch** ***(Courtesy of P&GBA and Kyung Hee University)***
1:30 PM – 3:00 PM	Room #2	Open Lecture
	Room #3	Marketing and Consumer Behaviors Management and Decision Science
	Room #4	Strategic and Change Management Tourism and Hospitality Management
3:00 PM – 3:15 PM	4th Fl. Lobby	**Coffee Break** ***(Courtesy of P&GBA)***
3:15 PM – 4:45 PM	Room #6	Global Great Debate
4:45 PM – 5:00 PM	4th Fl. Lobby	**Coffee Break** ***(Courtesy of P&GBA)***
5:00 PM – 7:30 PM	AMORIS	**Awards & Night Banquet** (***Courtesy of P&GBA)***

Thursday, July 2nd

9:00 AM – 2:00 PM		**Seoul City Tour** ***(Courtesy of P&GBA and Seoul City)***

Tuesday, June 30th	10:00 to 10:30	Room 6

Plenary Session
Introduction & Greeting

Speaker

Jeong-Gil Choi

President, P&GBA and Conference Chair, WCBM 2015

Editor-in-Chief, Global Business and Finance Review

Professor, Kyung Hee University, South Korea

Note

Tuesday, June 30th	10:45 to 12:15	Room 1

[E/J] Information and Technology Management / Service Science and Others

Session Chair
Carlos Alexandre Camargo de Abreu
Federal University of Rio Grande do Norte State, Brazil

Investigating the Consequences of M-Commerce Consumer Self-Confidence between U.S. and Korea: An International Comparison Study of Mobile Consumer Self-Confidence and Behaviors

Sung-Hee "Sunny" Park, University of South Carolina, USA
Kwanghyun Kim, KNUT, South Korea
Jeffery S. Smith, Florida State University, USA

Performance Appraisal Effect on Positive Psychological Capital (Samples of the Employees in the Sales Department of Financial Institutions in Indonesia)

Anthonius, Maranatha Christian University, Indonesia

The Effects of Extra Credit Assignment in Management Information Systems Classes: Do Extra Credit Assignments Lead Students to Moral Hazard?

Dongmin Kim, University of New Brunswick, Canada

The Factors of Choosing Non-Celebrity Endorsers on Instagram-Based Online Shops

Felicia Abednego, Maranatha Christian University, Indonesia
Yolla Margaretha, Maranatha Christian University, Indonesia

Tuesday, June 30th	10:45 to 12:15	Room 2

[B/G] Economics / Marketing and Consumer Behaviors

Session Chair
Bedanta Bora
Sikkim Manipal Institute of Technology, India

Organizational Analysis of Cashew Nut Supply Chain in Wonogiri Regency of Central Java

Endang Siti Rahayu, Sebelas Maret University, Indonesia
Rahmawati, Sebelas Maret University, Indonesia
Eko Murnianto, Faculty of Agriculture UNTRUN, Indonesia

Economic Inequality and Organization Management: Lessons from Thailand

Tim G. Andrews, Webster University Thailand, Thailand
Khin Thi Htun, Webster University Thailand, Thailand

The Effects of Metro System on the Trajectory of Housing Prices

Fen-may Liou, Chihlee Institute of Technology, Taiwan
Shih-Yu Yang, Chihlee Institute of Technology, Taiwan
Wan-Ping Hsieh, National Chiao Tung University, Taiwan

The Value of Financial and non-Financial Information in Japanese SMEs Risk Assessment

Michiko Miyamoto, Akita Prefectural University, Japan

The increasing productivity and value added for craftsmen gemstone in sangiran sragen through access technology, management, and utilization of resources power based local wisdom

Rahmawati, Sebelas Maret University, Indonesia
Soenarto, Yogyakarta State University, Indonesia
Sri Murnia, Sebelas Maret University, Indonesia
Agung Nur Probohudono, Sebelas Maret University, Indonesia

Tuesday, June 30th	10:45 to 12:15	Room 3

[H] Management and Decision Science

Session Chair
Sourav Ray
McMaster University, Canada

Using a Hybrid MCDM Model for Green Supplier Selection

James J.H. Liou, National Taipei University of technology, Taiwan
Her-Shing Wang, National Taipei University of technology, Taiwan
Chao-Che Hsu, Tamkang University, Taiwan
Yen-Ching Chuang, National Taipei University of technology, Taiwan

Revitalization of Cashew, Efforts to Use Critical Land in Wonogiri District - Central Java

Sri Seventi, Sebelas Maret University, Indonesia
Anastasia Riani, Sebelas Maret University, Indonesia
Muhamad Cholil, Sebelas Maret University, Indonesia
Yeni Fajariyanti, Sebelas Maret University, Indonesia

How Do Monetary Policy Surprises Affect U.S. Stock Returns at the Zero Lower Bound?

Chun-Li Tsai, National Cheng Kung University, Taiwan

Signaling Information in a Vertical Decentralized Supply Chain

Tian Li, East China University of Science and Technology, China
Weixin Shang, Lingnan University, Hong Kong

The Role of Humour in Workplace Relationships: Negotiating Confucius Boundaries in South Korean Organizations

HeeSun Kim, University of Auckland Business School, New Zealand

Tuesday, June 30th	13:30 to 15:00	Room 1

[I] Operation Management and Research

Session Chair
Sourav Ray
McMaster University, Canada

Effect of Leadership Ethics, Trust on Leadership, and Commitment on Attitude toward Changes: A Study on Batik Educational Foundation in Surakarta, Indonesia

Muhammad Cholil, Sebelas Maret University, Indonesia
Muthmainah, Sebelas Maret University, Indonesia

A Dyadic Examination of Workplace Incivility Influence on Wellbeing among Dual-Earner Couples

Chun-Hsien Lee, National Kaohsiung Normal University, Taiwan
Pi-So Chen, National Kaohsiung University of Applied Sciences, Taiwan
Fang-Ming Hwang, National Chiayi University, Taiwan

Allocating Coalition Payoffs under Diminishing Marginal Returns: Analytic Nucleolus Solutions for- Player Cooperative Games

Mingming Leng, Lingnan University, Hong Kong

The Role of Innovation on Batik SMEs' Performance, with Recognition and Training as Moderating Variables

Asri Laksmi Riani, Sebelas Maret University, Indonesia
J.J Sarungu, Sebelas Maret University, Indonesia
Margana, Sebelas Maret University, Indonesia

Tuesday, June 30th	13:30 to 15:00	Room 2

[K] Strategic and Change Management

Session Chair
Carlos Alexandre Camargo de Abreu
Federal University of Rio Grande do Norte State, Brazil

Co-opetition and Corporate Efficiency: The Role of Bancassurance in the Korean Insurance Industry

Byung-Seong Min, Griffith University, Australia

How Does External Knowledge Influence Innovation

Jaegun Lee, Kyungpook National University, South Korea
Moon-Goo Huh, Kyungpook National University, South Korea

Perceived Environmental Uncertainty, Organizational Structure, and Market-Oriented Strategies in Apparel Retail Stores in South Korea and China

Eun Jin Hwang, Indiana University of Pennsylvania, USA
Marjorie J.T. Norton, Virginia Tech, USA

Design of Competitive Strategy through the Companies Requirements and Value Chain Analysis in the e-Book Market

Hyeog-In Kwon, Chung Ang University, South Korea
Yun-Bin Na, Chung Ang University, South Korea

Tuesday, June 30th	13:30 to 15:00	Room 3

[L] Tourism and Hospitality Management

Session Chair
Sooun Lee
Miami University, USA

Effects of corporate social responsibility and internal marketing on employees' Work attitudes

Jungsun Kim, University of Nevada, USA
Hak-Jun Song, Pai Chai University, South Korea
Choong-Ki Lee, Kyung Hee University, South Korea

Should Franchise Restaurant Companies Own So Much Real Estate?

Abraham Park, Pepperdine University, USA

Examining the Adoption of Travel Information Using Geotag in Social Network Service

Heejeong Han, Kyung Hee University, South Korea
Namho Chung, Kyung Hee University, South Korea
Chulmo Koo, Kyung Hee University, South Korea

Tuesday, June 30th	15:15 to 16:45	Room 1

[B/H] Economics / Management and Decision Science

Session Chair
James J.H. Liou
National Taipei University of Technology, Taiwan

Business Turnaround in Thailand: An Exploration into the Impact of Indigenous Management Culture

James Jain, Webster University Thailand, Thailand
Tim G. Andrews, Webster University Thailand, Thailand

Probabilistic Promotions: Monetary vs. Non-monetary promotions

Sungchul Choi, University of Northern British Columbia, Canada
Xin Ge, University of Northern British Columbia, Canada

Entrepreneurship, Innovation and Growth

Olakunle Felix Adekunle, Marketing Director of Pusat Bahasa Laguna, Malaysia

Electronic Shelf Labels (ESL) and their impact on Prices and Pricing

Sourav Ray, McMaster University, Canada
Li Wang, McMaster University, Canada
Daniel Levy, Bar-Ilan University, Israel
Mark E. Bergen, University of Minnesota, USA

Tuesday, June 30th	15:15 to 16:45	Room 2

[C] Finance

Session Chair
Sungsoo Kim
Rutgers University, USA

Linkage amongst Emerging Asia-Pacific Equity Markets : An Empirical Overview
Anindita Adhikary, Sikkim Manipal Institute of Technology, India
Bedanta Bora, Sikkim Manipal Institute of Technology, India

Does Social Netwok Really Matter in FDIs?
Dongkyoon Kim, Montclair State University, USA

Valuation Accuracy of American Options of Computer Business Service Firms Traded in CBOE Using Fractional Black-Scholes Option Pricing Model
Sang Woo Heo, University of Southern Indiana, USA
Jun Gyu Kang, Dongeui University, South Korea

Managerial Behavior of Multinational Corporations around Global Financial Crisis
Jong Rhim, University of Southern Indiana, USA
Peter Cashel-Cordo, University of Southern Indiana, USA

Does Family Control Strengthen the Negative Influence of Earnings Management on the Performance of IDX Listed Banks?
Surifah, Cokroaminoto Universitas of Yogyakarta, Indonesia

Tuesday, June 30th	15:15 to 16:45	Room 3

Open Lecture

"Medical Tourism"

Lecture speaker

Walter Freyer

Professor, Chair of Tourism Economics and Management, Dresden University of Technology

Note

Tuesday, June 30th	15:15 to 16:45	Room 4

[H/ K] Manangement and Decision Science / Strategic and Change Management

Session Chair
Jong Chul Rhim
University of Southern Indiana, USA

Facilitation of Intergroup Communication Skills with the Help of Mobile Applications
Serkan Varol, Lamar University, USA
Asaf Varol, Firat University, Turkey

A Questionnaire on the Development of Green Transportation Acceptance
Chih-Yun Wu, Tunghai University, Taiwan
Pu-Tai Yang, Tunghai University, Taiwan
Kai-Chieh Yu, Tunghai University, Taiwan
Po-Wei Lin, Tunghai University, Taiwan
Kang-Xian Liu, Tunghai University, Taiwan

How Does Absorptive Capacity Influences Team Effectiveness?
Che-Hung Lin, Cheng Shiu University, Taiwan
Fu-Sheng Tsai, Cheng Shiu University, Taiwan
Kou-Cheng Chung, National Dong Hwa University, Taiwan
Hsiao-Mei Chiang, Cheng Shiu University, Taiwan

Wednesday, July 1st	9:00 to 10:30	Room 2

[A] Accounting

Session Chair
Sung-Hee Sunny Park
University of South Carolina, USA

Corporate social responsibility and accounting credit based on the case of Kang Zhi pharmaceutical co.

Sun Lu, Sichuan University, China

A Study of Ratings Changes at the Margin of Investment and Speculative Grades

Joseph Kerstein, Yeshiva University, USA
Sungsoo Kim, Rutgers University, USA
Murugappa (Murgie) Krishnan, William Paterson University, USA

Corporate Social Disclosure's Role on Board Governance's Effect of Financial Performance

Edy Supriyono, STIE Bank BPD Jateng, Indonesia
Rahmawati, Sebelas Maret University, Indonesia
Agung Nur Probohudono, Sebelas Maret University, Indonesia
Surifah, Universitas Cokroaminoto Jogjakarta, Indonesia

The Role of Earnings Management in Mediating the Impact of Ownership Concentration on Financial Performance of Banks

Surifah, Cokroaminoto University of Yogyakarta, Indonesia

Wednesday, July 1st	9:00 to 10:30	Room 3

[C] Finance

Session Chair
SangWoo Heo
University of Southern Indiana, USA

Culture and Other Determinants of Venture Capital Investments
Pascal Gantenbein, University of Basel, Switzerland
Christophe Volonté, University of Basel, Switzerland

Empirical Asset Pricing – Saudi Stylized Facts and Evidence
Wesam Mohamed Habib, The University of Business and Technology, KSA

Effects of Board Reforms on Capital Structure and Corporate Growth Strategy
Byung S. Min, Griffith University, Australia
S. Ghon Rhee, University of Hawaii, USA

Buy or Rent? A Real Option Valuation Model Point of View
Carlos Abreu, Federal Rio Gande do Norte State University, Brazil
Marcos Freitas, Federal Rio Gande do Norte State University, Brazil

Wednesday, July 1st	9:00 to 10:30	Room 4

[C/D] Finance / Health Care Management

Session Chair
Megawati Simanjuntak
Bogor Agricultural University, Indonesia

The Incubation-Networking Research: A Systematic Review from 2002~2014

Wen-Lung Sung, I-Shou University, Taiwan
Fu-Sheng Tsai, Cheng Shiu University, Taiwan
Julia L. Lin, I-Shou University, Taiwan

Business Analytics Certifications Program for IS Curriculum

Hae-Yeon Choi, Savannah State University, USA

Therapeutic Recreation for Children Development Applied in University

Kun-I Chiu, Ming-Hsin University of Science and Technology, Taiwan

Role of Organisational Culture on the Successful Adoption of a SAP System in Saudi Arabia: A Case Study

Mahmood Ali, University of Business and Technology, Saudi Arabia
Shoaib Ahmed, University of Business and Technology, Saudi Arabia
Lloyd Miller, University of Greenwich, United Kingdom

Wednesday, July 1st	9:00 to 10:30	Room 6

Junior Academic Competition

Session Chair
Jeong-Gil Choi
Kyung Hee University, South Korea

Leading successful 10 million "Youke" generation in Korea by employing Consumer-Centered Management

Seong Yeon Kim, Korean International School in Qingdao, South Korea
Young Seok Do, Korean International School in Qingdao, South Korea
Seung Hoon Lee, Korean International School in Qingdao, South Korea
Joon Koo Kim, Korean International School in Qingdao, South Korea

Relationship between socially responsible corporation (SRC) and African labors

Gahyun Kim, Hana Academy Seoul, South Korea

The research about the possibility of success of Chinese human-based management and the Relationship with Jiu Ling Hou(90后) Generation

Jinho Lee, Qingdao No2 High School, South Korea

Wednesday, July 1st	9:00 to 12:15	4th Lobby

Poster Session

MNE's Interfirm Network in Home Country and Liabilities of Foreignness in Host Country

Seong-Young Kim, ESC Rennes School of Business, France

Performance of company and its relation with financial structure: Research on Italy's Chemical Industry

Asim Khan, University of Siena, Italy

The Control Illusion of Conditioned Superstition: Investigation on Re-inforcers

Chia-Ching Tsai, National Yunlin University of Science and Technology, Taiwan

Investigating Cruisers' Activity-Based Segmentation

JuHee Kang, University of Central Florida, USA

David J. Kwun, University of Central Florida, USA

Study on the Use of High Speed Railway to Identify the Service's Core Improvement Points

Hyounku Kim, Korail, South Korea

Eunju Hwang, Korail, South Korea

Seunggyu Choe, Korail, South Korea

Jaedong Noh, Korail, South Korea

Minho Kim, KMAR, South Korea

Do Investor Heuristics Drive IPOs' First-day Returns and One year Post-listing Returns?

Chien-Feng Huang, National University of Kaohsiung, Taiwan

Chih-Hsiang Chang, National University of Kaohsiung, Taiwan

Li-Min Kuo, National University of Kaohsiung, Taiwan

Wednesday, July 1st	10:45 to 12:15	Room 2

[C] Finance

Session Chair
Eun Jin Hwang
Indiana University of Pennsylvania, USA

Effect of Transformation Leadership on Organizational Citizenship Behavior of Nurses Based on Work Value: A Case Study at Islamic Hospital of Surakarta, Indonesia

Muthmainah, Sebelas Maret University, Indonesia
Muhammad Cholil, Sebelas Maret University, Indonesia

Ranking Alternatives by a Relative Maximizing Set and Minimizing Set Method under Fuzzy Multiple Criteria Decision Making Environment

Ta-Chung Chu, Southern Taiwan University of Science and Technology, Taiwan
Elwin Kusumaningtyas, Southern Taiwan University of Science and Technology, Taiwan

Taking stock of the eWOM literature and Setting Research Agenda: A Communication-based Approach

Birud Sindhav, University of Nebraska at Omaha, USA

Factors Affecting Individual Domestic Investors to Invest in Securities through Capital Markets in Tanzania

Omary Juma Ally, College of Business Education, Tanzania

Wednesday, July 1st | 10:45 to 12:15 | Room 3

[G] Marketing and Consumer Behaviors

Session Chair
Bedanta Bora
Sikkim Manipal Institute of Technology, India

The Effects of Customer Citizenship Behavior and Involvement in CSR Activities on Purchase Intention

Eun-Mi Lee, Izmir University of Economics, Turkey
Sung-Joon Yoon, Kyonggi University, South Korea

Analysis of Musical Product Selection Properties Depending on Advance Ticketing Point

Hyelim Lee, Chung-Ang University, South Korea
Hyeog-in Kwon, Chung-Ang University, South Korea

Antecedent and Consequences of Firm Agility

Jeen Su Lim, The University of Toledo, USA
John H. Heinrichs, Wayne State University, USA
Thomas Sharkey, The University of Toledo, USA
Kee-Sook Lim, The University of Toledo, USA

Knowledge, Risk Perception, and Reading Behavior of Expired Label of Food Product

Megawati Simanjuntak, Bogor Agricultural University, Indonesia
Rola Nanda Widuri, Bogor Agricultural University, Indonesia

Wednesday, July 1st | 10:45 to 12:15 | Room 4

[C / I] Finance / Operation Management and Research

Session Chair
James J.H. Liou
National Taipei University of Technology, Taiwan

How Low Control Drives Preferences for High-Effort Products and Services
Jae-Baek Choi, Kyungpook National University, Republic of Korea
Dong-Mo Koo, Kyungpook National University, Republic of Korea

An Exploratory Comparative Analysis of Asian markets: China VS. India
Sooun Lee, Miami University, USA
Sumit Sircar, Miami University, USA

Value Relevance of Financial and Non-Financial Information to Market Performance
Setianingtyas, Sebelas Maret University, Indonesia
Y. AnniAryani, Sebelas Maret University, Indonesia
Rahmawati, Sebelas Maret University, Indonesia

The Empowerment of Waste Utilization Industry Based on Greenpreunership
Intan Novela QA, Sebelas Maret University, Indonesia
Sri Murni, Sebelas Maret University, Indonesia
Sri Wahyu Agustiningsih, Veteran Bangun Nusantara University, Indonesia

Wednesday, July 1st	10:45 to 12:15	Room 6

Junior Academic competition

Session Chair
Jeong-Gil Choi
Kyung Hee University, South Korea

The Moderating Effect of Firm Flexibility and Intangible Resources on the Relationship between Entrepreneurial Orientation and Performance of Korean SMEs

You-Min Choi, Bugil Academy, South Korea

A study on growth of Cooperatives and Income Inequality among related professions: the case of NACF

Minkyom Kim, Korean Minjok Leadership Academy, South Korea

Relationship between the consumer attitude toward the Corporate Public Advertisement and the Corporate Image

Seung Heon Oh, North London Collegiate School Jeju, South Korea

Wednesday, July 1st | 13:30 to 15:00 | Room 3

[G / H] Marketing and Consumer Behaviors / Management and Decision Science

Session Chair
Sung-Hee Sunny Park
University of South Carolina, USA

Ipteks Effect for Export Products, Government Policy, Environmental of Religious Culture Social, Cost Efficiency of Export Performance Craft Wood Furniture in Klaten Central Java Indonesia

Siti Nurlaela, Batik Islamic University, Indonesia
Sholichul Hadi, Batik Islamic University, Indonesia
Muh. Fajar Shodiq, Batik Islamic University, Indonesia
Pramono Hadi, Batik Islamic University, Indonesia

Does a Rainforest Alliance Certified Label Matter? An Investigation on its Influence on the Preferences for Coffee Products and Green Identity of Consumers

Yu-Long Chao, National Kaohsiung First University of Science and Technology, Taiwan

The Entrepreneurial Compentencies of Female-Owned Enterprises

Yolla Margaretha, Maranatha Christian University, Indonesia
Felicia Abednego, Maranatha Christian University, Indonesia

Natural Colour Batik Handicraft in Sragen (A Study to Improve Handicrafter's Welfare)

Anastasia Riani S, Sebelas Maret University, Indonesia
Sarah Rum H. Sebelas Maret University, Indonesia
Rahmawati, Sebelas Maret University, Indonesia
Sri Seventi P, Sebelas Maret University, Indonesia

Wednesday, July 1st | 13:30 to 15:00 | Room 4

[K/L] Strategic and Change Management / Tourism and Hospitality Management

Session Chair
Eun Jin Hwang
Indiana University of Pennsylvania, USA

Readiness of Employees for Organizational Change
Hunik Sri Runing Sawitri, Sebelas Maret University, Indonesia
Salamah Wahyuni, Maret University, Indonesia
Anastasia Riani Suprapti, Maret University, Indonesia
Desy Mayasari, Maret University, Indonesia

Impact of Regulatory Support on Absorptive Capacity
Ahmad Adriansyah, Sebelas Maret University, Indonesia
Surachman Surjaatmadja, Sebelas Maret University, Indonesia

The Study on the Relationship between Product Defects, the Factors of Product Recall and the Procedures of Product Recall
Yu-Hui Cheng, National Kaohsiung Marine University, Taiwan
Ching Yung Chai, National Kaohsiung Marine University, Taiwan

The Relationships among Job Standardization, Social Loafing and Group Cohesion for Employees in the Leisure Farm
Chien-Wen Tsai, Ming-Hsin University of Science and Technology, Taiwan
Wen-Yun Tseng, Ming-Hsin University of Science and Technology, Taiwan

The Effects of Metro System on the Trajectory of Housing Prices

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ABSTRACT

A number of studies have examined the impact of mass rapid transit (MRT) systems on house prices, and the conclusions vary. While prior studies focused on the analysis at an aggregate level, this paper develops multilevel hedonic price model to investigate the effects of MRT lines, particularly the proximity to the train stations and other house/neighborhood-specific characteristics on the longitudinal growth pattern of house prices in Great Taipei on the individual level. Longitudinal data were collected from the database, Real Estate Transaction Price Inquiry System, from the first quarter of 2004 to the second quarter of 2012, when the database was disrupted and switched from a self-assessment to an actual transaction price system. Sample houses are those located within a radius of one kilometer from selected MRT stations. We developed the hierarchical linear model of growth curve to carry out hypothesis tests. The empirical results show that: (1) the growth pattern of housing price over time is significantly upward; (2) the city in which the house is located and the type of building positively moderate such growth trajectory; and (3) the influences of both the distance to MRT on house prices and on the growth pattern of house prices are insignificant.

Keywords: real estate, hedonic price model, mass rapid transit, hierarchical linear model

Introduction

Real estates are durable, immovable properties that are heterogeneous in the space they locate and the surrounding geographic location as well as demographic environments (Case & Mayer, 1996). Each property is characterized by its unique constitute properties. Mass transportation train (MRT) systems are one of the most important attributes of house prices in metropolitan areas that catch the attention of real estate investors, academia, and policy makers (Anderson et al, 2010; Chatman, 2012; Kim & Lahr, 2014). The first MRT line with 24 train stations started operation in Taipei City in 1996. In May 2015, there were seven lines with 108 stations in total, covering most administrative districts in Taipei City and the major districts in New Taipei City.

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During 1998-2015, the Sinyi Housing Price Index, the house price index provided by Sinyi Real Estate, for Taipei Metropolitan, experienced a downward trend from the first quarter of 1998 to the second quarter of 2003 due to the negative impact of the Asian Financial Crisis in 1998 (Chang & Wu, 2002). It followed a price boom thereafter, and reached a peak in the second quarter of 2014 before turning to drop. Socialist groups have been criticizing that the increasing house prices driven by MRT has a negative impact to wealth equality.

Many studies examined how MRT station proximity and house-specific/ neighborhood-specific characteristics influence the price change in Great Taipei. Most of them used a dynamic hedonic price model based on time-series or panel analysis at aggregate level. However, the appreciation rates of housing prices differ depending on the idiosyncratic characteristics of houses (Bourassa et al., 2009). This paper is different from prior research in that it uses the hierarchical linear model of growth curve (GHLM) to formulate the dynamic hedonic price analysis to examine how MRT station proximity and other attributes of housing price affect the change pattern of housing prices at the individual level.

The hedonic price method, which is initialed by on Rosen (1974), is the most common model used to examine the determinants of house prices and to forecast house prices. The traditional hedonic house price models are cross-sectional since variables, including the structural characteristics of the housing unit, are time-invariant. The extended hedonic model, spatial panel model, incorporate spatial (locational and neighborhood-specific) and spatial-temporal characteristics to assess the dynamics of house prices (see Anselin et al., 2004 and LeSage & Pace, 2004 for details). These models examine how a change in macroeconomic variables affects housing prices. Time and space-time lags of the model variables are included in the model to predict the change pattern of house prices over time.

Alternatively, the hierarchical viewpoint suggests that households usually take a hierarchical decision-making process and suggests using a hierarchical linear model (HLM) to account for the inherent hierarchy in determining housing prices (Brown & Uyar, 2004). The covariates at the first level are neighborhood-specific characteristics, while those at the second level are house-specific characteristics. This HLM house model does not predict the long-term path of house prices. Kim & Lahr (2014) used repeat-sales data of properties that sold at least twice to investigate how relative accessibility gains across stations and anticipation of the commencement date of the HBLR station influence home price change. Their model did not examine the effects of house/neighborhood –specific characteristics on the initial stage of house prices and the price change pattern.

This paper proposes a two-level hedonic-price GHLM in which the effects of the time-varying spatiotemporal and socioeconomic variables (covariates at level 1) on the growth pattern of house prices are random and determined by neighborhood-specific and house-specific characteristics (covariates at level 2).

The remainder of the paper is structured as follows: Section 2 presents a brief overview of major findings of prior studies that examined the effects of MRT station proximity on residential property value and proposes hypotheses for testing. Section 3 develops the GHLM research model. Section 4 presents the results of the empirical study. Discussion is also provided.

Literature Reviews and Research Hypothesis

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House Prices Change with Time

Glaeser et al. (2006) examined metropolitan areas and found that the appreciation of house prices is associated with urban growth. This positive association between house price appreciation and urban growth can be explained by two reasons. First, in places where population density is low and the level of zoning or other land use regulations are loose, higher labor demand brings more population to the urban areas and drives increasing demand for houses, which leads to higher house prices. Alternatively, in places where population density is high and the level of land use regulations are restrictive, house supply is inelastic and housing prices are kept high. Second, Gyourko et al. (2006) showed that "superstar cities" in the US have a long-term pattern of appreciation higher than the national average.

Taipei City is not only the capital, but is also the largest financial and commercial center of Taiwan. The population density per square kilometer in Taipei City slightly increased by 2% from 9,713 in 1998 to 9,942 in 2014 while that of New Taipei City, the suburban area surrounding Taipei City, increased by 14% from 1,686 to 1,927. The house price index in the two cities increased 1.7 times from1998 to 2014. In accordance with the findings of prior studies, we give the first hypothesis that house prices in Taipei City and New Taipei City are positively correlated with time (Hypothesis 1a).

In addition, the growth pattern of house prices varies with location. For example, Abraham & Hendershott (1996) presented a significant difference in time series properties between coastal and inland cities. We assume that the growth pattern of house prices in Taipei City and New Taipei City differ (Hypothesis 1b).

Proximity to MRT Stations

A number of studies have tested the effects of proximity to MRT stations on residential property value, and the conclusions vary. Some findings suggested that housing prices are significantly higher near MRT stations than elsewhere, due to convenient access to daily life venues, such as place of employment, shopping, and schools (e.g., Chatman eta al., 2012; Debrezion et al., 2007; Hess, 2007; Lewis-Workman & Brod, 1997). Other studies have indicated a significant price-dumping effect of MRT proximity, due to noise pollution and unattractive views (e.g., Martínez & Viegas, 2009; Simons & Jaouhari, 2004). In contrast to the findings mentioned above, Portnov, et al. (2009) found no significant effect of train station proximity on residential property values. Similarly, Anderson et al. (2010) explored that station proximity of the high-speed railway line in southern Taiwan has at most a minor effect on house prices. Furthermore, Shyr et al. (2013), who examined the transit system and the property value in Hong Kong, Taipei and Kaohsiung, also found that increases in the spatial coverage of transit systems reduces the intraregional variability in overall transit accessibility.

Different from previous studies that examined the effects of train station proximity on the residential property value at aggregate levels, we tested the effects on growth pattern of house prices at individual levels. The decision of buying a house is usually based upon vague expectations for the future (Shiller, 2007). MRT station proximity is the most important characteristic in for-sale advertisement promoted by real estate companies and brokers in Taiwan. People believe that the value of houses near MRT stations will become very valuable in the future, and that may drive the prices up. Therefore, we propose the second hypothesis that

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house prices are negatively related to the distance from the house to the MRT station (Hypothesis 2a). However, the effect of the distance from MRT on the house price is decreasing over time while the MRT network coverage is expanding (Hypothesis 2b).

Other Attributes of House Prices

A number of attributes of house prices including house-specific and neighborhood-specific characteristics as well as macroeconomic variables have been investigated in prior literature. The variables available in the database include: house-specific characteristics, which are the age, size, and the type of the building; spatial attributes, which are frontal road width, land use zoning, and the city in which the house is located; and socioeconomic variables, which are population density, education level, and per capita income. The expected effects of these attributes on house prices are hypothesized in accordance with the findings in previous literature (Hypothesis 3a and 3b).

Hypothesis

The research hypotheses proposed above are summarized as follows:

Hypothesis 1a: House prices are positively related to time.

Hypothesis 1b: The growth patterns of house prices in Taipei City and New Taipei City differ.

Hypothesis 2: House prices are negatively related to the distance from the house to the MRT station.

Hypothesis 2a: The effect of the distance from MRT on the house price is decreasing over time.

Hypothesis 3a: The factors included in the hedonic price model, such as age, size, type of the building, frontal road width, land use zoning, and city in which the house is located, have effects on the house prices at the original state.

Hypothesis 3b: The factors included in the hedonic price model, such as age, size, type of the building, frontal road width, land use zoning, and city in which the house is located, have effects on the growth pattern of house prices.

Method

Model

We use a hierarchical linear model (HLM) of growth curves to analyze the patterns of price change of heterogeneous residential houses over time. First, a one-way analysis of variance is used to confirm that the variability in the house prices is significantly different than zero. An unconstrained null model, which shows only intercepts and error terms at both levels, was used to test whether or not there are any differences on the house prices at the group level, and confirms if hierarchical analysis is necessary. In addition, the intra-class correlation (ICC), which measures the percent of variance in price between groups, was estimated to examine whether the variance between houses is significantly different from zero.

If the criteria of the null model and ICC are met, we then develop a complete HLM model by treating time as nested within the house together with time-varying covariates at level 1. As shown in Equation (1), time is

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used as a Level-1 covariate to examine change over time together with three time-varying covariats. The time-invariant characteristics of the house and environmental attributes are at Level 2 as shown in Equation (2).

Level 1

$$Price_{it} = \pi_{0i} + \pi_{1i}(Time)_{it} + \xi_{1i}(HI)_t + \xi_{2i}(ED)_t + \xi_{3i}(PD)_t + \varepsilon_{it} \quad (1)$$

Level 2

$$\begin{aligned} \pi_{0i} &= \gamma_{00} + \gamma_{01}HA_i + \gamma_{02}TR_i + \gamma_{03}RW_i + \gamma_{04}UK_i + \gamma_{05}LK_i + \gamma_{06}CT_i + \gamma_{07}DT_i + \mu_{0i} \\ \pi_{1i} &= \gamma_{10} + \gamma_{11}HA_i + \gamma_{12}TR_i + \gamma_{13}RW_i + \gamma_{14}UK_i + \gamma_{15}LK_i + \gamma_{16}CT_i + \gamma_{17}DT_i + \mu_{1i} \end{aligned} \quad (2)$$

Combining equations (5) and (6) we receive the mixture model as Equation (3):

$$\begin{aligned} Price_{it} = {} & (\gamma_{00} + \gamma_{01}HA_i + \gamma_{02}TR_i + \gamma_{03}RW_t + \gamma_{04}UK_i + \gamma_{05}LK_i + \gamma_{06}CT_i + \gamma_{07}DT_i) + \\ & (\gamma_{10} + \gamma_{11}HA_i + \gamma_{12}TR_i + \gamma_{13}RW_i + \gamma_{14}UK_i + \gamma_{15}LK_i + \gamma_{16}CT_i + \gamma_{17}DT_i) \times (Time)_{it} + \\ & \xi_{1i}(HI)_t + \xi_{2i}(ED)_t + \xi_{3i}(PD)_t + \mu_{0i} + \mu_{1i}(Time)_{it} + \varepsilon_{it} \end{aligned} \quad (3)$$

whereas, $Price_{it}$ is the price of residential house *i* at time *t*; HA_i, TR_i, RW_i, and UK_i are the house i's characteristics, which are age, size, frontal road width, and the type of the building; LK_i and CT_i are environmental features, which are land use zoning and the city that house i is located in, respectively; HI_t, ED_t, and PD_t are time-variant socioeconomic attributes, which are per capital income, education level, and the population density in the district where house i is located; and *DT* denotes the distance from the house to the MRT station.

The residual errors $\varepsilon_{it} \sim N(0,\sigma^2)$ at Level 1 follow a first-order autoregressive process (AR(1)) while the error terms at Level 2 is

$$\begin{bmatrix} \mu_{0i} \\ \mu_{1i} \end{bmatrix} \sim N\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \tau_{00}\tau_{10} \\ \tau_{10}\tau_{11} \end{bmatrix} \right) \quad (4)$$

whereas, τ_{10} is the unstructured covariance of $\begin{bmatrix} \mu_{0i} \\ \mu_{1i} \end{bmatrix}$.

Data

Longitudinal data were collected from the database, the Real Estate Transaction Price Inquiry System from the first quarter of 2004 to the second quarter of 2012 (when the database was disrupted and switched from self-assessment to actual transaction price system thereafter). Sample houses are those located within a radius of a kilometer from ten selected MRT stations (one in New Taipei City and nine in Taipei City) covering nine administrative districts (one in New Taipei City and eight in Taipei City). There are 5,267 observations in total excluding those with incomplete information. We deleted outliers, which prices are higher (or lower) than the average price plus (or minus) three times the standard deviation, and received 5,079 observations in the database. We then used Google maps to measure the distance from the house to the nearest MRT stations and found the administrative district they belong to and the associated socioeconomic data from the government statistical database.

It is hard to find trading prices of a specific residential house for each of the nine years since houses are normally not traded frequently. We identified repeating measures of house prices by a matching process. That is, for each house that was traded between 2004 to 2006, we matched it, for each year, with a house located

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in a nearby area and with similar characteristics including age, size, type of the building, and the distance from MRT station, to form an object with repeating measures. Following the matching process, we received 69 objects, each of which has seven measures in average. The variables included in the HLM model are described below.

House prices are in 10,000 New Taiwan Dollars (NT$) per ping (a customary unit of measurement in Taiwan which is equivalent to 3.306 square meters) and are deflated by the consumer pricing index announced by the Bureau of Statistics, Executive Yuen. The age (*HA*) of the house was calculated according to the building year and the trading year of the house. The size (*TR*) of the house consists of land and building areas transferred in the transaction. There are several dummy variables, including (1) type of the building (UK): 1-building with elevator, and 0-otherwise; (2) land use zoning (LK): 1-commercial use, and 0-residential use; (3) distance to the MRT station (DT): 1-shorter than 500 meters, and 0-otherwise; and (4) City (CT): 1-Taipei City, and 0-New Taipei City.

The socioeconomic variables, including population density, education level, and per capita income, were collected from the government statistical database. The covariate *Time* consists of nine years from 2004 to 2012, of which 2004 is denoted as base year 1.

Conclusions

Results

The results of the null model (Table 1) show the variance of errors at Level 1 ($\sigma^2 = 261.39$), the variance between groups at Level 2 ($\tau_{00} = 79.48$), and the intragroup coefficient ICC, which presents that 23.3% variance of prices result from the heterogeneity among houses. Furthermore, the average price of all residential properties as a whole for the nine years under study (γ_{00}) was around 42.89 (i.e., NT$428.9 thousand) per ping with a standard error 1.33; the average price in 95% confidence interval was [40.28 45.50]. Alternatively, the average price of individual residential property for the nine years with a 95% confidence interval was $\left[42.89 \pm 1.96 \times \sqrt{79.48}\right] = [25.42\ 60.37]$. There was significant difference among house prices for the nine years under study (p<.001). These results confirmed that the HLM, in which differences among groups are incorporated, is a better fit to the data than the general regression model.

Table 1

Results of the Null Model

Fixed/random effects	Estimate	Standard error
Intercept (γ_{00})	42.892***	1.332
UN(1,1) (τ_{00})	79.476***	20.368
Residual (σ^2)	261.390***	18.080
$-2 \times log\ liklihood$	4135.000	
Null Model Likelihood Ratio Test - Pr > ChiSq	<.0001***	

*** $p < 0.001$

$$\rho = \frac{261.39}{79.48 + 261.39} = 23.3\%$$

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Variance Inflation Factor (VIF) tests identified there is no collinear problem among covariates at either one of the two levels. The convergence criterion of the HLM complete model was also met. The results of the complete model (Table 2) show that random effects are associated with the intercept (π_{0i}) and the slope (π_{1i}) of time at Level 1. That is, there are price differences among houses, confirming the viability of using the HLM model again. In addition, the autoregressive correlation (AR(1)) in the residual error at Level 1 is significant (0.2334***), which is consistent with the pre-assumption of the research model.

Table 2

Results of the Complete Model

Variables		Estimates
CT **Fixed effects**		
π_{0i}	Intercept (γ_{00})	–14.9704**
	Age (*HA*) (γ_{01})	–0.0065
	Size (*TP*) (γ_{02})	0.0334
	Front road width (*RW*) (γ_{03})	0.0871
	Type of building (*UK*) (γ_{04})	–0.9163
	Land use zoning (*LK*) (γ_{05})	0.5289
	City located (CT) (γ_{06})	4.9100†
	Distance to the MRT station (*DT*) (γ_{07})	0.1156
π_{1i}	*Time* (γ_{10})	3.3938
	Time × *HA* (γ_{11})	0.0071
	Time × TP (γ_{12})	–0.0136
	Time × RW (γ_{13})	–0.0241
	Time × UK (γ_{14})	1.0517*
	Time × LK (γ_{15})	–0.1559
	Time × CT (γ_{16})	2.1004***
	Time × DT (γ_{17})	0.3119
HI (ζ_{1i})		0.1102†
ED (ζ_{2i})		0.3442**
PD (ζ_{3i})		–0.0782
Random effects		
UN(1,1) (τ_{00})		0
UN(2,1) (τ_{01})		–0.8229
UN(2,2) (τ_{11})		1.2993
AR(1)		0.2334***
Residual (σ^2)		39.9941
$-2 \times log\ liklihood$		3220.20
Null Model Likelihood Ratio Test - Pr > ChiSq		<.0001***

$^{***}p < .001$; $^{**}p < .01$; $^{*}p < .05$; $^{\dagger}p < .1$。

The fixed effects (π_{0i}) show that at the original state (*time*=0), only the city of the housed significantly affects the house price (4.91†), indicating that the price of the residential properties in Taipei City was NT$49,000 higher than those in New Taipei City on average. The distance from the property to the MRT stations and other characteristics of the properties have insignificant effects on the price of that property at the original state.

The π_{1i} coefficients signify the change pattern of the house prices. The results show that time is positively correlated with the house prices (3.40**). In addition, two factors, the type of the building and the

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city in which the property is located, have a significant effect on the housing price pattern. The price of the buildings with elevators grew faster than those without elevators, specifically by NT$10,517 per ping per year, signifying the residents' preference for occupying modernized buildings. The price of the houses with elevators increased NT$44,455 (=33,938+10,517) per ping per year in real terms. The price of houses located in Taipei City grew NT$54,942 per ping per year, which is higher than those located in New Taipei City by NT$21,004 per ping per year. The different change patterns have enlarged the differences of house prices between the two cities.

The time-varying covariates, both per capita income and the education level, have significant positive effects on the house prices, as expected ($0.11^{\dagger}$ and 0.34^{**}, respectively). The effect of population density on the housing price is insignificant. One possible reason is that the population density in Taipei metropolitan has been high and had little change during the study period. The zoning structure also has an insignificant effect on the house prices. One possible reason for this insignificance is that residential and commercial mixed-use of buildings is common in Taiwan. Many residential buildings have some spaces occupied by commercial activities. The residential and commercial mixed-use narrows the value differentiation of land use zoning (Lin & Ma, 2007). All other characteristics of the houses, including frontal road width, size, and age, also have insignificant impact on the housing price, indicating that house buyers have no specific preference in these factors.

The effect of the distance from the residential house to the MRT station is insignificant either on the original state of house prices or on price changes. One explanation is that nearby MRT network and well-developed bus transportation systems make it convenient for the residents to travel back and forth between their houses and the MRT station. MRT passengers receive a discount if they take buses as the transition tool. Another possible reason is that MRT routes have been expanding over the past decade to cover many administrative districts (Shyr et al., 2013). The total length of MRT routs have expanded from 10 kilometers to around 120 kilometers, and the number of stations increased from 24 stations to 108 stations from 1998 to May 2015. Therefore, distance of MRT networks and the bus system make little difference in these two Taipei cities.

Discussion

The results of the research have implications both to the investors and the policy makers. For the investors, the house prices in Taipei City have been growing at a faster pace, implying a higher return on the investment, than those in New Taipei City for last decade. In addition, the price changes of houses located within 500 meters from MRT stations is not much different than others throughout the cities, but the price of residential buildings with elevators grew faster than those without. This result implies that investing in a condominium far away from an MRT station might receive a higher return than that of an older, smaller apartment near MRT station. As for age, size, land use zoning, and front road width, these are of little importance for investment evaluations. These results signify that the impacts of attributes on house prices vary at different time points and in different areas (Kohlhase, 1991).

For the policy makers, there is no evidence to show that the distance to the MRT station relates to

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appreciation in house price, indicating that the development of MRT routes may not be the most important attribute to increasing house prices, as suggested by socialist groups. Furthermore, close MRT networks may have the effect of diversifying people from downtown to the suburban areas. As Shiller (2007) suggested, "The psychological expectations coordination problem appears to be a major factor in explaining the extreme momentum of home price increases." However, the high growth pattern of housing price over time in the two Taipei cities during the last decade still needs to be discussed. People have long been moving to the urban areas where there are better and more job opportunities and higher quality living. High population density and high zoning levels or other use regulation might lead to higher levels of housing prices (Glaeser et al., 2006). This is an issue related to national spatial planning and is out of the research objectives of this study.

Limitation

The data we use have two constraints. The first constraint is the availability of the database only up to June 2012 so we were not able to examine the continuous price pattern thereafter. The second constraint is that the price of the house is reported by the realty companies rather than being the actual transaction price, which is available only starting in July 2012. This disruption in the type of data makes it difficult to carry out longitudinal analysis from the very beginning of the MRT services in place to date.

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the *World Conference on Business and Management (WCBM) 2015, June 29- July 2*

THE EFFECTS OF MASS RAPID TRANSIT SYSTEM ON THE TRAJECTORY OF HOUSING PRICES IN TAIPEI

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Chihlee Institute of Technology, Taiwan
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National Chiao Tung University, Taiwan

Research Purpose

- This paper develops a multilevel hedonic price model to investigate the effects of proximity to the MRT train stations on the growth pattern of house prices in Great Taipei at individual level.

Introduction

- Real estates are durable, immovable properties, which are heterogeneous in the space they locate and the surrounding geographic as well as demographic environments (Case and Mayer, 1996).
- Each property is characterized by its unique constitute properties, of which MRT system is one of the essential attributes of house prices in metropolitan areas.

Hedonic Price Methods

- Hedonic price method (based on Rosen, 1974) is the most common model used to examine the determinants of house prices and to make price forecasting.
  - **Hedonic price method** was cross-sectional since most house related attributes are fixed.
  - The **extended hedonic model**, spatial panel model, incorporates spatial (locational and neighborhood-specific) and spatial-temporal characteristics to assess the dynamics of house prices (see Anselin et al., 2004 and LeSage & Pace, 2004 for details).

Hierarchical Hedonic Price Model

- Hierarchical viewpoint emphasized a hierarchical decision-making process of households and suggests using a hierarchical linear model (HLM) to account for the inherent hierarchy in determining housing prices (Brown & Uyar, 2004).
- Kim & Lahr (2014) used repeat-sales data of properties that sold at least twice to investigate how relative accessibility gains across stations and anticipation of the commencement date of the HBLR station influence home price change.

Hierarchical Hedonic Price Model

- This paper proposes a two-level hedonic-price HLM of growth.
- It suggests that the effects of the time-varying spatiotemporal and socioeconomic variables (covariates at level 1) on the growth pattern of house prices are random and determined by neighborhood-specific and house-specific characteristics (covariates at level 2).

Literature Review: House Price and Urban Growth

- positive association between house price appreciation and urban growth
  - Glaeser et al. (2006)
    - In places where population density is low and the level of land zoning are loose: higher labor demand brings more population to the urban areas and drives increasing demand for houses, which leads to higher house prices
    - in places where population density is high and the level of land use regulations are restrictive, house supply is inelastic and housing prices are kept high.

Literature Review: House Price and Urban Growth

- Gyourko et al. (2006):
  "superstar cities" in the US have a long-term pattern of appreciation higher than the national average.
- Abraham & Hendershott, (1996): The growth pattern of house prices varies with location.

Literature Review: House Price and the Proximity to MRT Stations

- **Positive effects** due to convenient access to daily life such as the place of employment, shopping, and schools (Chatman eta al., 2012; Debrezion et al., 2007; Hess, 2007; Lewis-Workman & Brod, 1997)
- **Negative effects** due to noise pollution and unattractive views (e.g., Martínez & Viegas, 2009; Simons & Jaouhari, 2004).

House Price and the Proximity to MRT Stations

- Station proximity of the high-speed railway line in southern Taiwan has at most a minor effect on house prices (Anderson et al., 2010).
- Increases in the spatial coverage of transit systems reduces the intraregional variability in overall transit accessibility (Shyr et al., 2013).

House Price and the Proximity to MRT Stations

- In Taiwan, MRT station proximity is the most important characteristic in for-sale advertisement promoted by real estate companies and brokers.
- People believe that the value of houses near MRT stations will become very valuable in the future, and that may drive the prices up.

Other Attributes of House Prices

- Other attributes of house prices:
  - house-specific characteristics: age, size, and the type of the building;
  - spatial attributes: frontal road width, land use zoning, and the city in which the house is located;
  - socioeconomic variables: population density, education level, and per capita income.
-

Hypothesis

- **H_{1a}:** House prices in Taipei City and New Taipei City are positively correlated with time
- **H_{1b}**: The growth pattern of house prices in Taipei City is higher than that of the New Taipei City

- **H_{2a}**: House prices are negatively related to the distance from the house to the MRT station.
- **H_{2b}**: The effect of the distance from MRT on the house price is decreasing over time while the MRT network coverage is expanding.

Hypothesis

- **H_{3a}:** The factors included in the hedonic price model, such as age, size, type of the building, frontal road width, land use zoning, and city in which the house is located, have effects on the house prices at the original state.
- **H_{3b}:** The factors included in the hedonic price model, such as age, size, type of the building, frontal road width, land use zoning, and city in which the house is located, have effects on the growth pattern of house prices.

Hierarchical Linear Model of Hedonic House Price

Level 1

$$Price_{it} = p_{0i} + p_{1i}(Time)_{it} + x_{1i}(HI)_t + x_{2i}(ED)_t + x_{3i}(PD)_t + e_{it}$$

Level 2

$$p_{0i} = g_{00} + g_{01}HA_i + g_{02}TR_i + g_{03}RW_i + g_{04}UK_i + g_{05}LK_i + g_{06}CT_i + g_{07}DT_i + m_{0i}$$
$$p_{1i} = g_{10} + g_{11}HA_i + g_{12}TR_i + g_{13}RW_i + g_{14}UK_i + g_{15}LK_i + g_{16}CT_i + g_{17}DT_i + m_{1i}$$

Combined model

$$Price_{it} = (g_{00} + g_{01}HA_i + g_{02}TR_i + g_{03}RW_i + g_{04}UK_i + g_{05}LK_i + g_{06}CT_i + g_{07}DT_i) + (g_{10} + g_{11}HA_i + g_{12}TR_i + g_{13}RW_i + g_{14}UK_i + g_{15}LK_i + g_{16}CT_i + g_{17}DT_i)(Time)_{it} + x_{1i}(HI)_t + x_{2i}(ED)_t + x_{3i}(PD)_t + m_{0i} + m_{1i}(Time)_{it} + e_{it}$$

Taipei MRT System and House Price

- The first MRT line in Taipei City started operation in 1996. In 2015, there were seven lines with 108 stations, covering most administrative districts in Taipei.
- House price in Taipei:
  - a downward trend from 1998 to the second quarter of 2003 due to the negative impact of Asian Financial Crisis in 1998 (Chang and Wu, 2002)
  - a price boom thereafter, and reached the peak in the second quarter of 2014 before turning to drop.

Data

- Longitudinal data were collected from the database, the Real Estate Transaction Price Inquiry System from the first quarter of 2004 to the second quarter of 2012 (when the database was transferred from self-reported prices to actual transaction prices).
- Houses that are located within a radius of a kilometer from ten selected MRT stations (one in New Taipei City and nine in Taipei City) covering nine administrative districts.
- Received 5,267 observations in total excluding those with incomplete information.

Results: the null model

Results of the Null Model

Fixed/random effects	Estimate	Standard error
Intercept (γ_{00})	42.892***	1.332
UN(1,1) (τ_{00})	79.476***	20.368
Residual (σ^2)	261.390***	18.080
$-2\times log\ likliihood$	4135.000	
Null Model Likelihood Ratio Test - Pr > ChiSq	<.0001***	

*** $p < 0.001$

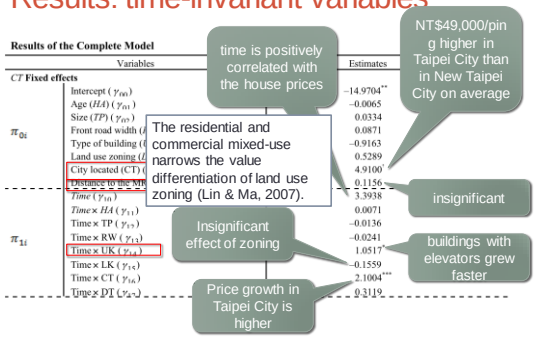
the variance of errors at Level 2

the variance of errors at Level 1

significant difference among house prices for the nine years

HLM, in which differences among groups are incorporated, is a better fit to the data than the general regression model

Results: time-invariant variables



Results: time-varying variables

Positive effects of per capita income and the education level

HI (ζ_{1i})	0.1102*
ED (ζ_{2i})	0.3442**
PD (ζ_{3i})	−0.0782
Random effects	
UN(1,1) (τ_{00})	0
UN(2,1) (τ_{01})	−0.8229
UN(2,2) (τ_{11})	1.2993
AR(1)	0.2334***
Residual (σ^2)	39.9941
$-2 \times log\ liklihood$	3220.20
Null Model Likelihood Ratio Test - Pr > ChiSq	<.0001***

Proximity of MRT station is insignificant

- either on the original state of house prices or on price changes.
  - nearby MRT network and well-developed bus transportation systems back and forth between their houses and the MRT station
  - MRT passengers receive a discount if they take buses as the transition tool.
  - MRT routes have been expanding over the past decade to cover many administrative districts (Shyr et al., 2013). Distance of MRT networks and the bus system make little difference in these two Taipei cities.

Conclusions

- **H_{1a}:** House prices in Taipei City and New Taipei City are positively correlated with time Supported
- **H_{1b}**: The growth pattern of house prices in Taipei City is higher than that of the New Taipei City differ Supported
- **H_{2a}**: House prices are negatively related to the distance from the house to the MRT station. Not supported
- **H_{2b}**: The effect of the distance from MRT on the house price is decreasing over time while the MRT network coverage is expanding. Not supported

Conclusions

- **H_{3a}:** The factors included in the hedonic price model, such as age, size, type of the building, frontal road width, land use zoning, and city in which the house is located, have effects on the house prices at the original state.
- **H_{3b}:** The factors included in the hedonic price model, such as age, size, type of the building, frontal road width, land use zoning, and city in which the house is located, have effects on the growth pattern of house prices.

Partially supported

Conclusions

- There is no evidence to show that the distance to the MRT station relates to appreciation in house price, indicating that the development of MRT routes may not be the most important attribute to increasing house prices in Taipei.
- High population density and urban growth might lead to higher levels of housing prices (Glaeser et al., 2006).

Research Constraints

- The availability of the database only up to June 2012 because of database transformation
- The price of the house is reported by the realty companies rather than being the actual transaction price, which is available only starting in July 2012.

The effects of MRT Station on the Trajectory of Housing Prices

Acknowledgement

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Thank you for listening.

科技部補助計畫衍生研發成果推廣資料表

日期:2015/08/16

科技部補助計畫	計畫名稱: 邁向一般競爭異質性理論－運用潛在群組成長模式與混合成長模型
	計畫主持人: 劉芬美
	計畫編號: 103-2410-H-263-009- 學門領域: 策略管理

無研發成果推廣資料

103 年度專題研究計畫研究成果彙整表

計畫主持人：劉芬美	計畫編號：103-2410-H-263-009-
計畫名稱：邁向一般競爭異質性理論－運用潛在群組成長模式與混合成長模型	

成果項目			量化			單位	備註（質化說明：如數個計畫共同成果、成果列為該期刊之封面故事...等）
			實際已達成數（被接受或已發表）	預期總達成數(含實際已達成數)	本計畫實際貢獻百分比		
國內	論文著作	期刊論文	0	0	100%	篇	
		研究報告/技術報告	1	1	100%		
		研討會論文	1	1	100%		
		專書	0	0	100%		
	專利	申請中件數	0	0	100%	件	
		已獲得件數	0	0	100%		
	技術移轉	件數	0	0	100%	件	
		權利金	0	0	100%	千元	
	參與計畫人力（本國籍）	碩士生	2	2	100%	人次	
		博士生	0	0	100%		
		博士後研究員	0	0	100%		
		專任助理	0	0	100%		
國外	論文著作	期刊論文	0	0	100%	篇	
		研究報告/技術報告	0	0	100%		
		研討會論文	1	1	100%		
		專書	0	0	100%	章/本	
	專利	申請中件數	0	0	100%	件	
		已獲得件數	0	0	100%		
	技術移轉	件數	0	0	100%	件	
		權利金	0	0	100%	千元	
	參與計畫人力（外國籍）	碩士生	0	0	100%	人次	
		博士生	0	0	100%		
		博士後研究員	0	0	100%		
		專任助理	0	0	100%		

其他成果 (無法以量化表達之成果如辦理學術活動、獲得獎項、重要國際合作、研究成果國際影響力及其他協助產業技術發展之具體效益事項等，請以文字敘述填列。)	無

	成果項目	量化	名稱或內容性質簡述
科教處計畫加填項目	測驗工具(含質性與量性)	0	
	課程/模組	0	
	電腦及網路系統或工具	0	
	教材	0	
	舉辦之活動/競賽	0	
	研討會/工作坊	0	
	電子報、網站	0	
	計畫成果推廣之參與（閱聽）人數	0	

科技部補助專題研究計畫成果報告自評表

請就研究內容與原計畫相符程度、達成預期目標情況、研究成果之學術或應用價值（簡要敘述成果所代表之意義、價值、影響或進一步發展之可能性）、是否適合在學術期刊發表或申請專利、主要發現或其他有關價值等，作一綜合評估。

1. 請就研究內容與原計畫相符程度、達成預期目標情況作一綜合評估

■達成目標

□未達成目標（請說明，以 100 字為限）

□實驗失敗

□因故實驗中斷

□其他原因

說明：

2. 研究成果在學術期刊發表或申請專利等情形：

論文：□已發表 ■未發表之文稿 □撰寫中 □無

專利：□已獲得 □申請中 ■無

技轉：□已技轉 □洽談中 ■無

其他：（以 100 字為限）

3. 請依學術成就、技術創新、社會影響等方面，評估研究成果之學術或應用價值（簡要敘述成果所代表之意義、價值、影響或進一步發展之可能性）（以 500 字為限）

本研究計畫首次將時間序列潛在群組分析法用於策略管理領域，在潛在因素未知的限制下，成功找出達到長期較優績效的廠商。未來可以分群結果為基礎，分析績效較優的潛在因素。