A Note from the Editor's Board

The YMC Management Review has been published forfive volumes so far. And theiFAIR conference has been changed to a new title as the Annual International Conference on Finance, Accounting, Investment, Risk Management and Management Science (the iFAIRS Conference) since 2012. We held a video iFAIRS conference between Los Angeles USA and Pingtung TAIWAN on 15 August 2012.

The YMC Management Review publishes two numbers each year. The first number publishes the cooperationof holding the iFAIRS conference. The secondnumber, discussed mainly in Mandarin, publishes topics about practical management. The editor's board welcomes all articles that are ready for submission,regarding thepractical managementdiscussions or management cases. Furthermore, we hope the YMC Management Review could be included as a member of the Social Science Citation Index (SSCI) in the near future.

I am pleased to announce that this number of the YMC Management Review contains eight papers which is the most plentiful number of English issue of YMCMR.*Biases in the Calculation and Use of Cohort Life Tables* discusssome biases in calculation in cohort life table. *Exploring the Antecedents of Business Performance*and*A Study of International Business Theory Development*discuss some development strategy in mid-small and international business separately. *Can Corporate Governance Activate R&D*discusses governance issue on R&D department.*Market Value in the Context of the Residual Income Valuation Model*discussesa valuation model for residual income. *The Research of Influential Factors of High Vacancies in Taiwanese Residential Industry*discusses anirrationalphenomenon in Taiwan's residential industry. *A Study of Applying FMEA in Preventive Maintenance Program Developing*discusses an application of FMEA in maintenance program. *A Measure of Service Quality for Taxi Company in Hanoi*discussessome determinants about service quality in Vietnam.Every paper is worth reading.

Once again, we invite you to submit your paper to the YMC Management Review any time, and we hope to meet you in the iFAIRS conference every year in the future.

Contents

Biases in the calculation and use of cohort life tables

Emilio Venezian
Professor Emeritus
Rutgers, The State University of New Jersey

ABSTRACT

Mortality tables, whether period or cohort, are the basic starting point for forecasting mortality and longevity. This paper explores the way in which standard methods of computing cohort life tables might distort reality by presenting some simple models of the relationship between age and cohort mortality. The results show that substantial distortions occur even in infinite populations with no migration because some of the assumptions are valid only in the limit of zero mortality. In some cases, a simple correction can be applied to the usual result to obtain a much better approximation to the underlying mortality schedule. The analysis also suggests that the habit of using the mid-point of the age range as representative of the age of a group will distort the relations at high ages and mortalities, therefore leading to a confounding of cohort effects and secular time effects in studies that attempt to explain or predict changes in mortality based on these factors.

Key Words: *Bias, Cohort, Life Table, Longevity, Mortality.*

1. Introduction

Forecasting mortality and longevity requires a long, consistent set of data as a starting point. The usual starting point is a either a period or a cohort life table that is derived from data on vital statistics. The data used in the construction of life tables is primarily data on population, births, and deaths. In recent years, with declining costs of data entry and storage, the data sometimes include the exact date of birth and death and in some cases the date of migration; that makes it easy to compute the person-years at risk in any triangle of the Lexis array, an array that represents the person-years lived by any cohort in any calendar period,[1] and hence permit calculation of the force of mortality in any given age. In the more distant past the collection and storage of such data was not feasible, so we typically use methods of approximating the force of

[1] Wilmoth et al., 2007 give a good description of the Lexis diagram.

mortality from the number of deaths and the population at mid-interval or the average of the populations at the beginning and end of the period.[2] Procedures for estimating the Lexis arrays from older data are often used as an intermediate step when using data that lacks the level of detail.

In theory, cohort rates, which describe how the mortality of people born in a given interval as a function of age, are more fundamental than period mortality rates, which describe the mortality of people alive at the beginning of a given calendar period. The theoretical advantage arises because insurance and annuities are sold on the basis of the year of birth and because census information at any time does include the year of birth (either directly or as the difference between the time of the census and the age of the individual). In practice, however, period life tables are used more often, probably because the use of cohort life tables require extrapolation over much longer periods of time than period life tables. The trade-off between errors in forecasting from the less relevant period tables over short time spans and from the more relevant cohort tables over long time spans are a matter for empirical analysis. This is complicated by the fact that consistent sets of cohort and period life tables are not easy to obtain.[3]

Much recent work has been devoted to the development of models in which both cohort effects and secular time effect are taken into account.[4] Refinements have also been proposed to take into account that populations are not homogeneous so that if genetics affect mortality then the genetic composition of the population changes over time and with age.[5] Most of these studies basically depart from computed life tables, rather than from the basic data.

The purpose of this paper is to point out that the generally available life tables have potentially serious biases that are built in by the assumptions made in their computation.[6] These biases are correlated with the level of mortality and are generally more severe at higher mortalities. This leads to distortions of time trends and may interfere significantly in studies designed to ―explain" or ―predict" mortality. I concentrate on cohort mortality, mostly because a comparison of the use of cohort and period mortality in the forecasting longevity suggests that errors due to lengthy

[2] The period is typically determined by the size of the population. For very large populations it is typically a year, for smaller populations tables are usually constructed base on three or five year periods. In the first year of life mortality changes markedly, with the first month accounting for roughly 80 percent of the deaths for the whole year; to get reliable estimates in intervals of two or three months of age it is usually necessary to use 10 years of data.

[3] See, for example, Venezian, 2011.

[4] See, for example, Lee, 2000, Pitacco *et al.* 2009, Haberman and Renshaw, 2011.

[5] See, for example, Vaupel, 1979, Manton *et al*., 1981.

[6] I base my characterization of standard methods largely on two sources: Wilmoth et al., 2007and Bowers *et al*., 1986.

extrapolation from cohort data are, on average, smaller than those due to biases of period data (Venezian 2011).

The major source of the distortion arises from the use of the population at mid-period as an estimator of the person years of exposure.[7] The person-years of exposure are determined mostly by immigration, emigration, and mortality. As long as we may assume that these processes are adding or removing people at a constant rate, this may be a reasonable working assumption.[8] But the approximate constancy of the removals by death can hold only at low levels of mortality or if mortality rises at the same rate as population declines. A second source of distortion arises if the results of the life table are used for statistical analysis under the assumption that the midpoint of an age range is representative of the group at different times. These conditions are not necessarily met in practice so it becomes important to determine how the assumption affects the results.

The existence of these problems can be illustrated quite well in a model of a closed population with age-independent mortality. Section 2 deals with some simple models of which constant mortality, independent of time and age, is the simplest. These illustrate analytically that problems exist when life tables are calculated using what appear to be traditional algorithms. Section 3 shows that in a more realistic model, with mortality generally decreasing from birth to 14 years and then increasing; that model does not provide closed solutions, so computations are used to illustrate the effects. Section 4 outlines some possible methods to make the cohort life tables correspond more closely to reality.

2. The simplest models

2.1 Constant mortality

Suppose that we had a population for which mortality is independent of age and that has is stationary birth rate so that the number of babies born between t and $t + dt$ is $\dot{N}dt$. Assume that there is no migration in or out of this population, the only entries being by birth and the only exits by death. The death rate[9] at age a is denoted by $\mu(a)$, so that if we denote the population born at time t, dt and alive at time $t + \tau$ by the symbol $\dot{N}(\tau)dt$ we have:

$$\frac{d\dot{N}(\tau)}{d\tau} = -\mu\dot{N}(\tau)$$

[7] See, for example, Bowers *et al*., 1986, Chiang, 1972.

[8] The counterargument is that people emigrating may, on average, have better health status than those not emigrating and that people immigrating may have mortality characteristics closer to those of the population from which they emigrated than those of the resident population.

[9] Throughout I will use "death rate" and "mortality" to denote what actuaries call the "force of mortality.

From this it is straight forward to find:

$$\dot{N}(\tau)dt = \dot{N}dte^{-\mu\tau}$$

I will refer to the group of people born a given period of length T, starting at time t, as the ~~"t~~ cohort." The time $t + kT$, at which the oldest member of the cohort would have attained k periods of life will be referred to as ~~"t~~he k^{th} epoch" of the cohort or as ~~"e~~poch k".

The total number of births in the cohort will have been:

$$N_T(t) = \int_{\tau=t}^{t+T} \dot{N}\, d\tau = T\dot{N}$$

Of the people born at time $t \leq t_1 \leq t + T$, the ones still alive at epoch k will be

$$\dot{N}(\, t + T|t_1)dt_1 = \dot{N}Tdt_1e^{-\mu(kT-t_1)}$$

The total number of people born between t and $t + T$ who will be alive at epoch k will be:

$$N_{kT+1}(t) = \int_{t_1=0}^{T} \dot{N}Te^{-\mu(kT-t_1)}dt_1 = \dot{N}Te^{-\mu kT} \int_{t_1=0}^{T} e^{\mu t_1}dt_1 = \dot{N}Te^{-\mu kT}\frac{e^{\mu T}-1}{\mu}$$

The age distribution for the surviving members of the cohort at epoch k will be between $(k-1)T$ and kT. The ratio of those born at t_1 and surviving to the end of the period to the total number surviving at the end of the period is:

$$f(\theta|T) = \frac{\dot{N}Te^{-\mu(kT-t_1)}}{N_{kT+1}(t)} = \frac{\mu e^{\mu\theta}}{e^{\mu T}-1}$$

for $0 \leq \theta \equiv (k-1)T - t_1 \leq T$, and zero outside of this range. Note that this is an increasing function of both μ for all values of θ and an increasing value of θ for all $\mu > 0$. In spite of this protocols usually assume that the distribution of ages for any cohort is uniform at every age.[10]

Figure 1 shows the shape of the curve at various levels of annual mortality.

[10] It is worth noting, moreover, that for small values of μ the function is approximately linear, $f(\theta|T) \approx (1+\mu\theta)/(1+\mu\theta/2)T$, but at values above 0.5 it becomes increasingly convex.

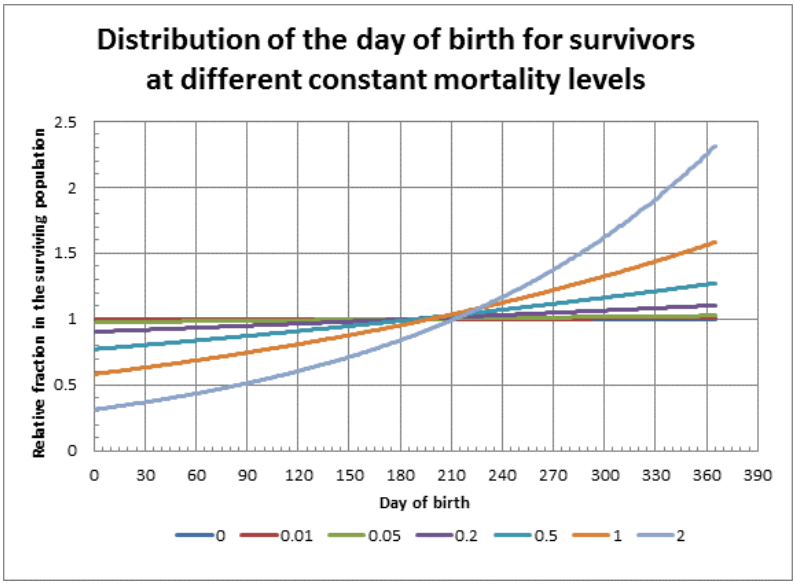


Figure 1. Distribution of the day of birth of survivors at any epoch greater than zero

For most purposes we could assume that if mortality is constant then

$$f(\theta|T) \approx \frac{1+\mu\theta+\frac{(\mu\theta)^2}{2!}+\frac{(\mu\theta)^3}{3!}}{T\left(1+\frac{\mu T}{2!}+\frac{(\mu T)^2}{3!}\right)}$$

At the time kT we have

$$\dot{N}(t+kT|t_1)dt = \dot{N}dt_1 e^{-\mu(kT-t_1)}$$

Hence

$$f(\theta|kT) = \frac{\dot{N}e^{-\mu(kT-t_1)}}{\dot{N}e^{-\mu kT}\int_t^{t+T} e^{\mu t_1}dt_1} = \frac{\mu e^{\mu t_1}}{e^{\mu(t+T)}-e^{\mu t}} = \frac{\mu e^{\mu\theta}}{e^{\mu T}-1} = f(\theta|T)$$

so for constant mortality the age distribution of the survivors does not vary with age.

Note that the average age of the survivors to epoch k is

$$A(kT) = kT + \int_0^T (T-\theta)\frac{\mu e^{\mu\theta}}{e^{\mu T}-1}d\theta = (k+1)T - \frac{\mu T e^{\mu T}-(e^{\mu T}-1)}{\mu(e^{\mu T}-1)}$$

This goes to the limit $kT + T/2$ when mortality is zero and for small mortalities can be approximated by

$$A(kT) = kT + \frac{T}{2}\left(1 - \frac{1}{6}\mu^2\right)$$

Figure 2 shows the effect of mortality on the difference between the mid-range in years and the average age of the survivors exposed to that mortality.

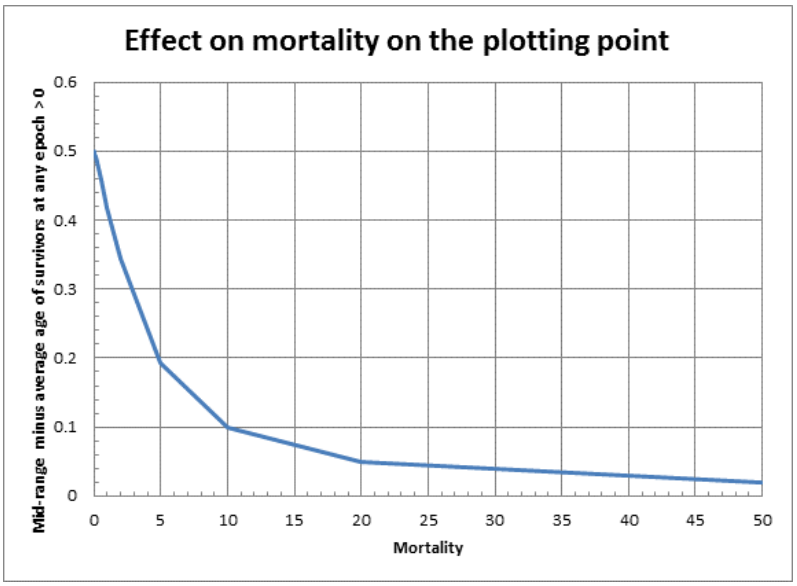


Figure 2. Effect of mortality on the plotting point

The total number of deaths between epochs k and $k+1$, is

$$D(k) = N_{kT+1}(t) - N_{(k+1)T+1}(t) = \dot{N}T\frac{e^{\mu T} - 1}{\mu}e^{-\mu kT}(1 - e^{-\mu T})$$

The mortality in cohort life tables is usually computed by dividing this number by the exposures estimated as the initial number minus one-half of the number of deaths. That is:

$$\hat{\mu}T = \frac{\dot{N}T\frac{e^{\mu T} - 1}{\mu}e^{-\mu kT}(1 - e^{-\mu T})}{\dot{N}Te^{-\mu kT}\frac{e^{\mu T} - 1}{\mu} - \frac{1}{2}\dot{N}T\frac{e^{\mu T} - 1}{\mu}e^{-\mu kT}(1 - e^{-\mu T})} = \frac{1 - e^{-\mu T}}{1 - \frac{1}{2}(1 - e^{-\mu T})}$$

$$= 2\frac{1 - e^{-\mu T}}{1 + e^{-\mu T}}$$

It is not difficult to see that

$$\lim_{\mu \to 0} \hat{\mu} = \mu$$

And

$$\lim_{\mu \to \infty} \hat{\mu} = 2$$

Further,

$$\frac{d\hat{\mu}}{d\mu} = \frac{8Te^{-\mu T}}{(1+e^{-\mu T})^2} > 0$$

So the estimate is always downward-biased and the bias increases monotonically as the mortality increases. It is a forgone conclusion that as mortality is high there will be ~~-m~~ortality compression." When $\mu T = 1$ the bias amounts to about 7.6 percent, when $\mu T = 2$ it is 23.8 percent.

It may be worth remembering that

$$\tanh(x) = \frac{e^{2x}-1}{e^{2x}+1}$$

So that for constant mortality we have:

$$\hat{\mu}T = 2\frac{1-e^{-\mu T}}{1+e^{-\mu T}} = -2\tanh\left(-\frac{\mu T}{2}\right)$$

So we could compute a second estimate:

$$\mu = -\frac{2}{T}\operatorname{atanh}\left(\frac{\hat{\mu}T}{2}\right)$$

This provides a simple way to adjust the estimated mortality for the fact that it is, in fact, not zero. We will see that under some circumstances this works reasonably well even if the underlying model is not one of constant mortality.

2.2 Linear mortality

Suppose now that we have a mortality increasing linearly with age, that is:

$$\frac{d\dot{N}(\tau)}{d\tau} = -(\mu_0 + \alpha\tau)\dot{N}(\tau)$$

So that:

$$\dot{N}(\tau)dt = \dot{N}dte^{-\int_0^{\tau}(\mu_0+\alpha\tau)d\tau} = \dot{N}dte^{-\left(\mu_0\tau+\frac{\alpha\tau^2}{2}\right)}$$

We still have

$$N_T(t) = \int_{\tau=t}^{t+T} \dot{N}\, d\tau = T\dot{N}$$

But now

$$N_{kT+1}(t) = \dot{N}T \int_{t_1=0}^{T} e^{-\left(\mu_0(kT-t_1)+\frac{\alpha(kT-t_1)^2}{2}\right)}dt_1$$

After some tedious algebra we have

$$\mu_0(kT-t_1)+\frac{\alpha(kT-t_1)^2}{2} = \frac{-\left(\frac{\mu_0}{\sqrt{\alpha}}\right)^2+\left(\frac{\mu_0+\alpha kT}{\sqrt{\alpha}}-t_1\sqrt{\alpha}\right)^2}{2}$$

This leads to

$$N_{kT+1}(t) = \dot{N}T \int_{t_1=0}^{T} e^{-\left(\mu_0(kT-t_1)+\frac{\alpha(kT-t_1)^2}{2}\right)}dt_1 = \dot{N}T \int_{t_1=0}^{T} e^{\frac{\left(\frac{\mu_0}{\sqrt{\alpha}}\right)^2-\left(\frac{\mu_0+\alpha kT}{\sqrt{\alpha}}-t_1\sqrt{\alpha}\right)^2}{2}}dt_1$$
$$= \dot{N}Te^{\frac{\mu_0^2}{\alpha}}\left(\int_{t_1=0}^{T} e^{-\frac{\left(\frac{\mu_0+\alpha kT}{\sqrt{\alpha}}-t_1\sqrt{\alpha}\right)^2}{2}}dt_1\right)$$

If we now define $u_1 \equiv \frac{\mu_0+\alpha kT}{\sqrt{\alpha}} - t_1\sqrt{\alpha}$ we have $du_1 = -dt_1\sqrt{\alpha}$, so that:

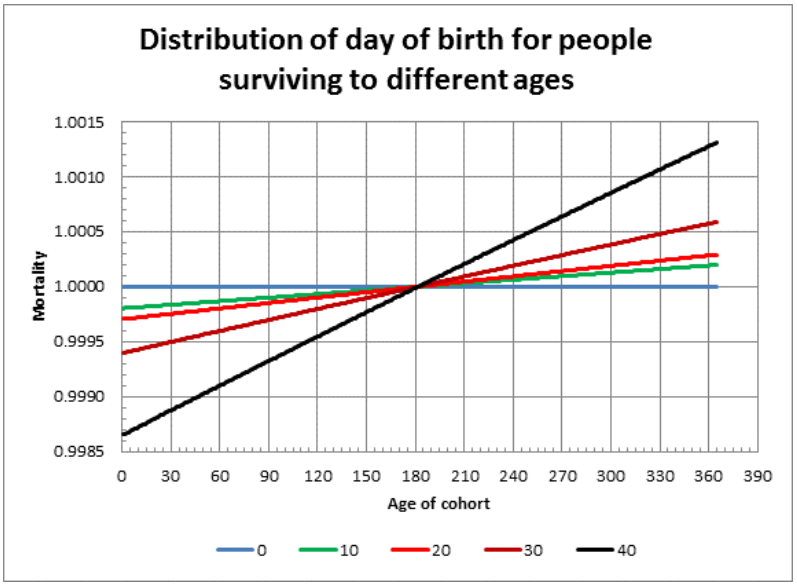
$$N_{kT+1}(t) = \left(\frac{2\pi}{\alpha}\right)^{1/2} \dot{N}Te^{\frac{\mu_0^2}{\alpha}} \left((2\pi)^{-1/2} \int_{u_1=\frac{\mu_0+\alpha(k-1)T}{\sqrt{\alpha}}}^{\frac{\mu_0+\alpha kT}{\sqrt{\alpha}}} e^{-u_1^2} dt_1 \right)$$

$$= \left(\frac{2\pi}{\alpha}\right)^{1/2} \dot{N}Te^{\frac{\mu_0^2}{\alpha}} \left(\Phi\left(\frac{\mu_0 + \alpha kT}{\sqrt{\alpha}}\right) - \Phi\left(\frac{\mu_0 + \alpha(k-1)T}{\sqrt{\alpha}}\right) \right)$$

This is the case of linear mortality we have:

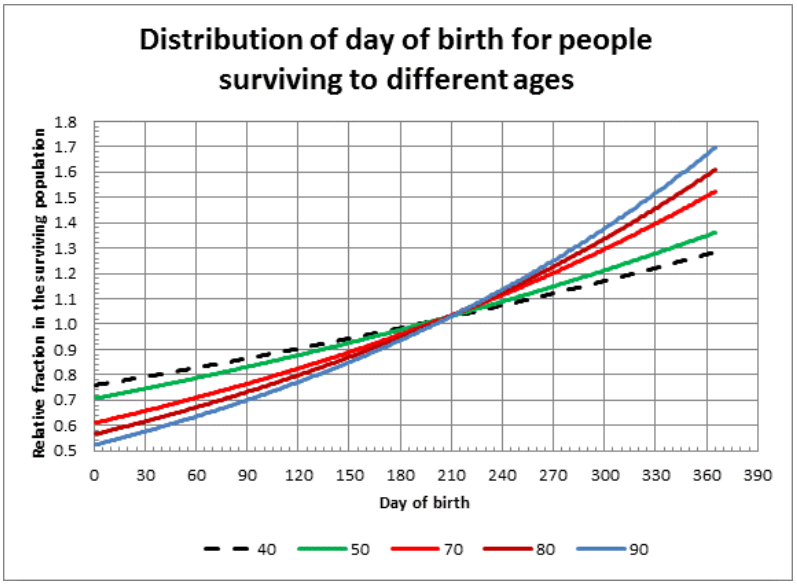
$$f(\theta|T) = \frac{\dot{N}Te^{-\mu(kT-t_1)}}{N_{kT+1}(t)} = \frac{\dot{N}Te^{-\mu(kT-t_1)}}{\left(\frac{2\pi}{\alpha}\right)^{1/2} \dot{N}Te^{\frac{\mu_0^2}{\alpha}} \left(\Phi\left(\frac{\mu_0+\alpha kT}{\sqrt{\alpha}}\right) - \Phi\left(\frac{\mu_0+\alpha(k-1)T}{\sqrt{\alpha}}\right) \right)}.$$

Thus the distribution of ages within a cohort depends on both the epoch and the mortality, as shown in the two panels of Figure 3.[11]



Panel A

[11] Even if the distribution day of the days of birth were constant, however, the distribution of the age at death would not be the same because in this case mortality is increasing with age.



Panel B

Figure 3. Fraction of survivors of different days of birth as a function of age with a linear mortality schedule

Even if the distribution day of the days of birth were constant, however, the distribution of the age at death would not be the same because in this case mortality is increasing with age.
Figure 4 shows the mortality results.

The line for the model represents the assumed linear mortality. From this mortality data the number of survivors at each epoch was computed. The difference in the number of survivors represents the number of deaths in the cohort over the interval. The usual approximation that would appear in a mortality table was computed by dividing the number of deaths in the cohort in a given epoch by the assumed exposure, represented as the number alive at the beginning of the epoch minus one-half of the deaths. The usual approximation underestimates the mortality at high ages. The adjusted mortality, using the inverse hyperbolic tangent equation appropriate for mortality computed in the first approximation, assumed constant over the interval. It does very well at correcting for the estimation error.

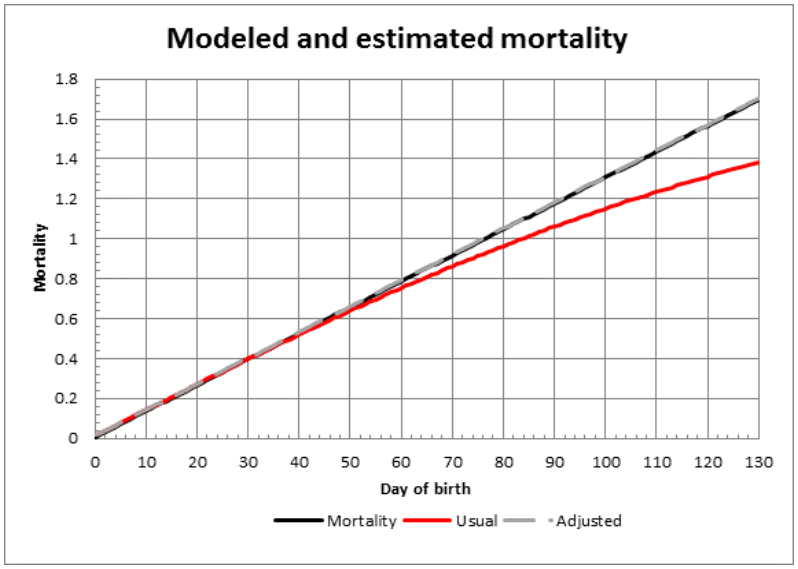


Figure 5. Estimates of cohort mortality for a linear underlying model.

The dependence of $f(\theta)$ on both μ and k brings with it a new issue. The average age of the people in a cohort at advanced ages will differ substantially from the mid-point of the age group. In the case of constant mortality, the difference is independent of age, so the main result is that the mortality table viewed as applying at the mid-point of the age range should be shifted slightly. This poses no great problem if we are analyzing a single cohort table but may become important if we are looking at changes from one cohort to another since the shift will depend on the mortality rate that applies to each cohort. Cohort effects thus become confounded with improper calculation of the mortality. The distortion is shown in Figure 6; the effect is modest in the example used.

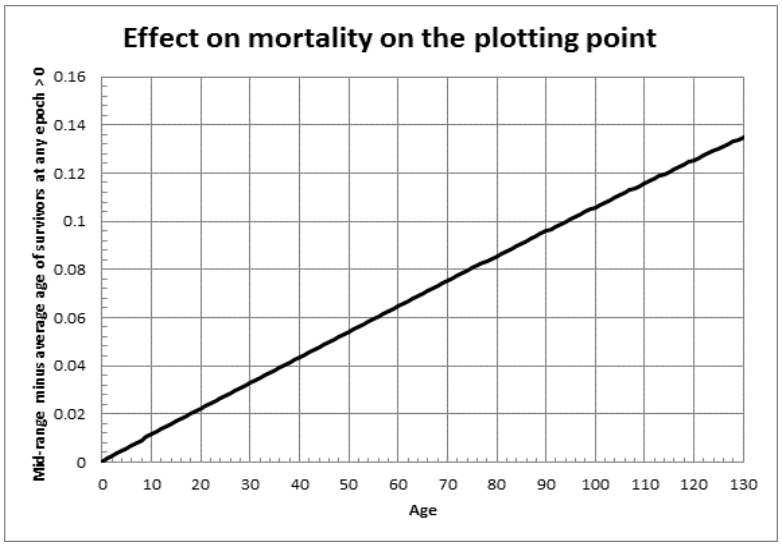


Figure 6. Distortion on the plotting point as a function of age for a linear mortality schedule.

3. A fairly general model

A fairly general model A fairly good representation of human mortality as a function of age is:[12] $\mu(\tau) = a_c(\tau + \delta_c)^{b_c} + a_m e^{b_m \tau}$
In this formulation the component $a_c(\tau + \delta_c)^{b_c}$ represents perinatal and childhood mortality[13] and the component $a_m e^{b_m \tau}$ represents mature mortality. A third component, representing mortality from accidents, suicides, and homicides is sometimes added.

With this representation we have:

$$\dot{N}(\tau)dt = \dot{N}dte^{-\int_0^\tau \mu(\tau)d\tau} = \dot{N}dte^{-\frac{e^{a_c}}{1+b_c}\left((\tau+\delta_c)^{1+b_c}-{\delta_c}^{1+b_c}\right)-e^{a_m+b_m\tau}}$$

This is much too complex to lead to closed form solutions, but simple enough to allow computation.

A set of parameter values that approximates mortality in modern developed countries[14] is

$$a_c = -6.7, b_c = -0.79, \delta_c = 0.05 \text{ days}, a_m = -9.4, b_m = 0.085 \text{ per year}$$

The mortality curve that results from these parameters is shown in Figure 7

[12] This representation views humans as homogeneous. An alternative is to view humans as a heterogeneous group made of individuals of different initial gene endowment, environment, and propensity to risky exposure in this case the joint distribution of endowment and environment would lead to the decline in mortality with age at very young ages and the cumulative effects of exposure would lead to the increase in mortality at higher ages. In such a model we would need to take into account the fact that the joint distribution of the three factors among the survivors is a function of age. Moreover, the initial distribution of these factors at birth should recognize the effect of genetic selection.

[13] The element δ_c ensures that mortality does not go to infinity as the age goes to zero. It is important to note that the rules for determining how live-births are to be distinguished from still-births change over time, both in terms of formal rules and their practical application. Since this determination is important in establishing what we mean by mortality at age zero, the value of this element may change substantially over time.

[14] This is patterned after the period mortality in the US in 1980.

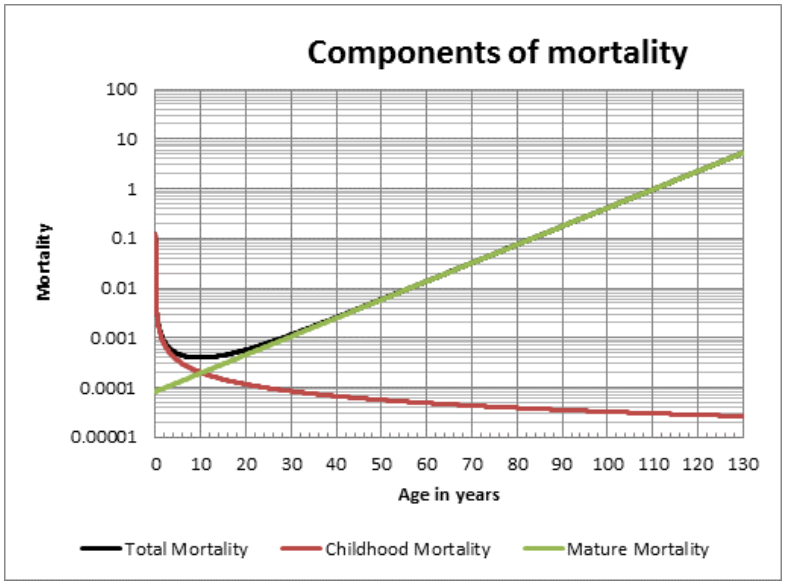


Figure 7. A more typical mortality pattern for modern developed economies

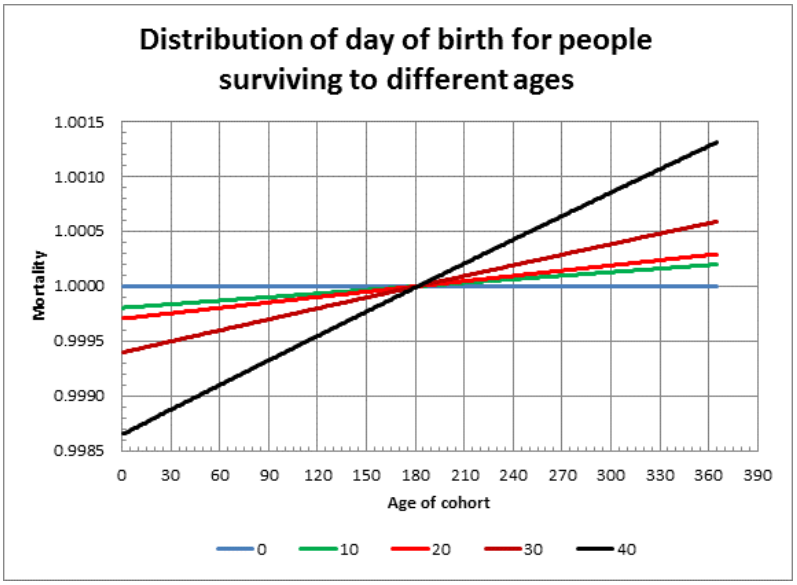
Figures 8, 9, and 10 illustrate the results obtained. These are much like those obtained from the linear model. The distributions of the day of birth of survivors of different ages, shown in Figure 8, are much closer to linear at high ages. The estimated mortality curve of Figure 9 shows the same compression at high ages and illustrates that the inverse hyperbolic tangent transformation provides a good approximation to the original mortality curve at high ages. At low ages this transformation is not enough, because the very steep decline of mortality in the perinatal period. Figure 10 shows the age distortion involved in assuming that the actual average age is at the midpoint of the range.

A set of parameter values that approximates mortality in developed countries in the middle 1700s[15] is

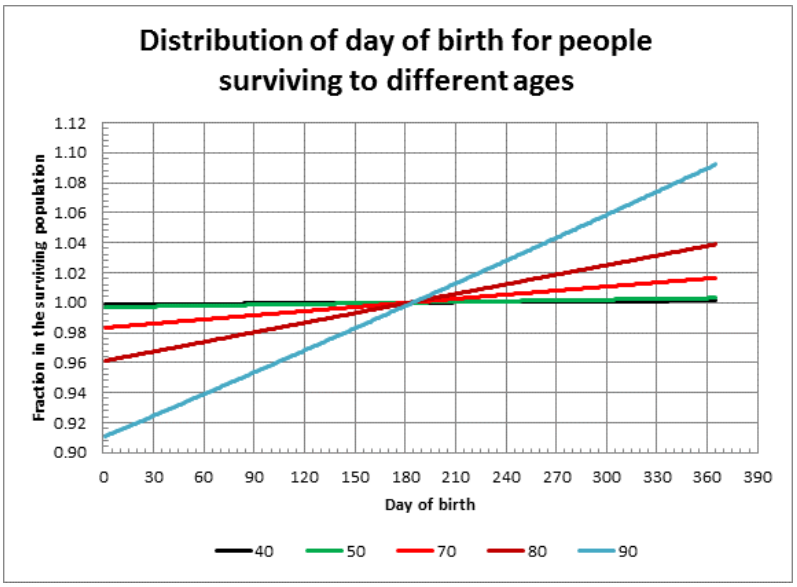
$$a_c = -3.0, b_c = -0.68, \delta_c = 0.05 \text{ days}, a_m = -7.4, b_m = 0.071 \text{ per year}$$

This is illustrated in Figure 11.

[15] This is patterned after mortality of the 1750 cohort in Sweden.

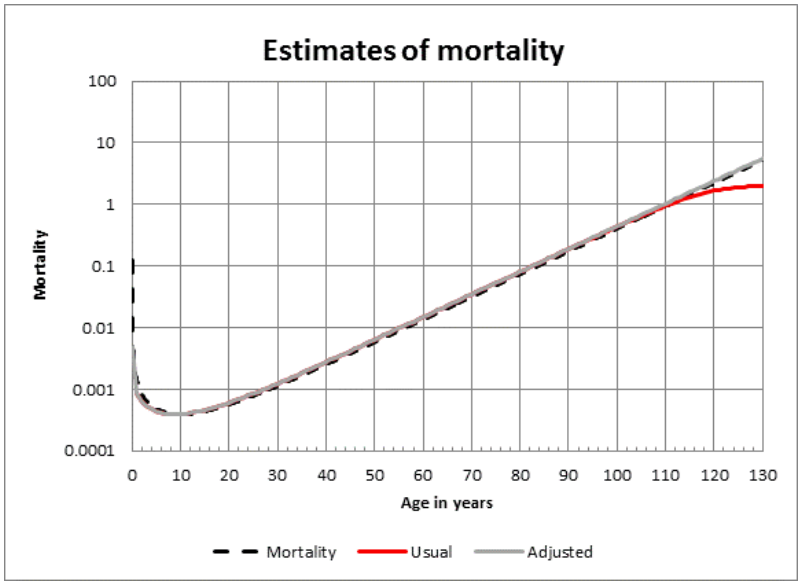


Panel A

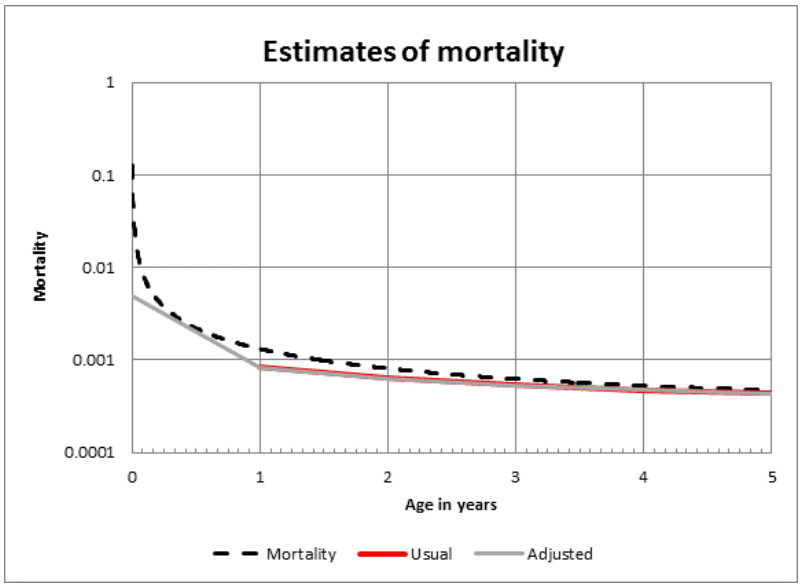


Panel B

Figure 8. Fraction of survivors of different days of birth as a function of age with a mortality schedule more appropriate for modern developed countries



Panel A



Panel B

Figure 9. Estimates of cohort mortality for a more general model using parameters for modern developed countries

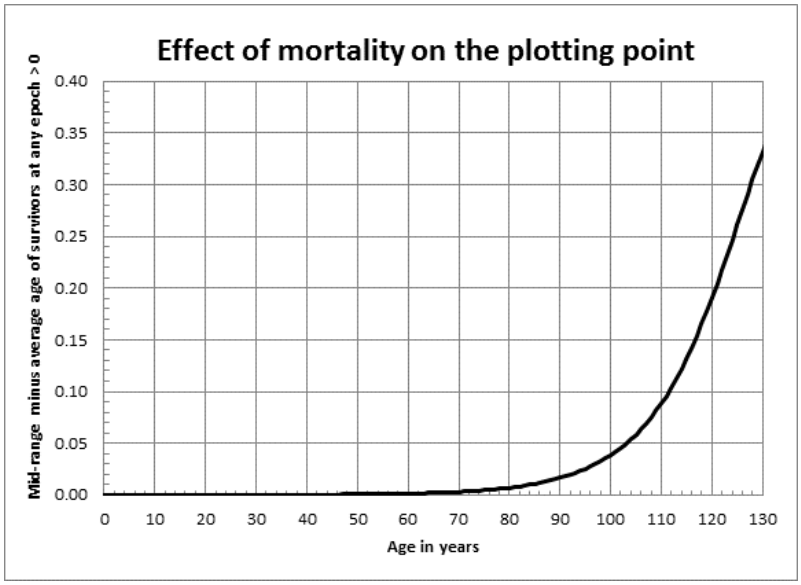


Figure 10. Distortion on the plotting point as a function of age for a more general model using parameters for modern developed countries

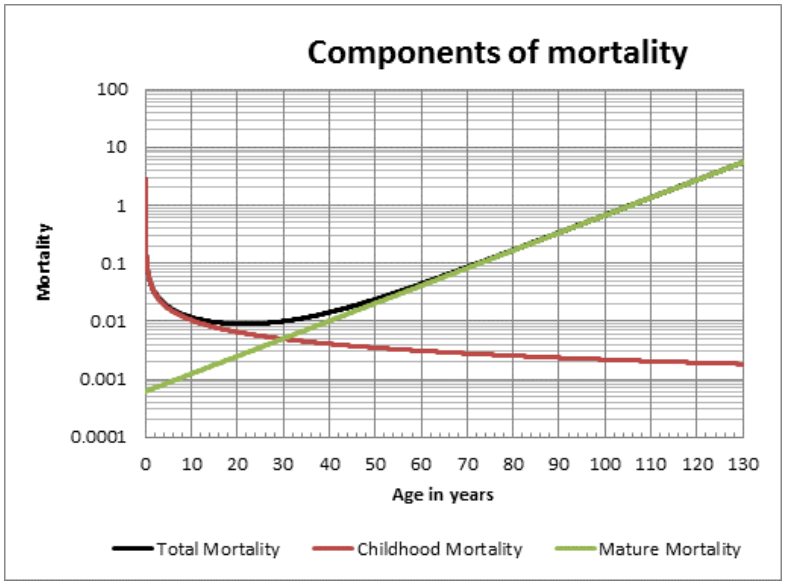
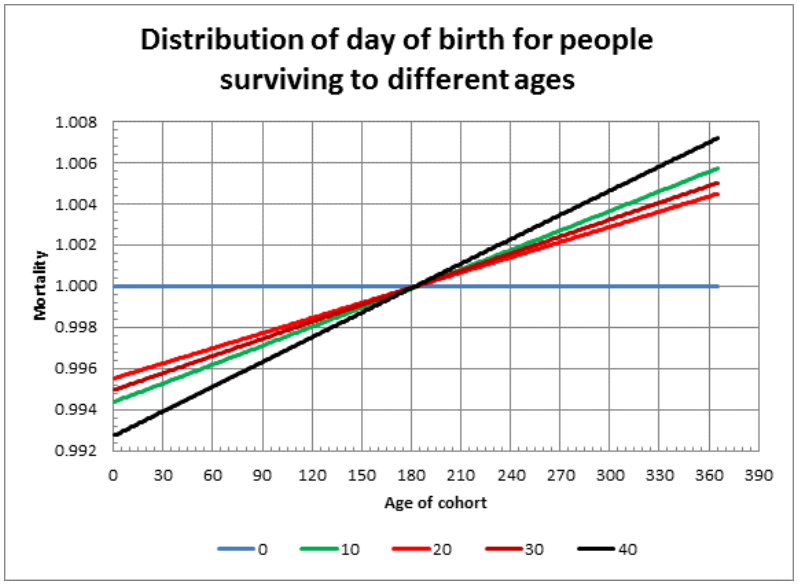


Figure 11. A more typical mortality pattern for developed economies around 1750

The results for this set of parameters are shown in Figures 12, 13, 1nd 14. Qualitatively nothing has changed; the descriptions given above still apply. Quantitatively, however, there are subtle changes that deserve attention. These are best summarized by Figure 15. Panel A of that figure shows the distortions in the plotting points for the two cases using the parameters given above.

The differences are not huge, but are enough to distort relations among cohorts if no adjustment is made. Panel B of Figure 15 show what the effect would be if the parameter a_m had been kept at a value of 0.085 for both calculations; in that event the distortions are quite appreciable.



Panel A

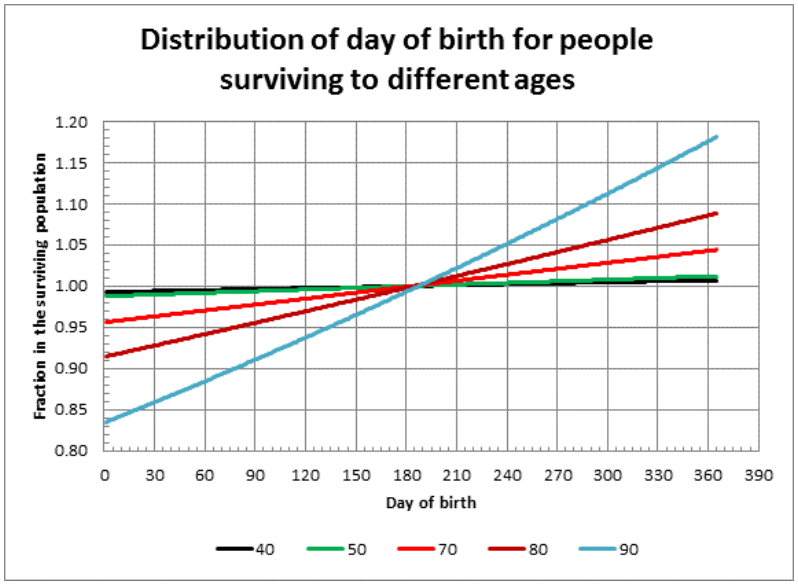
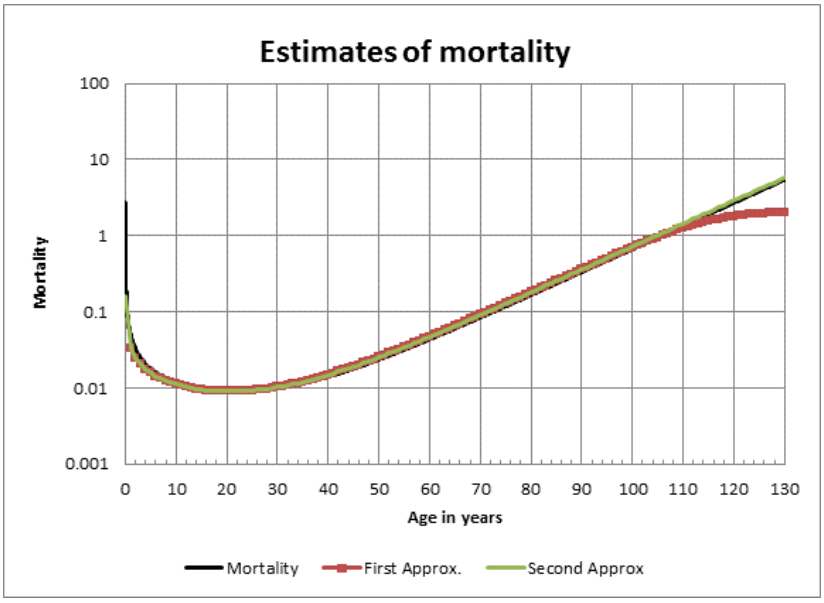
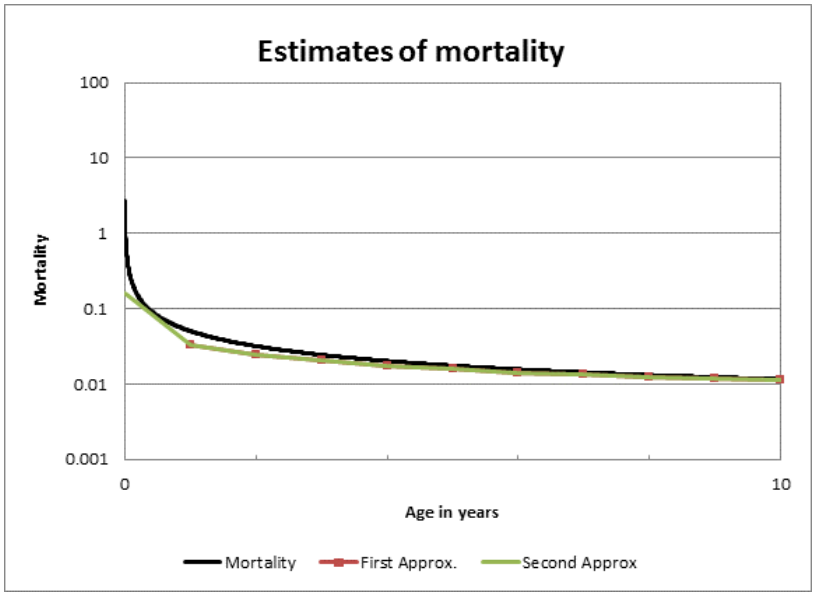


Figure 12. Fraction of survivors of different days of birth as a function of age with a mortality schedule more appropriate for developed countries in the 1750s



Panel A



Panel B

Figure 13. Estimates of cohort mortality for a more general model using parameters developed countries around 1750

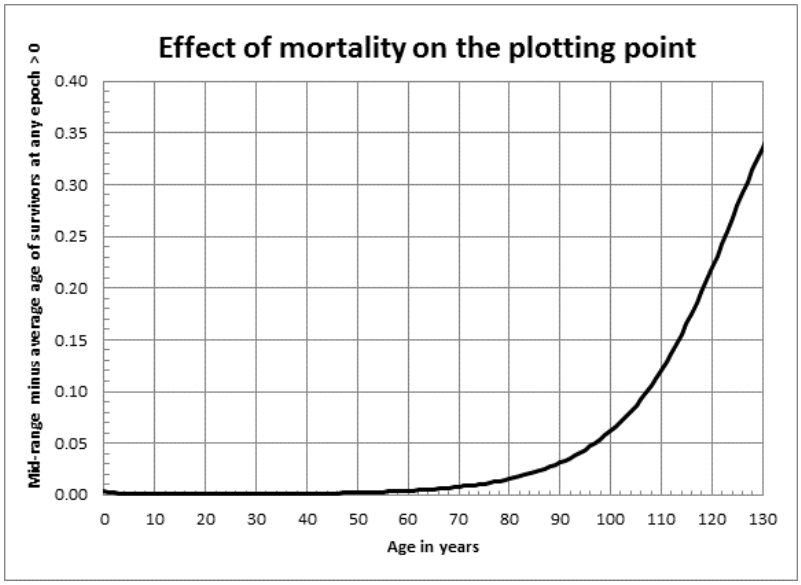


Figure 14. Distortion on the plotting point as a function of age for a more general model using parameters for developed countries in the 1750s.

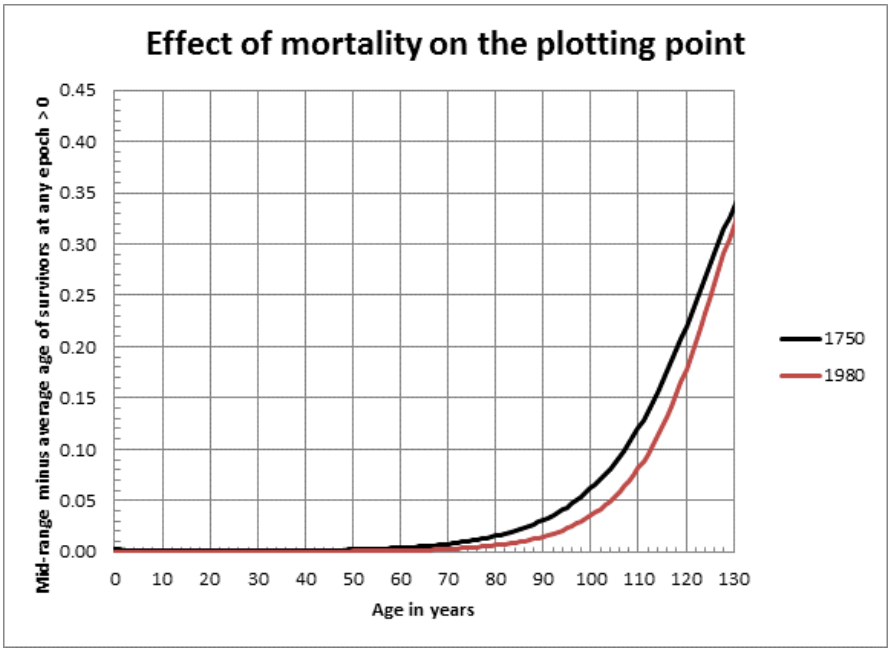
Thus the usual implicit assumption that the mortality applies to the midpoint of the age range may have a substantial effect when we attempt to partition effects into cohort effects and time effects.

4. Discussion

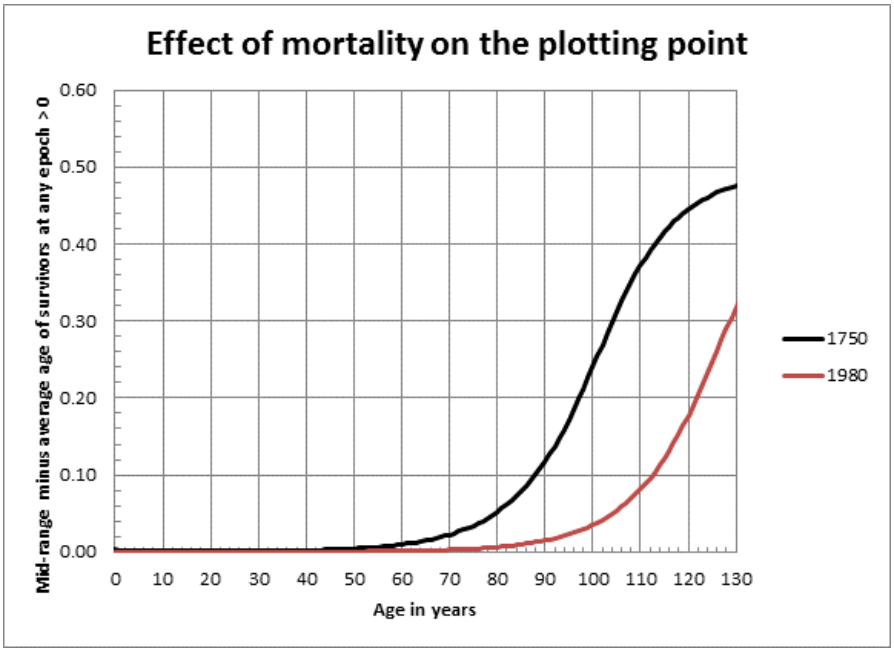
Even very simple models, including one with constant mortality, suggest that some of the assumptions underlying the computation of mortality tables are open to serious question. The problem is especially noticeable at high ages. Some re-examination of our techniques is in order. It is of at least passing interest to point out that the simple model with constant mortality implies that the highest value of mortality that would be obtained by simple calculations is 2, and that the more complicated models all seem to follow that rule. It is also useful to know that the use of the inverse hyperbolic tangent does very well at adjusting the simple computations to the actual underlying mortality at high ages.

The models also imply that the use of age mid-range in the analysis of data may create substantial distortions in attempts to use cohort-time-age models to explain mortality trends or to forecast future mortality.

The models have another, more practical aspect. They suggest that traditional life tables are underestimating cohort mortality at high ages. This would lead to chronic overestimates of the cost of pensions and social insurance costs if these mortalities are used and even more so if they are extrapolated to ages beyond the ones in the life tables. Hence it appears advisable to assess the potential distorting effects much more carefully.



Panel A – Specific values of b_m



Panel B– Common value of b_m

Figure 15. Comparison of the distortion on the plotting point as a function of age for a more general model using parameters for different conditions.

The methods shown here do not constitute a complete plan for estimation of cohort mortalities. Even with infinite populations it would be necessary to implement methods of successive approximations in order to get obtain valid estimates, especially in the perinatal and infant periods. Successive approximations will require interpolation between the averages for the age groups, and different interpolation formulas will necessarily give somewhat different answers. Thus the design of these methods is a daunting endeavor. The work presented here does, however, suggest that relatively simple interpolation formulas might work well enough for most practical purposes, except possibly at very young ages. [16]

[16] In this range, data in terms of days, weeks, and months may be essential for good representation of mortality. That poses substantial problems when we have to consider finite populations.

References

Bowers, N.L. Jr., H.U. Gerber, J.C. Hickman, D.A. Jones, and C.J. Nesbitt, 1986, Actuarial Mathematics, The Society of Actuaries, Itasca, IL, U.S.A.

Chiang, C.L., 1972, "On constructing current life tables", Journal of the American Statistical Association, vol. 67, pp. 538-541.

Haberman, S., and A. Renshaw, 2011, "A comparative study of parametric projection models", Insurance: Mathematics and Economics, vol. 48, pp. 35-55.

Human Mortality Database, University of California, Berkeley (USA), and Max Planck Institute for Demographic Research (Germany). Available at www.mortality.org or www.humanmortality.de

Lee, R., 2000, "The Lee-Carter model for forecasting mortality, with various extensions and applications", North American Actuarial Journal, vol. 4, pp.80-93.

Manton, K.G., E. Stallard, and J.W. Vaupel, "Methods for comparing the mortality experience of heterogeneous populations", Demography, vol. 18, pp. 386-410.

Pitacco, E, M. Denuit, S. Haberman, and A. Olivieri, "Modelling longevity dynamics for pensions and annuity business", Oxford University Press, Oxford, UK.

Vaupel, J.W., K.G. Manton, and E. Stallard, 1979, "The Impact of Heterogeneity in Individual Frailty on the Dynamics of Mortality", Demography, vol. 16, pp. 3, pp. 439-454.

Venezian, E., 2011, "Some remarks about forecasting longevity", paper presented at the Second China International Conference on Insurance and Risk Management, Beijing.

Wilmoth, J.R., K. Andreev, D. Jdanov, and D.A. Glei, 2007, "Methods Protocol for the Human Mortality Database", Human Mortality Database, University of California, Berkeley (USA), and Max Planck Institute for Demographic Research (Germany). Available at www.mortality.org or www.humanmortality.de.

Exploring the Antecedents of Business Performance: the Role of Innovation Capability and Entrepreneurship at Small and Medium Enterprises

Edlyn Khurotul Aini[a]
David Ching Lung Shen [b]
Mochamad Al Musadieq[c]
Siti Ragil Handayani[d]

[a] Master Student Double Degree, Department of Business Administration, Brawijaya University and National Pingtung University of Science and Technology

[b] Association Professor, Department of Business Administration, National Pingtung University of Science and Technology, Taiwan

[c] Association Professor, Department of Business Administration, Brawijaya University, Indonesia

[d] Association Professor, Department of Business Administration, Brawijaya University, Indonesia

Abstract

Small medium enterprises require strong innovation capability to achieve competitive advantage. Based on previous empirical researches, this study emphasizes the importance of innovation capability as the role on business performance. Data were collected from 228 of small medium enterprises in Kediri, East Java, Indonesia and analyzed using structural equation model. The major findings include first, innovation capability and entrepreneurship has significantly positive impact on business performance respectively. Second, learning orientation has a significant and positive effect on innovation capability. Third, IT resource has significantly positive impact on learning orientation and innovation capability respectively.

Key Words: *Learning Orientation, Information Technology Resources, Entrepreneurship, Innovation Capability, Business Performance.*

1. Introduction

The environment is changing constantly and rapidly as well as the market and customer need. Many SMEs presently evolve in a complex business environment characterized by the need for greater efficiency, effectiveness and competitiveness based on innovation and knowledge (Raymond and St-Pierre, 2005). Small medium enterprises (SMEs) are forced to learn new knowledge to develop new products in order to attract the new market and customer because innovation is the basis for organizational survival (Hurley and Hult, 1998). SME need to manage innovation capabilities effectively to provide the firms with opportunities for greater business performance. Innovation is a central strategy role in a firm's efforts to gain positional advantages in competitive markets.

Nasution, et al. (2011) suggested that innovation capability refers to the ability of an organization to adopt or implement new idea, processes, or products successfully. Some researchers have examined the influence of antecedent factors that really drives the innovation capability and its effect on business performance. Organizations improve innovation capability through emphasizing on learning orientation (Calantone, et al., 2002) and providing Information Technology (IT) resources, and thereafter to achieve

better performance. According to Lee and Hsieh (2010) research that entrepreneurship also could enhance competitive advantage. The nature of both IT resources and learning orientation are highly emphasized on an organization's willingness and capability to innovate within the organization (Nasution, et al., 2011 and Benitez-Amado, et al., 2010).

This study emphasizes the importance of innovation capability as the role on business performance. First, this study examines the effect of innovation capability and entrepreneurship on business performance. Second, it explores the effect of learning orientation on innovation capability. Third, this paper examines the effect of information technology (IT) resources on learning orientation and innovation capability. Limited study conducted to small medium enterprises in Kediri, East Java, Indonesia. Our study contributes to fulfill this research gap.

2. Theory and Hypothesis

2.1. Innovation Capability and Business Performance

Yang (2011) defined innovation capability as the potential ability of an organization to position itself in an arena of modernism such as new product development, technology and other advancements that result in competitive advantage over its rivals. In the research of Jimenez-jimenez and Sanz-Valle (2011) argued that the definition of innovation is sharing the idea that implies the adoption of a new idea or behavior. Furthermore, Robert (1999) gave definition of innovation is the broader concept of continuous improvement. Based on previous researchers this research defined innovation capability as capacity of organization to create new idea, process and product successfully. It means small medium enterprises need capacity to create something new to achieve competitive advantage.

According to Calantone, et al. (2002) that organization business must be innovative to survive in volatile environment. Whereas Jiménez-jiménez and Sanz-Valle (2011); Sinkula, et al. (2001) stressed that innovation helps the company to deal with the turbulence of external environment and, therefore, is one of the key drivers of long-term success in business. The organization business with innovation capability will be able to respond the challenges faster and to exploit new products and market opportunities better than non-innovative organization business.

The researches of Jimenez-jimenez and Sanz-Valle (2011), Allred and Swan (2005), and Wang and Wang (2012) found innovation capability has influence to performance significantly. Provided that firms possess a capacity to innovate, the capacity will allow those firms to develop a competitive advantage, enabling them to derive outcomes from it (Damanpour, 1991; Hurley and Hult, 1998). Rhodes, et al. (2008) focused on Taiwanese Company and the result is that innovation capability has impact on organizational performance. This result revealed that process innovation had a greater impact on organizational performance than product innovation research. Based on the above discussion, this paper proposes hypothesis as following:

Hypothesis 1: Innovation capability has a significant and positive effect on business performance

2.2. Entrepreneurship and Business Performance

According to Nasution, et al. (2011), the entrepreneurship was defined as a process of enhancement of wealth through innovation and exploitation of opportunities, which requires the entrepreneurial characteristics of risk-taking, autonomy, and pro-activeness. Whereas Wang (2008) and Covin and Slevin (1991) research concluded entrepreneurship as a process of engaging in product-market innovation, risk taking, proactive in introduce innovation, and aggressive to competitor.

Furthermore Slater and Narver (2005) asserted entrepreneurship in organizations enables to identify the latent needs of customers and innovative ways to fill their needs. A primary entrepreneurial activity is not only to create better products than competitors but also to lead the industry in recognizing customers' evolving needs. Entrepreneurship not only exists in new found technological organization, but also exists in the present and within organizations.

Wang (2008) points out that entrepreneurial firm instill flexibility, and grant individuals and teams the freedom to exercise their creativity and to champion promising ideas. So, who apply entrepreneurship can find the changes of environment and clue of opportunity in environment, and can understand the principle of successful business performance. Covin and Slevin (1991) research stated that entrepreneurship significantly influences on business performance. A high entrepreneurship provides business with the ability to find and/or discover new opportunities that can differentiate them from other firms and create a competitive advantage. Wiklunda and Shepherd (2005) focused on small medium size of 413 Swedish firms and the results showed that entrepreneurship has significant effect on business performance. This research proposes hypothesis as following:

Hypothesis 2: Entrepreneurship has a significant and positive effect on business performance.

2.3. Learning Orientation and Innovation Capability

Fiol and Lyles (1985) indicated that learning orientation essentially reflects whole process in the organization for learning, which begins from each individual level and builds up to the organizational level. Whereas Calantone, et al. (2002) advocated that learning orientation is organization-wide activity to create and use knowledge to enhance competitive advantage. Based on all researchers, this study concluded to define learning orientation as an organization activity which obtains the process of improving insights and knowledge to enhance organizational performance. Hult, et al. (2004) point out the premise underlying organization learning is that it facilitates flexibility, opportunities for growth, and overall better performance in those firms that possess such a capability. So it plays an important role in enabling firm to achieve speed and flexibility within the innovation (Jimenez-jimenez and Sanz-Valle, 2011).

Many researchers indicated sub-dimension to measure learning orientation. Baker and Sinkula (1999), Sinkula, et al. (2001) and Nasution, et al. (2011) used the three concept of learning orientation which consists of Commitment to Learning, Shared Vision, and Open Mindedness. Commitment to learning refers to the basic principles of learning. This is the foundation of organization to begin and continue learning in order to improve capability. Shared vision refers to an organization-wide focus on learning. Calantone, et al. (2002) stresses that without a shared vision, learning by members of an organization is less likely to be meaningful. In other words, even if they are motivated to learn, it is difficult to know what to learn. Open-mindedness is the willingness to critically evaluate the organization‘s operational routine and to accept new ideas.

Alegre and Chiva (2008) denoted that learning plays a determinant role in new product development projects because it allows new products to be adapted to changing environmental factors, such as customer demand uncertainty, technological developments or competitive turbulence. Generative learning, the most advanced form of organizational learning, occurs when an organization is willing to question long-held assumptions about its mission, customers, capabilities, or strategy and generate changes in its practices, strategies, and values (Aragón-Correa, et al., 2007). This kind of learning is a necessary underpinning for radical innovations in products and processes. Hurley and Hult (1998) focused on a large agency of the US federal government to show that organizational innovativeness was positively associated with a culture that emphasizes adaptation, innovation, and learning. Also according to Calantone, et al. (2001) research found out that learning orientation has an influence on firm innovativeness positively. Base on the previous research this paper proposes hypothesis as following:

Hypothesis 3: Organizational learning has a significant and positive effect on innovation capability.

2.4. Information Technology (IT) Resources, Innovation Capability and Business Performance

Real, et al. (2006) gave the concept of IT infrastructure in term knowledge management, defined as the shared IT capabilities that enable to support the flow of knowledge in an organization. According to White and Bruton (2011), they suggested technology as the practical implementation of learning and knowledge by individuals and organizations to aid human endeavor. This study concluded Information Technology (IT) resources is as tool, process, knowledge, and system which has ability to convert data into meaningful information to provide knowledge and learning activities.

Chairman Greenspan, former Chairman of the Federal Reserve (White and Bruton, 2011) argued that not only will the future of business be directed by technology but also that the root of business today is driven by technology and its application. His belief in the growth of technology is supported by the growth in patens worldwide.

Furthermore Tarafdar and Gordon (2007) indicated that IT resources such as technological IT and human IT resources could act as key enablers of business innovation. Technological IT resources can enable a firm to improve its ability to establish an innovative environment that encourages creativity and the development of new products or process. Creativity can be stimulated if the firm grants resources and also improves the empowerment of its employees. Thus, the employees can utilize technological IT resources such as database, applications or email systems to develop their task in a more innovative way (Chandler, et al., 2000). Benitez-Amado, et al. (2010) found the deployment of technological IT and human IT resources have an effect on the development of an innovative environment. This research proposes hypothesis as following:

Hypothesis 4: Information technology (IT) resource has a significant and positive effect on innovation capability.

The importance of IT in learning orientation implementation is established by theoretical and empirical evidence. According to Real, et al. (2006) research, Information technology has a significant direct influence on learning orientation. IT is a strong component to learning because it is used as tool, process, knowledge, and system which have ability to convert data into meaningful information to provide knowledge and learning activities. Rogé, et al. (2011) result showed that IT has positive direct relationship on learning orientation. Learning orientation is concerned with acquiring, disseminating, and using information. Lee and Choi (2003) found that ‗IT support' significantly impacted the learning organization process variable. Therefore this research proposes hypothesis as following:

Hypothesis 5: Information technology (IT) resource has a significant and positive effect on learning orientation.

3. Research Methodology

3.1. Data Collection

The samples in this study were owner or manager of small medium enterprises at Kediri, East Java-Indonesia. A personal interview approach was used to get the data from owner or manager of small medium enterprises. The reason to choose small medium enterprises at Kediri, East Java-Indonesia as the research object is that Kediri is The Central Business District at West area of East Java and has commitment to increase the business in this area, especially small medium enterprises. They improve the innovation for business to develop the performance.

This study adopt census and questionnaires were distributed to 228 SMEs at Kediri, East Java-Indonesia. The sampling frame was listed from Cooperative, Industrial, and Trade Official in Kediri. The usable respondents were 215, which provided the final effective response rate of 94%.

3.2. Measures

The variables in this study are measured by Likert Scale with range from 1 to 7 in which 1 equal to ―strongly disagree" and 7 equal to ―strongly agree". The variables that are studied consist of latent exogenous variable and latent endogenous variable.

Latent exogenous variable are:

a. Information technology (IT) resources

The measurement of IT resources developed by Ray, et al. (2005) and Benitez-Amado, et al., 2010) was adopted in this study. The proposed measurements of IT resource are 5 items, consist of 2 items for Technological IT resources and 3 items for Human IT resources.

b. Entrepreneurship

To assess entrepreneurship, this study adopted some of measurement which is developed by Wang (2008) and Nasution, et al. (2011). The proposed measurements of entrepreneurship are 4 items which include market pro-activeness, competitive aggressiveness, risk taking and innovativeness.

Whereas latent endogenous variable are:

a. Learning orientation

This study adopts the work of Nasution, et al. (2011), Calantone, et al. (2002), Hult, et al. (2002), Sinkula, et al. (2001). Three sub dimensions of learning orientation consist of 8 items to measure the learning orientation variable, consist of 3 items of sub-dimensions for commitment to learning, 3 items for shared vision, and 2 items for open mindedness.

b. Innovation capability

The scale developed by Rhodes, et al. (2008), Nasution, et al. (2011), and Jimenez-jimenez and Sanz-Valle (2011) were used to measure innovation capability. The innovation capability measure has 5 items: product innovation (two items) and process innovation (three items).

c. Business performance

This study adopts the research of Rhodes, et al. (2008) and Delaney and Huselid (1996) to build measurement of business performance. The measurement has 4 items which consist of 2 items for financial performance and 2 items for non-financial performance.

4. Result and Discussion

Data were analyzed using AMOS 17 software package and Structural Equation Model (SEM) program. According to Kaplan (2000), there were two-steps procedures of Structural Equation Model. First step is measurement model and the second step is structural model.

4.1. Measurement model

4.1.1. Goodness Fit Indices

This measurement model was estimated using Confirmatory Factor Analysis (CFA) method. Based on Hooper et al. (2008) the measurement of fit indices were Chi-square value ($\chi 2$), Goodness of Fit (GFI), Adjusted Goodness of Fit (AGFI), Root Mean Square Error of Approximation (RMSEA), Comparative fit index (CFI), and the other indicators was included in overall measurement model fit indices.

The analysis results in table 1 showed $\chi 2$/df-ratio of 1.99 was less than 2, it means that the model is acceptable. GFI, NFI, NNFI, and CFI are greater than or close to 0.9, so those are acceptable. For the RMSEA value was 0.07, it is still acceptable because according to MacCallum, et al. (1996) the range of RMSEA 0.05 to 0.10 was acceptable. The overall measurement indices showed a good fit to the model.

Table 1
The Measurement Model Fit Result

Index	Result
Chi-squire ($\chi 2$)	109.29
Chi-squire DF	55
Chi-squire ($\chi 2$/df)	1.99
Goodness of Fit (GFI)	0.92
Adjusted Goodness of Fit (AGFI)	0.87
Root Mean Square Error of Approximation (RMSEA)	0.07
Root Mean Square of Residual (RMR)	0.01
Normed fit index (NFI)	0.90
Non-normed Fit Index (NNFI)	0.92
Comparative fit index (CFI)	0.95

4.1.2. Reliability Analysis of Measurement Model

The measurement model of reliability is to meet the standards for the study variables, including all observed variables using the standardized factor loadings, and to calculate the composite reliability for each variable. Composite reliability in table 2 is about 0.6. The recommended value of Fornell & Larcker (1981), are greater than 0.60.

Table 2
Scale Composite Reliability and Convergent Validity Analysis

Construct (F) and Indicators (V)		Standardized Loading	t-value	Indicator Reliability	Composite Reliability
Learning Orientation (F1)					
V1	Commitment of Learning	0.661	9.15	0.437	0.57
V2	Shared Vision	0.612	8.49	0.375	
V3	Open Mindedness	0.367	4.88	0.135	
IT Resources (F2)					
V4	Technological IT resources	0.802	12.70	0.643	0.83
V5	Human IT Resources	0.881	14.20	0.775	
Entrepreneurship (F3)					
V6	Market pro-activeness	0.231	3.11	0.053	0.64
V7	Competitive aggressiveness	0.476	6.72	0.226	
V8	Risk taking	0.781	12.13	0.611	
V9	Innovativeness	0.683	10.32	0.466	
Innovation Capability (F4)					
V10	Product Innovation	0.778	11.88	0.605	0.69
V11	Process Innovation	0.680	10.27	0.462	
Business Performance (F5)					
V12	Financial	0.751	11.68	0.564	0.84
V13	Non-Financial	0.936	15.12	0.877	

4.1.3. Validity Analysis of Measurement Model

4.1.3.1. Convergent Validity

On the validity of the detection, this study used confirmatory factor analysis to measure the scale of convergent validity. From the table 2 in the t-value column, the standardized loading of all observed variables were significant (greater than 1.96), showing the path coefficient is significant, and this was the results of these indicators to meet the convergent validity (Anderson & Gerbing, 1988).

4.1.3.2. Discriminant Validity

The higher the correlation coefficient between two variables might indicate that the discriminant validity could not be satisfied. Therefore, this study intends to select "learning orientation" and "entrepreneurship, "entrepreneurship" and "innovation capability" which the correlation coefficient are higher than 0.8 to verify that the two pairs of variables has discriminant validity.

Table 3
Discriminant validity analysis

	Correlation Coefficient		Unidimensional Measurement Model	Measurement Model	The difference	p-value
Learning orientation ↔ Entrepreneurship	0.81***	Chi-square	117.14	109.285	7.855	< 0.05
		DF	56	55	1	
Entrepreneurship ↔ Innovation capability	0.86***	Chi-square	117.08	109.285	7.795	< 0.05
		DF	56	55	1	

Note: * p<0.05,
** p<0.01,
*** p<0.001.

The results from table 3 showed that the chi-square difference between measurement and unidimensional measurement model for both pairs are significant. It concludes that those variables were distinct. In general, all measures were shown to have discriminant validity because the biggest of correlation among variables was significantly different.

4.1.4. Common Method Variance (CMV)

The effect of common method variance (CMV) is a major potential validity threat in social sciences research (Sharma, et al., 2009). When two or more variables are collected from the same respondents and an attempt is made to interpret their correlation, a problem of CMV could happen. In the line opinion of Podsakoff, et al. (2003) that common method variance refers to a bias which occurs from having a common rater, a common measurement context, a common item context, or from the characteristics of the items themselves. Common method variance can have a substantial impact on the observed relationship between predictor and criterion variables in organizational and behavioral research.

This study used two ways to test the common method variance. First is Harman's single factor test. It stress if the majority of the variance can be explained by a single factor. The result for this test showed that the value of CMV was 40.04%. According to Podsakoff, et al. (2003) that CMV is not assumed to exist because a first factor doesn‘t explains the majority of the variance in the variables.

Second, this study used a common latent factor to capture the common variance among all observed variables in the model. The significant of the differences between common method model and measurement model was tested. The result showed in table 4 that the p value was less than 0.05. Overall of the CMV analysis indicate that there is no bias in the answer, so there was a low potential validity threat to the finding of this research.

Table 4
Common Latent Factor Result

	Common Latent Model	Measurement Model	The difference	p-value
Chi-square	247.142	109.285	137.857	< 0.05
DF	65	55	10	

4.2. Structural Model

This study provides empirical research about the role of innovation capability on business performance. To examine the research hypothesis, this research used analysis of structural equation model. The result of overall goodness fit of structural model was shown at table 5. Chi-square ($\chi 2$)/df-ratio was 2.65. According to Hooper, et al. (2008) that less than 3 was acceptable. GFI and NNFI still acceptable because larger than 0.8 and close to 0.9. RMSEA still was acceptable because it equal or less than 0.1. Overall of the goodness fit indices of structural model is acceptable. The structural model RNFI must be greater than 0.9, the closer to 1 is the better. RPR is in the detection of structural models to parsimony degree, the greater the better the goodness of fit. It can be seen from table 4 RNFI= 0.91, of RPR = 0.27, and RPFI = 0.24, this structural model indicated has a good goodness of fit and parsimony.

Table 5
Structural Model Indices

	Goodness Fit Indices										Structural model		
Model	Chi-square	DF	$\chi 2$/df	GFI	AGFI	CFI	NFI	NNFI	RMR	RMSEA	RNFI	RPR	RPFI
Structural Model	156.50	59	2.65	0.89	0.84	0.90	0.85	0.87	0.02	0.08	0.91	0.27	0.24

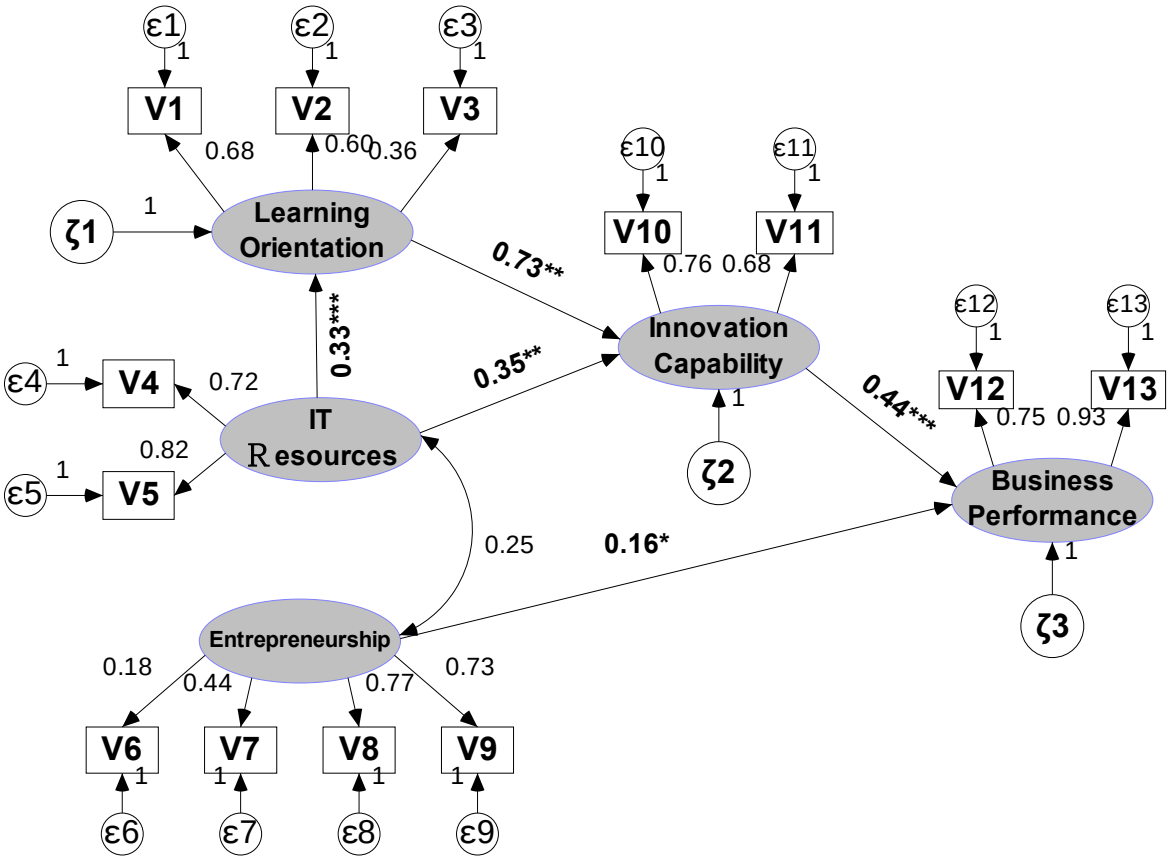
This part explored validation for the hypothesis. The causal path between the latent variables in the research hypothesis (H1 to H5) and the analysis results are shown in Table 6. The path of structural model result was shown in Figure 1. From the table results, the path coefficients were: innovation capability and entrepreneurship → business performance were 0.44 and 0.16 respectively; learning orientation → innovation capability was 0.73; IT resources → innovation capability was 0.35; and IT resources → learning orientation was 0.33. Furthermore, "innovation capability" as the dependent variable, the r2 value was 0.81; the "learning orientation" as the dependent variable, the r2 was 0.57; and the ~~"~~business performance" r2 was 0.57. According to Kleijnen, et al. (2007) categorized r2 effect sizes as: small: 0.02; medium: 0.13; large: 0.26, so it can be regarded that innovation capability, learning orientation, and business performance as having a high degree of support.

The result for the path analysis can be seen in table 5. Following is result of the hypothesis test.

Table 6
Structural Model Path Coefficient

Dependent Variable	Independent Variable	Standardized path coefficient	t value	Square Multiple Correlation (r2)
Business Performance	Innovation Capability (H1)	0.44	4.34***	0.52
	Entrepreneurship (H2)	0.16	2.27*	
Innovation Capability	Learning Orientation (H3)	0.73	2.60**	0.81
	IT Resources (H4)	0.35	3.23**	
Learning Orientation	IT Resources (H5)	0.33	7.37***	0.57

Note: * $p<0.05$, ** $p<0.01$, *** $p<0.001$



Note: * p<0.05,
** p<0.01,
*** p<0.001

Figure 1
Structural Model Result

5. Conclusion

According to the result and discussion, this section would address conclusion, limitation and suggestion.

5.1. Research Conclusion

5.1.1. The effect of innovation capability on business performance (H1 is supported).

The finding of data analysis found that innovation capability has a significant and positive effect on business performance (coefficient=0.44, t=4.34, p<.001). This result is consistent with the Allred and Swan (2005) and Jimenez-jimenez and Sanz-Valle (2011) empirical research that innovation capability has a significant direct impact on business performance. It indicates innovation capability plays a critical role in influencing on business performance. Small medium enterprises can increase the business performance whether in financial or non-financial by improving capability to create new product and process which more innovative than the competitor.

The effect of entrepreneurship on business performance (H2 is supported).

According to previous analysis and discussion, it indicates entrepreneurship has a significant and positive affect on business performance (coefficient=0.16, t=2.27, p<.05). This result is consistent with the previous empirical research by Covin and Slevin (1991) and Wiklunda and Shepherd (2005) that entrepreneurship has direct and significant impact on the business performance. Since small medium enterprises increase the entrepreneurship with market pro-activeness, competitive aggressiveness, risk taking, and innovativeness, it will create new opportunity to improve business performance due to achieve competitive advantage.

5.1.2. The effect of learning orientation on innovation capability (H3 is supported).

Based on analysis and discussion, learning orientation has significant and positive influence on innovation capability (coefficient=0.73, t=2.60, p<.01). The organization has higher willingness in term learning orientation will facilitate to increase innovation capability. This result is consistent with Calantone, et al. (2002) research that learning orientation has positive and significant effect on innovation capability. When small business enterprises have commitment to learning, it aspires to keep product and process development within SMEs. The entrepreneurs (owner or managers) have to share their vision within organization to encourage employees. It will increase the innovation capability for achieving organization objectives. Furthermore the willingness to open mindedness in which critical evaluate and accept new ideas will develop to more innovative within small medium enterprise (Sinkula, et al., 2001).

5.1.3. The effect of information technology (IT) resources on innovation capability (H4 is supported).

The findings of analysis is that IT resource has positive and significant effect on innovation capability (coefficient=0.35, t=3.23, p<.01). The result indicates small medium enterprises which have more IT resources will increase capability to innovate product and process within organization. It is consistent with result provided by Benitez-Amado, et al. (2010) and Rhodes, et al. (2008) that IT resource has significant impact to innovation capability. Integrated technological and human IT resources will enable to increase innovation capability within organization. Technological can empower employee to be more creative to create product and process development.

5.1.4. Relationship information technology (IT) resources on learning orientation (H5 is supported).

The result from previous analysis found that IT resources has positive and significant effect on learning orientation (coefficient=0.33, t=7.37, p<.001). Following to Real, et al. (2006) and Rogé, et al. (2011) research, this study supports that IT resources has positive and significant impact on learning orientation. IT resource is used as facilitator to increase learning within SMEs. Small medium enterprise needs technological IT resources as tool and human who has skill in IT to provide smoothness to create learning. When SMEs emphasize to more IT resources, it will increase capability to innovative in organization whether product or process.

5.2. Limitation and Suggestion

Although the role of innovation capability on business performance was based on extant research findings with the changing of environment business, this role of innovation capability may change over time. Based on previous analyzing in this research, it has the limitation and suggestion for further research.

5.2.1. Limitation

a. There is limitation in the reliability measurement model analysis that is learning orientation has composite reliability less than 0.60. It is because the standardized loading each indicators have a bit low.
b. The study focused on small medium enterprises because it was based on the data from Cooperative, Industrial, and Trade Official in Kediri, so it generalizes at small medium enterprises field.

5.2.2. Suggestion

This study can be extended in several directions for further research. There are suggestions based on this study.

a. SMEs should enhance the entrepreneurship to increase business performance. They should emphasize more proactive and aggressive in competitive to meet with the opportunity.
b. This study focused on small medium enterprises field and in the specific area in Indonesia. The suggestion for future research can extent the result by analyzing different country and including big enterprises.
c. The analysis method of this study is a cross-sectional analysis. The aim is to explore the role innovation capability within a certain period of time, and the effect to business performance. However, some variables may be changes over time so it makes the results change. Therefore, this study suggests that future researchers can develop theoretical model to be more exhaustive construct.
d. The theoretical framework in this study consists of five variables as research variables such as learning orientation, IT resources, entrepreneurship, innovation capability, and business performance. Therefore, this study suggests that future research can develop the study by analyzing the moderating effect of contextual such as culture and turbulence environment.

References

Alegre, J. & Chiva R. (2008). Assessing the Impact of Organizational learning Capability on Product Innovation Performance: An Empirical Test. Technovation, 28, 315-326.

Allred, B.B. & Swan K.S. (2005). The Mediating Role of Innovation on The Influence of Industry Structure and National Context on Firm Performance. Journal of International Management, 11(3), 229-252.

Anderson, J.C. & Gerbing D.W. (1988). Structural equation modeling in practice: a review and recommended two step approach. Psychological Bullentin, 103. 411-423.

Aragón-Correa, J. A. & García-Morales V. J. (2007). Leadership and organizational learning's role on innovation and performance: Lessons from Spain. Industrial Marketing Management, 36(3), 349-359.

Baker, W.E. & Sinkula J.M. (1999). The Synergistic Effect of Market Orientation and Learning Orientation on Organizational Performance. Journal of The Academy of Marketing Science, 27(4), 411-427.

Benitez-Amado, J., Perez-Arostegui M.N., & Tamayo-Torres J. (2010). Information Technology-Enabled Innovativeness and Green Capabilities. Journal of Computer Information System, 87-96.

Calantone, R. J., Cavusgil S.T., & Zhao Y. (2002). Learning orientation, firm innovation capability, and firm performance. Industrial Marketing Management, 31, 515-524.

Chandler, G.N., Chalon K., & Douglas W.L. (2000). Unraveling the Determinant and Consequences of an Innovation-Supportive organizational Culture. Entrepreneurship theory and practice, 59-76.

Covin, J.G. & Slevin D.P. (1991). A Conceptual Model of Entrepreneurship as Firm Behaviour. Entrepreneurship theory and practice, 7-25.

Damanpour, F. (1991). Organizational Innovation: A Meta-Analysis of Effects of determinants and Moderators. Academy of Management Journal, 34, 555-590.

Delaney, J.T. & Huselid M.A. (1996). The Impact of Human Resource Management Practices on Perceptions of Organizational Performance. Academy of Management Journal, 39(4), 949-969.

Fiol, C.M. & Lyles M.A. (1985). Organizational learning. Academy of Management review, 10(4), 803-813.

Fornell, C. & Larcker, D.F. (1981). Evaluating structural equation models with unobservable variables and measurement error. Journal of Marketing Research, 18, 39-50.

Hult, G.T.M., Ferrell O.C., & Hurley R.F. (2002). Global organizational learning effects on cycle time performance. Journal of Business Research, 55, 377-387.

Hult, G.T.M., Hurley R.F, & Knight G.A. (2004). Innovativeness: Its antecedents and impact on business performance. Industrial Marketing Management, 33(5), 429-438.

Hurley, R.F. & Hult G.T.M. (1998). Innovation, Market orientation, and Organizational Learning: An Integration and Empirical Examination. Journal of Marketing, 62(3), 42-54.

Hooper, D., Coughlan J., & Mullen M.R. (2008). Structural Equation Modelling: Guidelines for

Determining Model Fit. The Electronic Journal of Business Research Methods, 6(1), 53-60.

Jiménez-Jiménez, D. & Sanz-Valle R. (2011). Innovation, organizational learning, and performance. Journal of Business Research, 64(4), 408-417.

Kaplan, D. (2000). Structural Equation Modeling Foundation and Extensions. London: Sage publication.

Kleijnen, M., Ruyter K.D., & Wetzels M. (2007). An assessment of value creation in mobile service delivery and the moderating role of time consciousness. Journal of Retailing, 83 (1), 33–46.

Lee, H. & Choi B. (2003). Knowledge Management Enablers, Processes, and Organizational Performance: An Integrative View and Empirical Examination. Journal of Management Information Systems, 20, 179-228.

Lee, J.S. & Hsieh C.J. (2010). A Research in Relating Entrepreneurship, Marketing Capability, Innovative Capability, and Sustained Competitive Advantage. Journal of Business & Economics Research, 8(9), 109-119.

MacCallum, R.C., Browne M.W, & Sugawara H.M. (1996). Power Analysis and Determination of Sample Size for covariance Structure Modeling. Psychological methods, 1(2), 130-149.

Nasution, H. N., Mavondo F.T., Felix T.M., Margaret J.M, & Nelson O.N. (2011). Entrepreneurship: Its relationship with market orientation and learning orientation and as antecedents to innovation and customer value. Industrial Marketing Management, 40(3), 336-345.

Podsakoff, P.M., MacKenzie, S.B., Lee, J.Y., and Podsakoff, N.P. (2003). Common method biases in behavioral research: a critical review of the literature and recommended remedies. Journal of Applied Psychology, 88, 879-903.

Ray, G., Muhanna W.A., & Barney J.B. (2005). Information Technology and The Performance of The Customer Service Process: A Resource-Based Analysis. MIS Quarterly, 29(4), 625-652.

Real, J. C., Leal A., &Rolan J.L. (2006). Information technology as a determinant of organizational learning and technological distinctive competencies. Industrial Marketing Management, 35(4), 505-521.

Rhodes, J., Hung R., Lok P., Lien B.Y., & Wu C.M. (2008). Factors influencing organizational knowledge transfer: implication for corporate performance. Journal of Knowledge Management, 12(3), 84-100.

Roberts, P.W. (1999). Product Innovation, Product–Market Competition and Persistent Profitability in The U.S. Pharmaceutical Industry. Strategic Management, 20(7), 655.

Rogé, J.N., Hughes J., Simpson, P.N. (2011). Learning to thread the needle: Information technology strategy. The journal of computer information systems, 52(1), 76-86.

Sharma, R., Yetton P., & Crawford J. Estimating the effect of common method variance: The method-method pair technique with an illustration from TAM research. MIS Quarterly, 33(3), 473-490.

Sinkula, J.M., Baker W.E., & Noordewier T. (2001). A Framework for Market-Based Organizational Learning Linking Values, Knowledge, and Behaviour. Journal of The Academy of Marketing Science , 24(4), 305-318.

Slater, S.F. & Narver J.C. (1995). Market Orientation and The Learning Organization. Journal of

Marketing, 59, 63-74.

Tarafdar, M. & Gordon S.R. (2007). Understanding the influence of information systems competencies on process innovation: A resource-based view. The Journal of Strategic Information Systems 16(4), 353-392.

Wang, C.L. (2008). Entrepreneurial Orientation, Learning Orientation, and Firm Performance. Entrepreneurship Theory and Practice, 635-657.

Wang, Z. & Wang N. (2012). Knowledge sharing, innovation and firm performance. Expert Systems with Applications, 39(10), 8899-8908.

White, M.A. & Bruton G.D. (2011). The Management of Technology and Innovation : a strategic approach. Australia: South-Western, Cengage Learning.

Wiklund, J. & Shepherd D. (2005). Entrepreneurial orientation and small business performance: a configurational approach. Journal of Business Venturing, 20(1), 71-91.

Yang, J. (2011). Innovation capability and corporate growth: An empirical investigation in China. Journal of Engineering and Technology Management, 1-13.

A Study of International Business Theory Development

Ya-Ping Chou
Cheng-Hsuan Huang
Liang-Hua Chien
Jia-Ying Zhang
Ying-Ying Zhuo
Chia-Shan Tsai
Yi-Chou Wang*
Lecturer and students of Department of International Business Management
Tainan University of Technology, Taiwan, R.O.C
TEL: +886-922520523 E-Mail: yichou@hotmail.com
The authors are deeply indebted to Professor McLee Yender, PhD, of Chang Jung Christian University, who inspired the conceptual framework of this paper.

ABSTRACT

This study is focus on IBR (International Business Review) and JIBSs (Journal of International Business Studies) for recent decades. Using the high cite references to find out the most influential articles and scholars, which presents a solid foundation for a knowledge network in international business area. It also can explore the process to relevant knowledge network. To map the intellectual structure of international business in the past 30 years, which can identify traces the evolution of international business research. It is not only finding the current popular topic, but also provides a valuable tool for researchers to point out e future direction and Contributors.

Key Word: *International Business, Knowledge Network, Citation Analysis, Mapping.*

1. Introduction

International business management includes five major topics which are accounting, finance, business management, information management and international trade. Students need to learn skills in such a wide range departments. It is a very difficult work to has full picture about international business relevant subject, not to mention about to recognize well-known scholars in the field. It should be an easier way to understand aspects of business knowledge. This study is trying to solve this problem. scholars who are interested in international business and who are not familiar will have a short-cut to cut into this area without having to spend a lot of valuable time on ―start-up" stage.

There are 2731 journal in SSCI (Social Science Citation Index) database, but only two journals relevant international business which is IBR (international business review) and JIBS (journal of international business studies). This study was collected all article from these two journals from 1982 to 2011. There are three purposes for this research. First, find out the most influential articles and scholars. Second, discuss theory differential between two periods. The data was divided by two parts (1982-1999) and (2000-2011). Finally, explore the process of international business.

International enterprises are with branches in two or more countries. Punnett (1989) found that the internationalization of enterprises is active and passive which depend on the environment. International business management are often discuss about the internationalization may face problems, such as cost, risk, competitiveness, labor, political and economic and cultural issues. The popular issue including timing of internationalization, choice of the host country, the global division of labor, strategic alliances, human resources management etc. These management issues are rich and diverse. Robinson (1981) described the development of international companies which divided into four phases: (1) after the Second World War to 1955 (2) 1955 to1970, (3) 1970 -1980, (4) after 1980. This study use literature analysis to understand the trend of international business research topics for the past and present.

There are two kinds of literature; the Primary literature (original literature) is creating by researcher which has the greatest influence. Secondary literature are that formed primary literature through sorting and treatment. Garfield (1963) build SCI (Science Citation Index) computerized database. Which can be generate the number of citations, co-citation and self-references from analysis the database (Tsay , 2003). The ISI (Information Sciences Institute) Garfield had said that citation must be a meaningful relationship references and cited articles. The more citation times will indicate that greater of influence.

2. Methodology

First Steps: calculate numbers

Citation analysis has proved a meaningful tool which has been used in information science and other areas (Tsay, 2009). Researchers may consider the earlier concepts so important as they have high cited. Therefore, the numbers of publication gets cited also reflects its influence and become key node. Each key node will present the academic star into the international business domain. key nodes are further loaded with new concepts, ideas, frameworks, or theoretical essentials, i.e., This step is the accumulative of knowledge generation.

Proposition 1: The higher number of times they will get cited in then the article than more important in the field.

Second steps: cross-fields knowledge

key nodes are bridges to connect different theory, which rich the knowledge communication and transmission between relevant parts. As this research mention before the highest number of citations will receive the most recognition, which has more influential status.

Proposition 2: The more important key nodes are more likely to be co-cited.

Third steps: build linkages

In the early stages, these pioneer scholars may constituent fields and publish their ideas. After that, similar follower will enrich the new filed and publication their work. With more linkages between key nods than the new field becomes more integrated and build the knowledge network. The new scholars and their publications will gain their status than new field show up. Such an evolving process, a new field is growing and maturing.

Proposition 3: The linkages among key nodes are built new field.

Fourth Steps: Mapping the Intellectual Structure of international business.

Collected data were analyzed and systematized by sorting, and the structures developed. The knowledge network of international business was mapped to describe the knowledge network.

3. Data Analysis

Citation data was collected from articles between 1982 and 2011. The cited publications in these papers include both published books and other journal articles. a total of JIBS article 1618, reference 68824, IBR article 351, reference 20340. A total of 1969 articles, references 89164. Please see the Table 1 & Table 2.

Table 1:Number of JIBS Articles and Number of References Listings 1982-2011

JIBS	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
Articles	38	52	52	41	57	42	43	49	47	47
References	563	863	885	680	835	733	953	1185	1286	1463
JIBS	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Articles	43	48	45	44	51	36	51	48	42	55
References	1673	1645	1508	1964	1852	2059	2128	2105	1812	2069
JIBS	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Articles	49	51	50	53	64	77	89	94	98	62
References	1905	2178	2400	2896	3553	5357	5535	6339	6264	4136

Table 2:Number of IBR Articles and Number of References Listings 2005-2011

IBR	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Articles	44	44	44	55	55	52	57
References	2113	2277	2392	3016	3297	3438	3807

Ten most Frequently Cited Articles or Books: 1982-1999

NO	FQ	Author	year	Title	Publication Name	
1	97	Hofstede, G.	1980	Culture's Consequences: International differences in work related values.	Beverly Hill, CA, Sage.	
2	65	Buckley, P.J Casson, M.C.	1976	The Future of the Multinational Enterprise	Homes & Meier: London.	
3	58	Stopford JM, Wells LT Jr.	1972	Managing the Multi- national Enterprise	Basic Books: New York.	
4	50	Caves, R.E.	1982	Multinational enterprise and economic analysis Cambridge University Press	Cambridge, MAJ.	
5	42	Prahalad C.K.	1987	The Multinational Mission	Balancing Local Demands and Global Vision. Free Press, New York.	
6	42	Williamson,O.E	1975	Markets and Hierarchies	Analysis and Antitrust Implications. Free Press: New York.	
7	41	Kogut, B.	1988	Joint Ventures	Theoretical and Empirical Perspectives, Strategic Management Journal	319-332
8	41	Porter, M.E.	1980	Competitive Strategy	Techniques for Analyzing Industries and Competitors. New York: Free Press.	
9	39	Johanson, J. Vahlne, J.-E.	1977	The internationalization process of the firm - a model of knowledge development and increasing foreign commitments	Journal of International Business Studies	23-32
10	39	Vernon,R.	1966	International Investment and International Trade in the Product Cycle	The Quarterly Journal of Economics	190-207

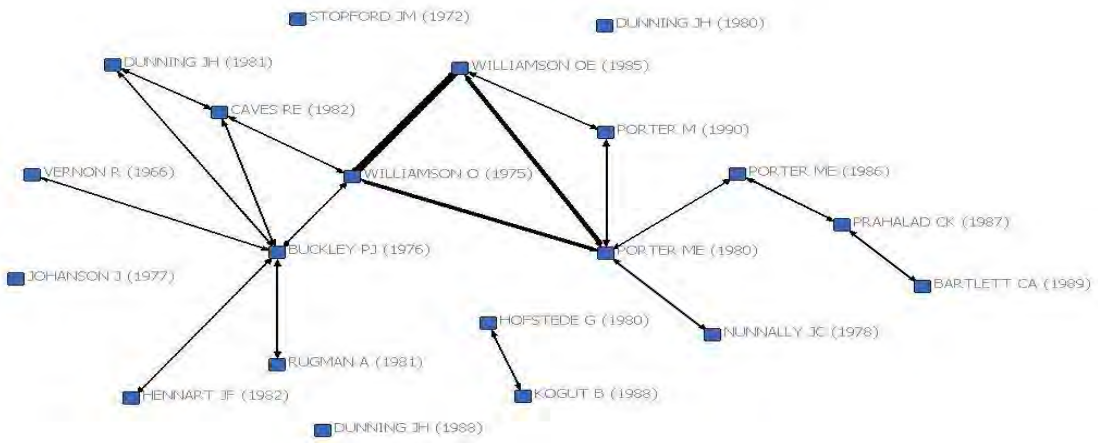
NO：Ranking FQ：Citation

Ten most Frequently Cited Articles or Books: 1999-2011

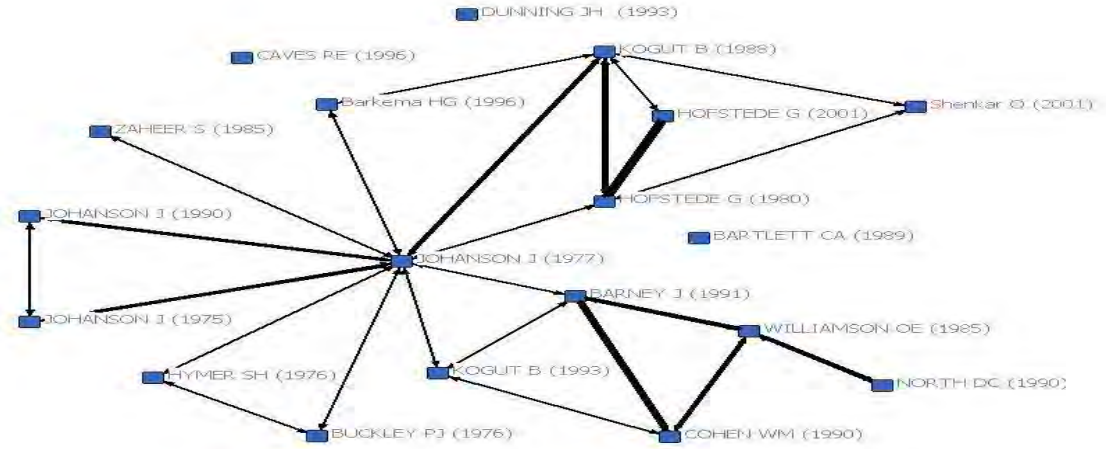
NO	FQ	Author	year	Title	Publication Name	
1	178	Johanson, J., Vahlne, J.-E.	1977	The internationalization process of the firm: a model of knowledge development and increasing foreign market commitments	Journal of International Business Studies	23-32
2	172	Hofstede, G.	1980	Culture's consequences	Beverly Hills, California: Sage.	
3	172	Kogut B.	1988	On designing contracts to guarantee enforceability	Journal of International Business Studies	47-61
4	113	Buckley, P.J. Casson, M.C	1976	The Future of the Multinational Enterprise	Homes & Meier: London.	
5	100	Barney, J	1991	Firm Resources and Sustained Competitive Advantage	Journal of Management	99-120
6	97	North, D.C.	1990	Institutions, Institutional Change, and Economic Performance, Cambridge	Cambridge University Press.	
7	92	Cohen, W. M., D. Levinthal.	1990	Absorptive capacity: A new perspective on learning and innovation	Administrative Science Quarterly	128-152
8	92	Hofstede, G.	2001	Culture's consequences	Thousand Oaks, CA: Sage.	
9	91	Kogut B, Zander I	1993	Knowledge of the firm and the evolutionary theory of the multinational corporation	Journal of International Business Studies	625-645
10	88	Dunning JH.	1993	Multinational Enterprises and the Global Economy	Addison-Wesley: New York.	

NO：Ranking FQ：Citation

By the following two charts we can clearly see that in 20th century because internet was not popular than articles‘ references were most form books. The journal papers were cited relatively small. After 20th century, journal papers and books keep pace with the point and even beyond. The possible factor is popularity of the Internet.



Intellectual Structure of International Business: Before 20th Century



Intellectual Structure of International Business: After 20th Century

We can see from Figure 2 Hofstede, (1980) point out the impact of culture, power distance, individualism and collectivism, uncertainty avoidance and masculinity still many scholars refer to the theory. In early stage Buckley and Casson (1976) who was description of the trend of globalization because cost considerations, plant relocation or transfer of technology to areas of competitive advantage. These theories still attract many scholars‘ attention.

The book which ranked 3th, 4th and 5th had disappeared from latter part of figure. These three books are reducing the number cited because that the issue of multi-national corporations is losing their novelty. Williamson (1975) transaction costs, uncertainty and opportunism, also showing the aging of the literature. Kogut (1988) proposed the theory of internalization. Porter (1980) competitive strategy, cost strategy, differentiation strategy, focus strategy, also has the same phenomenon.

On the contrary, Johanson & Vahlne (1977) the internationalization process of the firm - a model of knowledge development and increasing foreign commitments which become first ranked. The issues had raise at a later stage, which description of the process of internationalization of the firm, increasing foreign market commitment and knowledge management in international companies play an increasingly important role.

4. Implications and Conclusion

In this study we identify the most influential scholars and publications and mapping knowledge network of international business field. The authors chose the period of 1982-2011 because it represented the most current and up-to-data, Citation and co-citation analysis provide significantly effort in this research. Scholars who are interested in this field can access this area through this research, without having to spend a plenty of their time on the start-up stage. Both searchers and researchers can benefit from maps that identify and rate available publishing venues and routes. (Holsapple, 2009). This model can also be easily applied to other disciplines. Researchers can explore to their own fields which can also benefit from understanding the citing processes and outcomes. This methodology combining both citation analysis and content analysis, which can play more important role in the study of international business and other interdisciplinary fields.

References

Buckley, P.J. and Casson, M.C. (1976) *The Future of the Multinational Enterprise*, Homes & Meier: London.

Hofstede, G. (1980).Culture's Consequences: *International differences in work related values*. Beverly Hill, CA, Sage.

Holsapple, C. W. (2009). *A new map for knowledge dissemination channels*. Communications of the ACM, 52(3), 117-125.

Johanson, J. & Vahlne, J.-E. (1977). The internationalization process of the firm-a model of knowledge development and increasing foreign commitments. *Journal of International Business Studies*. 8 (1): 23-32.

Kogut, B. (1988). Joint Ventures: Theoretical and Empirical Perspectives, *Strategic Management Journal*, 9: 319-332.

Ming-Yueh Tsay (2003), *bibliometric and literature features (first edition.)*, National Institute for Compilation and Translation, Taipei.

Ming-Yueh Tsay (2009) , An Analysis and Comparison of Scientometric Data between Journals of Physics, Chemistry and Engineering, *Scientometrics*, Vol.78, No.2, pp.279-293

Porter, M.E. (1980). *Competitive Strategy: Techniques for Analyzing Industries and Competitors*. New York: Free Press.

Punnett, B. J. (1989), *Experiencing International Management,* Boston, MA: PWS-KENT Publishing Company.

Robinson, R. D. (1981), *Background Concepts and Philosophy of International Business from World War II to the Present*. Journal of International Business Studies, pp.13-22.

Vernon,R. (1966).International Investment and International Trade in the Product Cycle. The Quarterly Journal of Economics, 80,190-207.

Williamson, O. E. (1975), *Markets and Hierarchies: Analysis and Antitrust Implications*. Free Press: New York.

Can Corporate Governance Activate R&D?

Li-Hsun Wang[1]
Chu-Hsiung Lin [2]
Chia-Hui Lin [3]

[1]Assistant Professor of Department of International Business Administration
Wenzao Ursuline College of Languages, Taiwan, R.O.C
TEL: +886-7-3426031 E-Mail: 97027@mail.wtuc.edu.tw
[2]Assistant Professor of Department of Finance
National Kaohsiung First University of Science and Technology, Taiwan, R.O.C
TEL: +886-7-6011000 E-Mail: chusiung@mail.nkfust.edu.tw
[3] Ph.D. candidate of College of Finance and Banking, Corresponding Author
National Kaohsiung First University of Science and Technology, Taiwan, R.O.C
Tel: + 886-7-6011000 E-mail: u9747902@ccms.nkfust.edu.tw

ABSTRACT

Extant literature suggests that not all the R&D activities incur pleasing outcome. This study tries to examine whether the corporate governance activates R&D, consequently leading to positive market reaction by using the unbalanced panel Taiwan data from January 1998 to December 2010. We find that market reacts conservatively to electronic firms and positively to non-electronic firms. While the quality of corporate governance is taken into consideration, the interaction between corporate governance and R&D is found to associate positively with stock return in electronic industry. Whereas, no significant relation is found for those non-electronic firms. We suggest that investors might regard R&D as a substitution of corporate governance mechanism in non-electronic industries based on the agency cost hypothesis and the corporate governance enhancing the confidence of investors on R&D activity in electronic industry.

Key Words: *Corporate Governance, R&D, Stock Performance.*

1. Introduction

Either the academic literature or the financial press have long advocated the continual innovation is often the key to companies' growth and competitiveness (e.g., Sundaram et al., 1996; Chan et al., 2001). However, some studies find a positive relation between the market reaction and the R&D expenditure announcement (e.g., Sundaram et al., 1996; Chan et al., 2001; Guo et al., 2006; Xu et al., 2007), while others (e.g., Doukas and Switzer, 1992; Xu, 2006) do not. To date, empirical studies provide no consistent evidence and inconclusive result on the market reactions to the R&D expenditure announcement.

R&D has been deemed essentially as one of the dynamics to improve firm's operational performance, as well as a value relevant information about firm's innovation and future earnings. The apparently characteristic of R&D activity is the expenditure cannot guarantee the increases on firm's growth, profit, or competitiveness. Such scenario is especially often seen in the high-tech industries. Therefore, the R&D sometimes can be regarded as an adventure or a risk taking program. The trade-off between the opportunity and the sunk cost probably makes investors reacting conservatively to firm's R&D.

This study posits that a firm with better corporate governance should associate with a higher probability to harvest the sweet outcome from their R&D and also with the positive market reaction. The corporate governance helps stakeholders of a corporation exercising control over managements for protecting their interests (John and Senbet, 1998). As subsequently, we argue the better corporate governance can enhance the output of R&D activity, as well as the confidence or support of investors on firms' R&D. Wright et al. (2009) propose that changes in levels of R&D spending may be more positively associated with changes in levels of subsequent corporate performance for firms with greater external monitoring or with higher CEO ownership incentives. Therefore, this paper attempts to provide a better understanding on how the quality of corporate governance interacts with the R&D to the initial market reaction.

In recent years, many firms have attained strong domestic and international market positions in products created and developed by high-technology R&D (Liao and Cheung, 2002). These R&D-oriented firms belief that R&D can accelerate the introduction and application of technology in enhancing and creating demand, market value, and competitive advantage. However, does the R&D effect or the market reaction to R&D behave the same and across industries? Cameron (2000) finds the positive impact of R&D on total factor productivity growth, but the effects varied significantly across industries. That is, the divergent R&D effect might lead to different market reaction. Since most studies have focused on high-technology (such as electronic) industries on the issue of R&D (Tsai and Wang, 2009), the second purpose of this study is to investigate whether the market reacts differently to R&D-oriented and non-R&D-oriented firms.

Using the unbalanced panel data from January 1998 to December 2010, we examine the effect of R&D expenditure and the interacted effect of R&D and corporate governance on stock prices of Taiwan public firms. This study utilizes the corporate governance index (GI) of Chen et al. (2007) as a measure of firm's quality of corporate governance. We find that there is no significant relation between firm's excess return and their R&D expenditure in our panel regression analysis. Subsequently, we separate the sample into electronic firm group and non-electric firm group. The R&D expenditure is found to associate positively with the market reaction for non-electronic firms. However, no significant result is found for electronic firms. That is, the R&D spending makes no impact on market reaction in R&D-oriented industries. While the GI and the interaction item of R&D and corporate governance are involved in the regression model, the positive relation we found for non-electronic firms disappears. We interpret that, for non-R&D-oriented firms, investors might regard R&D as a substitution of corporate governance

mechanism. Even the R&D does not play essentially in firms' performance improvement, adopting R&D yields a signal that managements try to make effort on operation. In turn, protect the interests of stakeholders.

An interesting finding is that we find the significant interaction between corporate governance and the R&D expenditure. The interaction effect and the R&D spending associate positively and negatively with the excess return. Such result indicates the investors regard R&D as a risky activity and the better corporate governance can enhance the success of R&D.

In sum, our results provide several contributions to literatures. Since the benefit from R&D will not show up within a short run, results from this study only present how the investors react to the R&D information. In here, we evidence the market reacts differently to R&D across industries. Second, we show the R&D can be used as a substitution of firm's corporate governance in non-R&D-oriented industries. Finally, we evidence the corporate governance play an important role in the initial market reaction to firm's R&D expenditure. The better corporate governance can enhance the confidence of investors on firm's risky activity and have a positive market reaction.

The rest of the paper is organized as follows. In the next section we present the literatures and previous empirical results. In turn, we describe the sample, the variables and the methodology to test the relation between R&D expenditure and market reaction. Subsequently, the analysis of the results is presented in Section 4 and Section 5 concludes.

2. Literature review

Investment in R&D is one of the ways for firms to create new knowledge that can help them to identify and apply the appropriate technology and in turn, increase firms' profitability. Prior literatures suggest that the firm's R&D expenditure is positively associated with either its market value or future profitability (Chan et al., 2001; Guo et al., 2006; Xu et al., 2007). However, Chen et al. (1990) find that firms in high-technology industries which announce increases in R&D spending experience positive abnormal returns, but firms in low-technology industries experience negative returns. Sundaram et al. (1996) also find an insignificant average announcement effect in studying the stock-price response to the changes in R&D spending. They posit the strategic interaction within an industry can affect the wealth of companies and the value of their shares[17] and find the positive (negative) announcement effect of R&D spending when the announcing firm competes in strategic substitutes (strategic complements). However, Chung et al. (1998) document that share price reaction to a firm‘s capital expenditure decisions depends critically on the market‘s assessment of the quality of its investment opportunities rather than its industry affiliation. Hence, even the investment on R&D increases firm's competitiveness and profit, investors react to it depending on what they observed.

[17] They categorize competitive behavior as 'strategic substitutes' or 'strategic complements'. The idea of strategic substitutes is that competitors accommodate a firm's strategic move, and thus act complaisantly. The other is competitors match a firm's strategic move, thereby escalating competition.

R&D investment is equivalently a risky project. Firms probably get no reward from R&D expenditure, especially for those with poor management. Jensen (1993) documents that shareholders might suffer an opportunity loss from the R&D investment when the management is ineffective. Chung et al. (1998) also document that even firms in high-technology industries may have better investment opportunities than firms in low-technology industries, it is quite possible that poorly managed firms in high-technology industries would have lower growth potential than well-managed in low-technology industries. That is, the managements play critically in the R&D program and determine whether the expenditure maximize shareholders‘ wealth. Some studies also find the CEO intention affects the R&D decision. Lundstrum (2002) suggest that R&D expense decreases in the age of the CEO. Nam et al. (2003) evidence that as the sensitivity of managers‘ stock option portfolios to stock return volatility increases firms tend to make higher levels of R&D investment. The intention is stronger when firms are with low outside monitoring. For securing the benefit from the investment on R&D, good corporate governance therefore might be advocated for the improvement on the managerial efficiency.

Corporate governance essentially consists of a set of mechanisms to ensure the suppliers of finance get an adequate return from their investment. Firms with good governance mechanism can possess effective monitoring and controlling on their management about the implement of firm‘s strategies. Therefore, a better corporate governance practices lead to operative and productive management that not only ally the interests of shareholders but also incur higher valuation of rate of return (Gompers et al., 2003; Bebchuk et al., 2009). In other words, stringent corporate governance can enhance the probability of achieving success in firm‘s ongoing investment such like R&D and bring confidence to investors regarding firm‘s prospection. This idea partially gets support from the study of Wright et al. (2009) who find that changes in levels of resource allocations (advertising expenditure, R&D spending, capital intensity) may be more positively associated with changes in the levels of subsequent corporate performance for firms with greater external monitoring.

The monitoring role of the board of directors is an important component of corporate governance. Board of directors is presumed to carry out the monitoring function on behalf of shareholders. It aligns the interests of the shareholders to accomplish its monitoring function (Hirshleifer and Tankor, 1994) and is central to corporate governance mechanisms in market economies (Johan and Senbet, 1998). Essentially, the board effectiveness in its monitoring function is determined by its independence, size, and composition (Johan and Senbet, 1998). A more independent board is assumed to with a higher portion of outside directors in the board since those outside directors act without regarding their personal interest in monitoring managements. However, most of the board contains only one or two outside directors (Bhagat and Black, 1997), making it difficult to exercise that function.

Meanwhile, the monitor function of board should increase as the more directors are added since a closer monitoring by the board can improve the quality of managers' decisions. Worth noting that, the increase in board size would result a less effective performance due to the overwhelming problems in coordination and process. John and Senbet (1998) and Lipton and Lorsch (1992) documented the benefit may be outweighed by the cost of slower decision-making, less-candid discussions of managerial performance, and biases against risk-taking. However, Yermack (1996) finds an inverse association between board size and firm value and further proposes that small boards of directors are more effective.

Even there is no conclusion on whether the board size affects firm's performance; one thing is for sure that a board increases its size due to their poor post performance. Therefore, a larger board size possibly associates with poor performance. Cole et al. (2008) find a U-shaped relationship between the board size and firm performance. That is, a large board of directors makes investors lacking confidence on the monitoring function of the board as well as firms' operation or investments.

The effectiveness of a board in fulfilling their responsibility could be affected by the way the board is constructed. Klein (1995) proposes a board structure with specialized roles can enhance the board's performance in its productivity and monitoring. That is, the board should be constructed by members specialized in different management fields. Through the monitoring of specialized board of directors on the specialized CEO, firms can perform better. However, should a small firm have two executives? This question raises the CEO duality issue. The board of directors is responsible in setting the corporate goals, which aim at realizing shareholders‘ wealth. Meanwhile, they should monitor the performance of the management for ensuring the operational efficiency and give rewards or punishments to the management. As such, CEO duality incurs the inefficient monitoring. Palmon and Wald (2002) provide suggestion from the prospective of firm size. They find that small firms benefit more from the clarity and decisivness of decision-making under a single executive, while large frims benefit more from the checks and balances of having two executives. Therefore, for firms who are small should apply the CEO duality and firms who are large should be prohibited.

Several prior studies have documented the function of institutional investors in corporate governance (e.g., Gillan and Starks, 2000; Demiralp et al., 2011). Due to the institutional investors typically control a large portion of votes, managers are more amenable to their demands (Parrino et al., 2003). Burns et al. (2010) report that monitoring by certain types of institutional investors reduces earnings management. Aggarwal et al., (2011) also document that firms with higher institutional ownership are more likely to terminate poorly performing CEOs. Through such powerful monitoring, institutional investors may enhance shareholder value by preventing value dissipating or the free cash flow problem in the firm. An argument that institutional investment managers, who generally focus on short-term corporate earnings, are a dominant force in affecting stock prices. For attracting these institutional investors, managers are discouraged from investing for the long-term project such like R&D investment. To this, Wahal and McConnell (2000) find no support for the contention that institutional investors cause corporate managers to behave myopically and document a positive relation between the R&D expenditure and the fraction of shares owned by institutional investors. According to the above studies, investors should react more confidently to the R&D expenditure of firms who are with institutional investors.

3. Data and methodology

In order to accommodate the impact of R&D on stock prices and understand whether the corporate governance interacts with the R&D in pricing, we utilize the three-factor model of Fama and French (1993) by using firm-level panel data. The primary advantage of panel data is that it mitigates the correlated omitted variables bias where most unobservable factors affecting firm value are unlikely to vary much for a given firm during a short time period. Since Callen and Morel (2005) document that most of researches in this field undertake the analysis of cross-sectional samples (e.g., Wahal and McConnell,

2000; Veugelers and Cassiman, 2006; Schmiedeberg, 2008) or the fixed effect panel regression (Callen and Morel, 2005; Cruz-Cázares et al., 2010). In this study, we undertake the fixed effect panel model and the quarterly data. The data we used are obtained from the Taiwan Economic Journal (TEJ).

Excluding the sample with insufficient data, this study embraces 51,489 observations corresponding to 1,010 firms for the unbalanced panel data from 1998:Q1 to 2010:Q4. For ascertaining whether the market reacts differently to firms in innovation-oriented industry, we separate the Taiwan sample into two groups. One is the electronic industry and the other is non-electronic industry. As such, this study obtains 685 samples with 34,915 observations in electronic group and 325 samples with 16,574 observations in non-electronic group.

3.1 Panel regression model

Following the three-factor model of Fama and French (1993), the dependent variable is set as the excess return (*ER*), which is measured as the difference of quarterly stock return and risk free interest rate. For investigating how the market response to firm's R&D expenditure, we modified the three-factor model as:

$$ER_{i,t} = \beta_1 \cdot (R_{m,t} - R_{f,t}) + \beta_2 \cdot HML_t + \beta_3 \cdot SMB + \beta_4 \cdot Debt_{i,t} + \beta_5 \cdot ROA_{i,t} + \beta_6 \cdot Turn_{i,t} + \beta_7 \cdot RD_{i,t} \quad (1)$$

where the $R_{m,t}$ is the market return and the $R_{f,t}$ is the risk free rate in quarter *t*. The HML_t and SMB_t are the Fama-French book-to-market and size factor returns. HML_t is the high-minus-low book-to-market portfolio return in month *t* and SMB_t is the small-minus-big size portfolio return in month *t*.

The control variables are firm's debt ratio (*Debt*), return-on-asset (*ROA*), and stock turnover (*Turn*). They are measured as:

$$Debt_{i,t} = \frac{Total\ Liability_{i,t}}{Total\ Asset_{i,t}} \quad (2)$$

The $Total\ Liability_{i,t}$ is the total liability of firm *i* at the end of quarter t, and the $Total\ Asset_{i,t}$ is the total asset of firm *i* at the end of quarter *t* (Chen et al., 2007).

$$ROA_{i,t} = \frac{net\ income\ before\ extraordinary\ items_{i,t}}{(total\ asset_{i,t} + total\ asset_{i,t-1})/2} \quad (3)$$

The $ROA_{i,t}$ is equal to the net income before extraordinary items scaled by the average of beginning- and ending period book value of total asset for firm *i* at quarter *t* (Grullon and Michaely, 2004).

$$Turn_{i,t} = \frac{trading\ volumn_{i,t}}{The\ number\ of\ shares\ outstanding_{i,t}} \quad (4)$$

The $Turn_{i,t}$ is measured as the number of shares traded in the quarter *t* scaled by the total number of outstanding shares for firm *i* at quarter *t*. As to the R&D expenditure (*RD*), we measure it as the ratio of R&D expenditure to the sales as Lundstrum (2002) as:

$$RD_{i,t} = \frac{R\&D\ Expenditure_{i,t}}{Sales_{i,t}} \cdot 100\% \quad (5)$$

3.2 Corporate governance index

For measuring the quality of corporate governance for each firm, we employ the governance index (GI) constructed by Chen et al. (2007) as a proxy measure of the effectiveness of the corporate governance mechanism. The GI is built based on four different aspects of the firm's governance structure: the CEO duality, the size of the board of directors, the managements' holdings, and the block shareholders' holding. As Palmon and Wald (2002) showed, once a chairperson of the board (COB) also serves as a CEO, the duality can establish a stronger and clear leadership in a small firm and can incur agency cost in a large firm. Therefore, Chen et al. (2007) construct the CEO duality indicator as 1 for small firms if the COB also serves as the CEO or for large firm if their COB does not serve as CEO, and 0 elsewhere. Meanwhile, due to that a large board harms firm value (Yermack, 1996), Chen et al. (2007) construct a size indictor as 0 if the board size is less than the minimum legal requirement or is larger than two standard deviations from the mean and 1 elsewhere.

According to the convergence of interest hypothesis of Jensen and Meckling (1976), the managerial interests converge with those of outside minority shareholders while management shareholding increasing. Chen et al. (2007) employ the percentage of shares owned by the top five largest shareholders as a proxy for the managerial ownership. They set the managerial ownership indicator to be 1 if those top five largest shareholders own more than 10 percent of the firm shares, and to be 0 otherwise. Finally, the block shareholders' holding indicator, which presents the effectiveness of monitoring by the outside block shareholders. Chen et al. (2007) set the block shareholder indicator as 1 if there is an individual who holds a minimum of 5 percent shares of the firm and as 0 elsewhere.

These four indicators measure the quality of corporate governance of a firm and the GI is calculated as the sum of those four indicators and can be expressed as:

$$GI_{i,t} = CEO\ Duality\ Indicator_{i,t} + Board\ Size\ Indicator_{i,t} + Managerial\ Ownership\ Indicator_{i,t} + Block\ Shareholders'\ Holding\ Indicator_{i,t} \quad (6)$$

Therefore, GI is range from 0 to 4 and the higher the GI value, the better the governed the firm is. We obtain the four indicators from the quarterly financial report for each firm from TEJ or the Market Observation Post System[18].

[18] According to the Securities and Exchange Law, firms who have issued securities should disclosure their information on Market Observation Post System.

3.3 The interaction

For investigating whether the corporate governance helps the market to react to firm's R&D expenditure, we extend the model (1) by adding the corporate governance index as:

$$ER_{i,t} = \beta_1 \cdot (R_{m,t} - R_{f,t}) + \beta_2 \cdot HML_t + \beta_3 \cdot SMB + \beta_4 \cdot Debt_{i,t} + \beta_5 \cdot ROA_{i,t} + \beta_6 \cdot Turn_{i,t} + \beta_7 \cdot RD_{i,t} + \beta_7 \cdot GI_{i,t} + \beta_8 \cdot Interaction_{i,t} \quad (7)$$

The $Interaction_{i,t}$ is the interaction item which is calculated as the product of $RD_{i,t}$ and $GI_{i,t}$ for firm i at quarter t. We use it to capture the interaction between R&D expenditure and the corporate governance. As this study posited, we should find a positive and significant coefficient (β_8).

Due to the studies on R&D expenditure and firms' performance use either the cross-section regression or the panel regression with fixed effect model, this study takes the advantage of panel data and apply the fixed effect regression model. For the consideration of the heterogeneous variance, we implement the White cross-section approach to process the covariance.

4. Empirical result

In this study, samples are selected from the period of 1998:Q1 to 2010:Q4. We obtained 1,010 firms with a maximum of 52 quarterly data points per firms. In sum, 51,489 firm-quarterly of data is formed as an unbalance panel. Table 1 shows the descriptive statistics of the variables used in this study.

[Insert Table 1 herre]

As can be seen, the average of *GI* is about 1.4067 on quarterly base, indicating that the improvement on corporate governance is needed for Taiwanese frims. This result is similar to the finding of Chen et al. (2007) that the average GI is about 1.83 measured on yearly base. In addition, the average GI for electronic firms is 1.3812, which is less than the value (1.4604) for non-electronic firms. The reason is many start-up technology firms, which are generally small and lack of well corporate governance mechanism, are classified in the electronic group. Furthermore, firms invest about 4.01% of their quarterly sales as R&D expenditure averagely. Due to the sales for electronic firms are higher than that for non-electronic firms averagely. The average R&D expenditure in electronic industry is 3.6254%. That is also lower than the average spending for non-electronic firms on R&D activities.

Due to the panel data combines both the cross-sectional and time series information. On the issue of stationarity, accounting and market data are generally be assumed to exhibit unit roots. For investigating whether the deterministic trend exists, this study undertakes the unit root test for solving the doubt that generally raised from time series data. The Adjusted Dickey Fuller test or the Phillips-Perron test shows the rejection of the null hypotheses that R&D expenditures exhibit unit roots. Therefore, the R&D ratio can be assumed to act as random walk.

In our panel regression analysis (Table 2), we find that market does not react to firms' R&D expenditure. Similar result is also found for electronic firms. However, the significantly positive relation between R&D spending and the market return is found for non-electronic firms. These findings suggest that market reacts differently across industries. Meanwhile, it is possible that investors might neglect firms' R&D investment in R&D-oriented industry since the spending on R&D is prevalent. Contrarily, investors might regard the R&D expenditure as a message that firms are trying to undertake a strategic competition for non-electronic firms. As such, the market reacts positively to the R&D expenditure.

[insert Table 2 here]

For investigating whether the corporate governance interact with firms' R&D investment, we utilize the corporate governance index and the interaction term in the panel regression analysis. Our findings are reported in Table 3. The results show the interaction item and R&D expenditure displays a positive and negative relation with firms' excess return respectively in the sample of electronic firms. Such positive and negative relations partly explain why there is no significant relation was found in Table 2 and the results indicate that corporate governance helps the market to react to firms' R&D expenditure.

[Insert Table 3 here]

Interestingly, the positive relation we found in Table 2 disappears when the GI and interaction term are involved in the regression analysis. Moreover, the relation between GI and excess return is significantly positive. These findings suggest that investors might take firms' R&D expenditure as a substitution of corporate governance. Based on the agency cost hypothesis, the agency cost can be reduced by firms' spending. Therefore, market will react positively to the R&D spending since the investment somewhat reduces indistinct agency problem by the distribution of firms' free cash flow. However, the corporate governance dominates the effect from the cash distribution.

5. Conclusion

Investment on R&D has long been suggested as a key factor to improve firm's growth, performance, and competition. It is also well known that not every R&D activity meets the expected outcome. As Xu (2006) documented, R&D progress conveys useful risk-relevant information to the market. To date, no consistent conclusion is made for how the market reacts to firms‘ R&D expenditure. We question that market might stand upon the trade-off between the opportunity and the suck cost generated by R&D activity and react conservatively to firms' R&D expenditure. Due to the corporate governance can protect shareholders‘ interests from the management inefficiency, we posit that for firms who are better governed are more likely to receive the benefit from their R&D and investigate whether the corporate governance can enhance the confidence of investors on firms‘ R&D activities.

Using unbalanced panel data gathered from 1998:Q1 to 2010:Q4, we obtain 1,010 firms and 51,489 observations on a quarterly base. Of these, 685 samples are classified in electronic industry, which is R&D-oriented firms, and 325 firms are non-electronic firms. Similar to most empirical studies, we find the market reacts positively to non-electronic firms' R&D expenditure. However, when we take the corporate governance into consideration, the positive relation is superseded by the quality of corporate governance. We suggest that the investors probably take firms' R&D expenditure as a substitution of corporate governance mechanism since the expenditure reduces the agency problem by expending their free cash flow.

For those electronic firms, we initially find the market does not react to the investment on R&D, which is different with the finding for non-electronic firms. Such result provides support to the suggestion of Sundaram and John (1996) that announcement effects can depend totally on whether the market is characterized by strategic substitutes or complements. Interestingly, the interaction between corporate governance and R&D expenditure impacts positively on market reaction and the market reacts negatively to the R&D spending. Such findings indicate that investors regard R&D activity as a risky process. However, the corporate governance can provide protection and confidence to them in this risky game.

In sum, this study provides evidence that corporate governance helps market to react to firms' R&D expenditure. Due to that the benefit from R&D activity cannot be received in the short run, this study only presents how the investors deal with the information of R&D expenditure associating with the corporate governance.

Reference

Brennan, M.J., and T.E. Copeland, 1988, "Beta Changes Around Stock Splits: A Note," *The Journal of Finance*, Vol. 43, No.4, p.p.1009-1013.

Abdullah, S.N., 2004," Performance among Malaysian listed companies," *Corporate Governance,* Vol. 4, p.p.47-61.

Bebchuk, L.A., C. Alma, and A. Ferrell, 2009, "What matters in corporate governance?" *Review of Financial Study*, Vol. 22, p.p783-827.

Burns, N., S. Kedia, and M. Lipson, 2010, "Institutional ownership and monitoring: Evidence from financial misreporting", *Journal of Corporate Finance*, Vol. 16, p.p.443-455.

Cameron, G., 2000, "R&D and growth at the industry level," *Nuffield Colldge Economic Papers 2000-W4*. University of Oxford, UK.

Chan, L.K.C., J. Lakonishok, and T. Sougiannis, 2001, "The stock market valuation of research and development expenditures," *Journal of Finance,* Vol. 56, p.p.2431-2456.

Chan, S.H., J.D. Martin, and J.W. Kensinger, 1990, "Corporate research and development expenditure and share value," *Journal of Financial Economics*, Vol. 26, p.p.255-276.

Chen, A., L. Kao, M. Tsao, C. Wu, 2007, "Building a corporate governance index from the perspectives of ownership and leadership for firms in Taiwan," *Corporate Governance: An International Review*, Vol. 15, p.p.251-261.

Chung, K.H., P. Wright, and C. Charoenwong, 1998, "Investment opportunities and market reaction to capital expenditure decisions," *Journal of Banking and Finance*, Vol. 22, p.p.41-60.

Coles, J.L., N.D. Daniel, and L. Naveen, 2008, "Boards: Does one size fits all," *Journal of Financial Economics*, Vol. 87, p.p.329-356.

Cruz-Cázares, C., Bayona-Sáez, and T. García-Marco, 2010, "R&D strategies and firm innovative performance: A panel data analysis," *International Journal of Innovation Management*, Vol. 14, p.p.1013-1045.

Gillan, S., and L. Starks, 2000, "Corporate governance proposals and shareholder activism: the role of institutional investors," *Journal of Financial Economics*, Vol. 57, p.p.275-305.

Gompers, Pl, J. Ishii, and A. Metrick, 2003, "Corporate governance and equity prices," *Quarterly Journal of Economics*, Vol. 118, p.p.107-155.

Guo, R., B. Lev, , and C. Shi, 2006, "Explaining the short- and long-term IPO anomalies in the US by R&D," *Journal of Business Finance and Accounting*, Vol. 33, p.p.550-579.

Jensen, M.C., 1993, "The modern industrial revolution, exit, and the failure of internal control systems," *Journal of Finance*, Vol. 48, p.p.831-880.

Jensen, M.C., and W.H. Meckling, 1976, "Theory of the firm: Managerial behavior, agency costs, and ownership structure," *Journal of Financial Economics*, Vol. 3, p.p.305-360.

John, K., and L.W. Senbet, 1998, "Corporate governance and board effectiveness," *Journal of Banking and Finance*, Vol. 22, p.p.371-403.

Kafouros, M.I., 2005, "R&D and productivity growth: Evidence from the UK," *Economics and Innovations and New Technology*, Vol. 14, p.p.479-497.

Kallunki, J., E. Pyykkö, and T. Laamanen, 2006, "Stock market valuation, profitability and R&D spending of the firm: The effect of technology mergers and acquisitions," *Journal of Business Finance and Accounting*, Vol. 36, p.p.838-862.

Lipton, M., and J.W. Lorsch, 1992, "A modest proposal for improved corporate governance," *Business Lawyer*, Vol. 48, p.p.59-77.

Lundstrum, L.L., 2002, "Corporate investment myopia: a horserace of the theories," *Journal of Corporate Finance*, Vol. 8, p.p.353-371.

Nam, J., R.E. Ottoo, and J.H. Thornton, 2003, "The effect of managerial incentives to bear risk on corporate capital structure and R&D investment," *The Financial Review*, Vol. 38, p.p.77-101.

Palmon, O, and J.K. Wald, 2002, "Are two heads better than one? The impact of changes in management structure on performance by firm size," *Journal of Corporate Finance*, Vol. 8, p.p.213-226.

Parrino, R., R. Sias, and L. Starks, 2003,." Voting with their feet: institutional ownership changes around forced CEO turnover," *Journal of Financial Economics*, Vol. 68, p.p.3-46.

Ryan, H.E., and R.A. Wiggins, 2002, "The interactions between R&D investment decisions and compensation policy," *Financial Management*, Vol. 31, p.p.5-29.

Schmiedeberg, C., 2008, "Complementarities of innovation activities: An empirical analysis of the German manufacturing sector," *Research Policy*, Vol. 37, p.p.1492-1503.

Veugelers, R., and Cassiman, B., 2006. In search of complementarity in innovation strategy: Internal R&D and external knowledge acquisition. Management Science 52, 68-82.

Wahal, S., and J.J. McConnell, 2000, "Do institutional investors exacerbate managerial myopia?" *Journal of Corporate Finance*, Vol. 6, p.p.307-329.

Wright, P., M. Kroll, A. Mukherji, and M.L. Pettus, 2009, "Do the contingencies of external monitoring, ownership incentives, or free cash flow explain opposing firm performance expectations?" *Journal of Management and Governance*, Vol. 13, p.p.215-243.

Xu, B., 2006, "R&D progress, stock price volatility, and post-announcement drift: An empirical investigation into biotech firm," *Review of Quantitative Finance and Accounting*, Vol. 26, p.p.391-408.

Xu, B., M.L. Magnan, and P.E. André, 2007, "The stock market valuation of R&D information in Biotech firms," *Contemporary Accounting Research*, Vol. 24, p.p.1291-1318.

Yermack, D., 1996, "Higher market valuation of companies with a small board of directors," *Journal of Financial Economics*, Vol. 40, p.p.185-211.

Table 1
The descriptive statistics

This table presents the descriptive statistics of variables used in this study. Using the data from 1998:Q1 to 2010:Q4, this study obtains 1,010 samples and 51,489 quarterly-firm observations. Of these, 685 firms are in electronic industry and 325 firms are classified as non-electronic firms. The ER is the quarterly excess return, which is computed as the quarterly return minus the risk free rate. The DEBT, ROA, and TURN are the control variables. The RD is the firm's R&D expenditure scaled by the quarterly sales. Finally, the GI is the proxy measure on the quality of firm's corporate governance. The definitions of all variable are reported in the text.

All sample						
	ER	DEBT	ROA	TURN	RD	GI
Mean	2.1922	27.7423	1.8180	40.0118	4.0118	1.4067
Median	-1.0208	29.3200	1.4000	15.4102	0.9800	1
Maximum	546.287	195.570	61.460	598.020	31155.10	4
Minimum	-86.394	0	-83.610	0.000	-144.460	0
Std. Dev.	26.3196	21.1061	3.2501	60.0445	137.2251	0.8935
Observations			51,489			
Electronic firms						
	ER	DEBT	ROA	TURN	RD	GI
Mean	2.1800	25.5311	1.8585	43.5108	3.6254	1.3812
Median	-1.0483	26.4100	1.2300	15.9967	1.3500	1
Maximum	546.2873	111.050	61.460	598.020	684.56	4
Minimum	-86.3941	0	-72.730	0.0000	-52.4600	0
Std. Dev.	27.4443	21.1638	3.4201	64.7184	9.9460	0.9181
Observations			34,915			
Non-Electronic firms						
	ER	DEBT	ROA	TURN	RD	GI
Mean	2.2178	32.4006	1.7327	32.6408	4.8259	1.4604
Median	-0.7653	34.5900	1.5700	14.7968	0.5600	1
Maximum	353.8491	195.570	52.980	461.272	31155.10	4
Minimum	-85.6482	0	-83.6100	0.0000	-144.4600	0
Std. Dev.	23.7777	20.2078	2.8574	47.9267	241.4397	0.8367
Observations			16,574			

Table 2

Panel regression analysis on the R&D expenditure to market reaction

This table presents whether market reacts to firms' R&D expenditure. Using the data from 1998:Q1 to 2010:Q4, this study obtains 1,010 samples and 51,489 quarterly-firm observations. Of these, 685 firms are in electronic industry and 325 firms are classified as non-electronic firms. For investigating how the market reacts to firms' R&D expenditure, we extend the three-factor model of Fama and French (1993) for conducting empirical study. The dependent variable is the excess return. The MP presents the difference between the market return and the risk free rate. The SMB and HML are as same as those used in the three-factor model. In addition, the control variables are firm's debt ratio (Debt), return-on-asset (ROA), and stock turnover (Turn) that have been defined in the text. Finally, the RD is utilized as the proxy of firms' R&D expenditure. We also use the White cross-section method to deal with the heterogeneous error.

	All samples	Electronics	Non-Electronics
MP	0.6152***	0.6513***	0.5429***
	(0.0000)	(0.0000)	(0.0000)
SMB	0.1361*	0.1382	0.1368
	(0.0749)	(0.1207)	(0.1859)
HML	-0.0932*	-0.0636	-0.1608**
	(0.0520)	(0.2671)	(0.0401)
DEBT	-0.1196***	-0.1353***	-0.0588*
	(0.0007)	(0.0001)	(0.0840)
ROA	0.8567***	0.8292***	0.9690***
	(0.0000)	(0.0000)	(0.0000)
TURN	0.1237***	0.1160***	0.1549***
	(0.0000)	(0.0000)	(0.0000)
RD	0.0003	-0.0488	0.0004*
	(0.2246)	(0.2649)	(0.0765)
Adj. R^2	0.2191	0.2184	0.2312
Number of Firms	1010	685	325
Observations	51,489	34,915	16,574

*significant at the 10% level
**significant at the 5% level
***significant at the 1% level

Table 3

Interaction of corporate governance and R&D expenditure on market reaction

Using the data from 1998:Q1 to 2010:Q4, this study obtains 1,010 samples and 51,489 quarterly-firm observations. Of these, 685 firms are in electronic industry and 325 firms are classified as non-electronic firms. For investigating whether the corporate governance interacts with firms' R&D expenditure on the market reaction, we extend the three-factor model of Fama and French (1993) for conducting empirical study. The dependent variable is the excess return. The MP, SMB, HML, Debt, ROA, Turn, and RD are as same as we used in Table 2. We also regress the quality of corporate governance (GI) and the cross item (Interaction) on the excess return. The definitions of all variable are reported in the text. We also use the White cross-section method to deal with the heterogeneous error.

	All samples	Electronics	Non-Electronics
MP	0.6155***	0.6515***	0.5388***
	(0.0000)	(0.0000)	(0.0000)
SMB	0.1360*	0.1376	0.1348
	(0.0743)	(0.1206)	(0.1853)
HML	-0.0927*	-0.0631	-0.1648**
	(0.0533)	(0.2686)	(0.0366)
DEBT	-0.1167***	-0.1304***	-0.0670**
	(0.0003)	(0.0001)	(0.0385)
ROA	0.8545***	0.8417***	0.9518***
	(0.0000)	(0.0000)	(0.0000)
TURN	0.1238***	0.1162***	0.1548***
	(0.0000)	(0.0000)	(0.0000)
GI	-0.1369	-0.4739	1.1586*
	(0.7583)	(0.3542)	(0.0655)
RD	-0.1087**	-0.1529**	-0.0448
	(0.0221)	(0.0363)	(0.3870)
Interaction	0.0546**	0.0724***	0.0226
	(0.0215)	(0.0053)	(0.3815)
Adj. R2	0.2197	0.2191	0.2320
Number of Firms	1010	685	325
Observations	51489	34915	16574

*significant at the 10% level
**significant at the 5% level
***significant at the 1% level

Market Value in the Context of the Residual Income Valuation Model

Chao-Hui Yeh

Department of Business Administration; I-Shou University, Taiwan, ROC;

TEL: +886-7-6577711#5914 E-Mail: chy@isu.edu.tw

ABSTRACT

We generalize Yeh's (2001) model to growth rates. Our analysis of the case when earnings suffice for valuation yields two models. Both (I) and (II) models can explain the price-to-forward-earning (P/E) ratio, but they do so with different dependent variables. In case of (I) formula, the return on equity (ROE) explains the P/E ratio. In case of (II) formula, the growth in expected net income explains the P/E ratio. Therefore one obtains two distinct ways of explaining the P/E ratio with transforming the mathematics. With growth being expected, it follows that the firm's price equates book values add growth or equates capitalized forward net income add growth. The contribution of this paper is to add a new model to the valuation theory.

Key Words: *Valuation Model, Residual Income, and Growth.*

1. Introduction

After Ohlson 1995(O95) and Yeh (2001), literatures (2012 Silvestri and Easterday 2011) have been published numerous papers on accounting data and value. A review of this literature reveals that many themes and insights recur across the papers. This paper addresses the essence of O95 and tries to integrate the O95 literatures, and thereby making the O95 literatures more accessible to the average reader. Only with a systemized overview of the O95 literatures can a reader compare how models differ in their key characteristics (like their reliance on certain measures of growth). The paper considers situations in which price equal capitalized forward net income add growth in net income and book values.

O95 and Yeh (2001) built on the foundations provided by Residual Income Valuation (RIV) model that is not empirically testable. Thus, the main contribution of this paper is to provide additional assumptions linking the RIV model to testable propositions by modeling the information dynamics. When compared to other model such as O95 and Yeh (2001), this paper integrates and systemizes the O95 literatures.

As a preliminary to deal with growth, the paper lays out the framework for (I) Book Value plus Residual Income (BVRI) valuation model and (II) Capitalized Earning & Increments in Residual Income (CE&IRI) valuation model. The derivations of the (I) and the (II) are from present value of expected dividends (PVED), but the (I) emphasizes book values while the (II) emphasizes earning (earning also called net income). The (I) represents PVED via book value plus the present value (PV) of residual net income. Residual net income can be thought of as simply the change in book values with an adjustment

for dividends. This manner of treating at residual net income causes an emphasis of growth of book values. On the other hand, the (II) formula derivation does not introduce book values. The (II) formula represents PVED via capitalized both forward earning and the PV of capitalized increments in residual net income. Both (I) and (II) are valuation tools; the goal of this paper is to show how growth influences valuation.

2. Model

This paper uses the following notation: V_t = Value of equity, D_t = Dividends, B_t = Book value, I_t = net Income. $I_t^R = I_t - r \times B_{t-1}$ = Residual (abnormal) Income (RI), $R = 1 + r$ = the discount factor, an exogenous constant equals the risk-free rate. RI is defined as current earnings minus the risk-free rate times the beginning of period book value, that is, earnings minus a charge for the use of capital. As is normal, this paper assumes that present value of expected dividends (PVED) determines value:

$$V_t = \sum_{s=1}^{\infty} E_t \left[\frac{\tilde{D}_{t+s}}{(1+r)^s} \right] \text{[PVED]}$$

We use table 1 to describe the notations of this paper.

Table 1 is the Table of notations.

V is the equity value of a firm	D is the Dividends of a firm	B is the book value	I is the net Income of a firm	I^R is the Residual Income of a firm
r is the discount rate	R is the discount factor (R=1+r)	x is the random variable	g is the growth rate (g < r)	$(\Delta I_{t+1}^R)/I_t^R$ *is growth in* I_t^R.

$$V_0 = x_0 + \sum_{t=1}^{\infty} R^{-t}(x_t - Rx_{t-1} + D_t) \cdots\cdots (1)$$

□

Certainly, the analysis is valid for any x-series

(I) Book Value plus Residual Income (BVRI) valuation model.

$$V_0 = B_0 + \sum_{t=1}^{\infty} R^{-t}(I_t^R) \cdots\cdots (2)$$

(II) Capitalized Earning & Increments in Residual Income (CE&IRI) valuation model.

$$V_0 = \frac{I_1}{r} + \sum_{t=1}^{\infty} R^{-t}\left(\frac{I_{t+1}}{r} - R\frac{I_t}{r} + D_t\right) = \frac{1}{r}\left[I_1 + \sum_{t=1}^{\infty} R^{-t}(\Delta I_{t+1}^R) \right] \cdots\cdots (3)$$

We build on the dividend discount model (PVED) using the following unified valuation framework. The framework emphasizes that from a mathematical point of view, one can use dividends, earnings, residual earnings, or free cash flows for valuation. To simplify the mathematical expressions, hereafter date 0 (NOT t) specifies the valuation date.

Mathematical zero-sum series equality provides the analytical starting point. For any series of numbers $x_0, x_1, \cdots$

$$0 = x_0 + R^{-1}(x_1 - Rx_0) + R^{-2}(x_2 - Rx_1) + \cdots = x_0 + \sum_{t=1}^{\infty} R^{-t}(x_t - Rx_{t-1})$$

$R^{-t}x_t \to 0$, When $t \to \infty$.

If x_t (numerator) grows slower than R^{-t} (denominator), then $R^{-t}x_t \to 0$.

That $R^{-t}x_t \to 0$ makes sense; due to no firm will grow forever.

Adding PVED to zero-sum series produces the first (1) equation.

$$V_0 = x_0 + \sum_{t=1}^{\infty} R^{-t}(x_t - Rx_{t-1} + D_t) \cdots\cdots (1)$$

Certainly, the analysis is valid for any x-series. The idea is that one can represent value in respect of two parts: a starting point, x_0, and a complement defined by the present value of a generic series, $x_t - Rx_{t-1} + D_t$ which implants the series of dividends.
One starts with the book value of equity as follows.
By putting $x_t = B_t$ and combining it with residual income (RI) and clean surplus relation (C.S.R.).
We get $B_t - RB_{t-1} + D_t = I_t^R$ and the second equation (2) and call it as
(I) Book Value plus Residual Income (BVRI) valuation model.

$$V_0 = B_0 + \sum_{t=1}^{\infty} R^{-t}(I_t^R) \cdots\cdots (2)$$

The price (V_0) is explained by the initial book value (B_0) and the subsequent growth in book value. If the firm has no growth (R.I.), then price (V_0) equate the initial book value (B_0). The model fastens value on book value and plus a premium for the present value of residual income (super growth in book value). The super growth is the growth beyond what could be achieved by making the normal rate of return on book value. Book value growth is explained by the I_t^R due to the subsequent book value increase in I_t^R ($I_t^R = B_t - (R-r)B_{t-1}$).
The subsequent book value increase in I_t^R, due to

□ $I_t^R = B_t - RB_{t-1} + D_t = B_t - RB_{t-1} + rB_{t-1} = B_t - (R-r)B_{t-1}$, $if\ D_t = r \times B_{t-1}$

□

The $D_t = r \times B_{t-1}$ means fixed dividends policy and $r = 0$ means zero dividends policy and the $B_t - (R-r)B_{t-1}$ means growth in book value. $The\ growth\ in\ b_{t-1}: \dfrac{\left[b_t - (R-r)b_{t-1}\right]}{b_{t-1}}$

The market-to-book ratio ($\dfrac{V_0}{B_0}$) increases as subsequent I_t^R increases.

Book value and its growth are famous valuation models only in banking industries. Analysts in many other industries focus on earnings and earnings growth. In the following, we show that instead of starting the valuation with book value, one can start with capitalized forward earnings and then plus a premium for abnormal earnings growth. We call this model the Capitalized Earning & Increments in Residual Income (CE&IRI) valuation model.

Instead of starting with book value of equity, one can start with the Capitalized earning as follows. In a similar spirit, by putting $x_t = \dfrac{I_{t+1}}{r}$, we get the third equation (3) and call it as

(II) Capitalized Earning & Increments in Residual Income (CE&IRI) valuation model.

$$V_0 = \frac{I_1}{r} + \sum_{t=1}^{\infty} R^{-t}\left(\frac{I_{t+1}}{r} - R\frac{I_t}{r} + D_t\right) = \frac{1}{r}\left[I_1 + \sum_{t=1}^{\infty} R^{-t}(\Delta I_{t+1}^R)\right] \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots (3)$$

The price (V_0) is explained by capitalization of next period's expected earning ($\dfrac{I_1}{r}$) and the subsequent growth (increments) in residual net income.

Residual earning (income) growth is explained by the $\left[\sum_{t=1}^{\infty} R^{-t}(\Delta I_{t+1}^R)\right]$ due to $(\Delta I_{t+1}^R)/I_t^R = growth\ in\ I_t^R.$

If the firm has no growth (ΔI_{t+1}^R), then price (V_0) equate the capitalization of next period's expected earning ($\dfrac{I_1}{r}$). That $V_0 \times r = I_1$ means time value of money. The V_0 is the beginning investment, the r is ROR and the I_1 is income. Each dollar of stock price (V_0) forecasts r dollars of next period earnings. In a certainty setting (referred to as the "savings account"), where V_t is the amount deposited in the savings account; x, is earnings (the dollar amount of the interest on the savings account deposit) for period t; r is the rate of interest on the savings account deposit; and D_t is the dividend paid to the owner of the savings account (the amount that the depositor chooses to withdraw) at time t.

In the third equation ($V_0 = \dfrac{1}{r}\left[I_1 + \sum_{t=1}^{\infty} R^{-t}(\Delta I_{t+1} - r(I_t - D_t))\right]$), One interprets the item $(\Delta I_{t+1} - r(I_t - D_t))$ as the increase in expected earnings in excess of the increase due to reinvestment of wealth $(I_t - D_t)$ during the period. The equity value equals capitalized forthcoming earnings add a premium for growth in expected earnings in excess of the growth that could be realized by simply retaining the wealth generated in a fixed return ($r(I_t - D_t)$) instead of paying dividends. In a fixed rate savings account, the item $(-D_t)$ is the withdrawal and remaining amount $(I_t - D_t)$ increases the savings

account balance and yields additional interest income: $r(I_t - D_t)$. For a savings account, the item $r(I_t - D_t)$ equates ΔI_{t+1} and the item $(\Delta I_{t+1} - r(I_t - D_t))$ is zero. Thus, there is no premium over capitalized forthcoming earnings. That is, the marginal investment in a savings account has zero NPV.

In a similar spirit, by putting $x_t = \frac{D_{t+1}}{r}$, we get the fourth equation (4) and call it as capitalized dividends& increments in dividends valuation model (CD&IDVM).

$$V_0 = \frac{D_1}{r} + \sum_{t=1}^{\infty} R^{-t}\left(\frac{D_{t+1}}{r} - R\frac{D_t}{r} + D_t\right) = \frac{1}{r}\left[D_1 + \sum_{t=1}^{\infty} R^{-t}(\Delta D_{t+1})\right] \cdots\cdots\cdots\cdots\cdots\cdots (4)$$

The price (V_0) is explained by capitalization of next period's expected dividends ($\frac{D_1}{r}$) and the subsequent growth (increments) in dividends.

Dividends growth is explained by the $\left[\sum_{t=1}^{\infty} R^{-t}(\Delta D_{t+1})\right]$ due to $(\Delta D_{t+1})/D_t = growth\ in\ D_t$.

Those derivations (equations (2), (3) and (4)) do not depend on any conceptual restrictions on accounting data. There is, for example, no clear distinction between the distribution (D) and creation (I) of wealth.

If net income means creation of wealth, then dividends mean distribution of wealth.

After those derivations (equation (2), (3) and (4)), the reader will see why the author want to introduce equation (1). Because equation (1) has item $x_t - Rx_{t-1} + D_t$. Item $x_t - Rx_{t-1} + D_t$ mean growth.

If $x_t = B_t$ in the $x_t - Rx_{t-1} + D_t$, then $x_t - Rx_{t-1} + D_t$ means growth in book value.

If $x_t = \frac{I_{t+1}}{r}$ in the $x_t - Rx_{t-1} + D_t$, then $x_t - Rx_{t-1} + D_t$ means growth in earning.

If $x_t = \frac{D_{t+1}}{r}$ in the $x_t - Rx_{t-1} + D_t$, then $x_t - Rx_{t-1} + D_t$ means growth in dividend.

That $x_t - Rx_{t-1} + D_t = 0$ in equation (1) means zero growth in all accounting variables.

Moreover, this growth item $x_t - Rx_{t-1} + D_t$ goes beyond the call of duty due to retained net income. In other words, this growth item $x_t - Rx_{t-1} + D_t$ is, in fact, a dividend-adjusted growth. Now the question arises whether one can find some useful, additional assumption that parameterizes this growth item $x_t - Rx_{t-1} + D_t$. All parameterizes are known.

2.1 comparisons 0f model (I) BVRIVM and model (II) CE&IRIVM

Model (I) BVRIVM develop market value as book value plus a premium above book value for expected growth in book value, model (I) anchors valuation on book values. Such focus on book values is justified when book values near market values, for example, financial instruments are marked to market. So, model (I) is good to value financial institutions. But, the emphasis on book values is lost when firms are conservative accounting rules. E.g., the most important assets of knowledge intensive corporations are not shown on their books as investments in intellectual assets are not shown on their financial statements. Thus, their book values are under-estimated and the ROE is over-estimated. Analysts valuing these firms usually do not use book value of equity as the starting point in their valuation. Thus, model (II)

CE&IRIVM focus on the earnings and earnings growth expected from these "off-balance sheet" properties. Analysts focus on capitalized earning & increments in residual income (CE&IRIVM) because future earnings and earnings growth are less affected by conservatism than are book values. Thus, model (II) are heavily used for valuation.

In model (I) BVRIVM ($V_0 = B_0 + \sum_{t=1}^{\infty} R^{-t}(I_t^R)$), if the item $I_t^R = 0$ i.e., ROE=r, then model (I) reduce to $V_t = B_t$. Similarly, in model (II) CE&IRIVM ($V_0 = \frac{1}{r}\left[I_1 + \sum_{t=1}^{\infty} R^{-t}(\Delta I_{t+1}^R) \right]$),if the item $\Delta I_{t+1}^R = 0$, then model (II) reduce to $V_t = \frac{I_{t+1}}{r}$. In a fixed rate savings account, the interest income expected from a savings account equals $I_{t+1} = r \times B_t$, which implies $V_t = B_t = \frac{I_{t+1}}{r}$. For a savings account, the model (I) and model (II) are equivalent. Real firms, however, are not savings accounts.

3. Parameterized models explaining the P/E ratio

In what follows I do not initially attach any economic interpretation to this growth item $x_t - Rx_{t-1} + D_t$. One can derive V_0 as a function of x_0 and $x_0 + x_1$ alone, given suitable assumptions on the x-series. Unsurprisingly, the assumption requires the y_t -series ($y_t = x_t - Rx_{t-1} + D_t$) to grow (or decay) geometrically. By imposing some structure on the pattern on y_t, we get a short formula. To make the model more realistic yet simple we do not restrict on one-year ahead y_t allowing y_1 being any positive number. After year 1, we assume y_t grows at a constant rate. Specifically,

$y_{t+1} = \gamma \times y_t,\ t \geq 1,\ 0 < \gamma < R.$ Where $0 < \gamma$ is some presumed growth parameter and $0 < y_1$. If $y_1 = 0$, then $V_t = \frac{I_{t+1}}{r}$.

Given PVED and consider any series $\{x_t\}_0^{\infty}$ satisfying $R^{-t}x_t \to 0$ when $t \to \infty$ and a related series $y_t \equiv x_t - Rx_{t-1} + D_t$ such that $y_{t+1} = \gamma \times y_t,\ t \geq 1,\ 0 < \gamma < R.$

Then

$$V_0 = x_0 + \frac{y_1}{R-\gamma} = x_0 \times \frac{\left[\left(\frac{x_1 + D_1}{x_0}\right) - \gamma\right]}{R-\gamma} \quad \cdots\cdots (5)$$

And

$$V_0 = \omega \times x_0 + (1-\omega) \times \frac{(x_1 + D_1)}{R} \quad \cdots\cdots (5.1)$$

Where all parameterizes ($\omega,\ \gamma$) are constants.

$$\omega = -\frac{\gamma}{(R-\gamma)} < 0$$

Armed with these analytical results, I next identify the two cases that explain the P/E ratio. The first approach, (a), refers to the growth in book value, and the second, (b), refers to the growth in net income.

(I) Setting $x = B$ in (5) simply changes the notation and the (5) decreases to (6)

$$V_0 = B_0 \times \frac{\left[\frac{(B_1 + D_1)}{B_0} - \gamma\right]}{R - \gamma} \cdots\cdots (6)$$

One reads $\frac{(B_1 + D_1)}{B_0}$ in (6) as the forthcoming growth in the expected book value, adjusted for dividends. The numerator adjustment for dividends is important: it reflects dividend policy irrelevancy (DPI). That is, the numerator does not depend on the next period's dividend decision since the cum-dividend book value, $(B_1 + D_1)$, does not depend on the dividend. Thus the choice of date-one dividends does not affect V_0.

In CSR we replace $(B_1 + D_1)$ with $(B_0 + I_1)$

Standard derivations of the model assume CSR. It causes the textbook expression:

Given (6),

$$V_0 = B_0 \times \frac{\left[\frac{(B_1 + D_1)}{B_0} - \gamma\right]}{R - \gamma} = B_0 \times \frac{\left[\frac{(B_0 + I_1)}{B_0} - \gamma\right]}{R - \gamma} = B_0 \times \frac{[ROE_1 - (\gamma - 1)]}{r - (\gamma - 1)} \cdots\cdots (7)$$

Where $ROE_1 = \frac{I_1}{B_0}$ equals the forthcoming expected return on equity. It follows that $\frac{V_0}{B_0}$ increases as ROE_1 increases. With respect to γ — where now $y_{t+1} = \gamma \times y_t \Rightarrow I_{t+1}^R = \gamma \times I_t^R$

The market-to-book ratio ($\frac{V_0}{B_0}$) increases as γ increases when $ROE_1 > r$. These conclusions are reasonable because they decrease to the idea that "growth in residual net income is good assuming they are initially positive". Relating the $\frac{V_0}{B_0}$ ratio to ROE_1 has some attraction, certainly. Investors tend to ask "What factors explain the P/E ratio?" rather than "What factors explain the $\frac{V_0}{B_0}$ ratio?" More important for our purposes, the last question is of interest because it has already been established that $V_0 = \frac{I_1}{r}$ is valid for time value of money ($V_0 = \frac{I_1}{r} \rightarrow r = \frac{I_1}{V_0}$). A model resting on book values ought not to rule out an explanation of the P/E ratio (V_0 / I_1).

Shifting the focus to the P/E ratio, simple manipulations of the last equation causes

$$V_0/I_1 = K_1 + \left(K_2/ROE_1\right) \cdots\cdots (8)$$

Where

$$K_1 = 1/(R-\gamma)$$
$$K_2 = (1-\gamma)/(R-\gamma)$$

The left-hand-side variable of interest, the P/E ratio (V_0/I_1), depends only on the right-hand-side variable ROE_1, in addition to the parameters γ and R.

An evaluation of how ROE_1 influences the P/E ratio (V_0/I_1) depends on the sign of K_2. Signing K_2 sequentially lays the duty on the sign of $1-\gamma$. Is γ greater or less than one? It makes sense to require γ to exceed 1 if residual net income (I_t^R) is positive (i.e., ROE_1 > r), just as γ should be less than one if I_t^R is negative (ROE_1 <r). The first claim is based on the idea that if the firm is profitable, then, in expectation, the dollar amount of I_t^R should expand with time. Such an expected situation occurs if conservative accounting is combined with growth in the firm (if ROE_1 > r but γ < 1, then I_t^R and $V_t - B_t$, decline with t and both go to zero, which is conflicting with conservative accounting). As the second possibility, if the firm is unprofitable (ROE_1 < r), then one should expect that the gap, ROE_1 versus r, to be slowly closed in the future. And given ROE_1 < r (or I_t^R <0), I_t^R goes to zero as $t \to \infty$ if and only if γ < 1.Thus ROE_1 < r causes the condition y < 1.

Given the above restrictions — summarized by $I_t^R(\gamma-1)>0$ — it follows that if ROE_1 is less than r, and then the price-to-forward net income ratio, the P/E ratio (V_0/I_1) decreases as ROE_1 increases. For ROE_1 greater than r, the P/E ratio now increases as ROE_1 increases. In other words, as an empirical matter one should expect the function V_0/I_1 on ROE_1 to be U-shaped.

Despite the fact that the analysis may seem somewhat self-important and mechanical, it makes more intuitive sense than one might think initially. Consider a firm with ROE_1 of, say, 20 percent when r = 10 percent. Such a firm is profitable, and the setting corresponds to γ > 1. Now it is clear that if the firm remains about equally profitable some day, then a computation shows that the growth in expected net income will be superior. Hence the P/E ratio ought to show a premium (exceed 1/r).Next consider when ROE_1 is poor, say, 5 percent, which is the setting when γ < 1.Now there is reason to expect that ROE improves with the passage of time. A computation now shows that even a modest improvement in ROE to, say, 6 percent implies a considerable growth, in expected net income. Again, the growth principle causes the conclusion that the P/E ratio reflects a premium. (As an empirical matter, it is easily verified, looking at real-world data, that the huge firms with subpar ROE_1, such as than 7 percent, indeed have relatively large P/E ratios. Yet, as any textbook will note, such firms will also have below-average $\frac{V_0}{B_0}$ ratios.)

The modeling allows for the case when the capitalized forward net income alone decides value:

$\gamma = 1$ or $ROE_1 = r$ give the necessary and sufficient conditions. The case $ROE_1 = r$ is rather stale since now $I_t^R = 0,\ V_0 = B_0,\ B_0 = I_1 / r$ .The idea behind $\gamma = 1$ is more clever; now the conclusion follows even though $V_0 - B_0 \neq 0$ (the sign depends on the sign of I_t^R , of course).

In $x = B$ setting and also $\gamma = 0 \leftrightarrow \omega = 0$, that means no growth and price decay to $V_0 = \frac{B_1 + D_1}{R}$. The equation $V_0 = \frac{B_1 + D_1}{R}$ implies $V_0 = B_0 = \frac{B_1 + D_1}{R} = \frac{V_1 + D_1}{R}$.

Hence the more general model $V_0 = \omega \times x_0 + (1-\omega) \times \frac{(x_1 + D_1)}{R} \cdots (5.1) \rightarrow V_0 = \omega \times B_0 + (1-\omega) \times \frac{(B_1 + D_1)}{R} \cdots (5.2)$ admits for a growth in book values, $\frac{B_1 + D_1}{B_0} > R,\ or\ B_1 + D_1 > RB_0$, to explain the $\frac{P_0}{E_1}$ ratio less than $\frac{1}{r}$. In the equation (5.2) that P_0 increases as B_0 decreases, holding $(B_1 + D_1)$ fixed.

In $x_t = B_t$ setting and also $\gamma = 1 \leftrightarrow \omega = \frac{-1}{r}\ and\ (1-\omega) = \frac{R}{r}$, thus $P_0 = \frac{-1}{r} B_0 + \frac{R}{r} \frac{B_1 + D_1}{R} = \frac{I_1}{r}$, this setting thereby interlock between $x_t = B_t$ and $x_t = \frac{I_{t+1}}{r}$.

(II) Set $x_t = \frac{I_{t+1}}{r}$ .This setting interlocks with the (CE&IRIVM: $V_0 = \frac{1}{r}\left[I_1 + \sum_{t=1}^{\infty} R^{-t} (\Delta I_{t+1}^R) \right] \cdots (3)$) model framework. A geometric growth (decay) assumption now causes the equation (9).

$$V_0 = \frac{I_1}{r} \times \frac{[g_2 - (\gamma - 1)]}{r - (\gamma - 1)} \cdots\cdots (9)$$

Where

$$g_2 \equiv \frac{\Delta I_2 + rD_1}{I_1}$$

The item $g_2 \equiv \frac{\Delta I_2 + rD_1}{I_1}$ defines the short-term growth (STG) in expected net income, adjusted for dividends. Like the book value model, DPI constructs in an adjustment for dividends. In the present case, the idea is that $I_2 + rD_1$ does not depend on dividends because I_2 depends directly on D_1 . A savings account illuminates the idea as it shows that D_1 gives up net income in the subsequent period such that $I_2 + rD_1$ is independent of D_1 .

4.Conclusion

The paper proceeds in three steps. First it presents and critiques the extant valuation approaches namely the present value of expected dividends (PVED) and the residual income valuation model (RIVM). Second, it presents a framework to unify these extant models and to derive a model based on residual income and growth on residual income, which are the two most heavily watched metrics in the real world. Third, it presents a parsimonious parameterization of the net income-based model that is easy to implement and yet gives powerful insights into a firm‘s value and its perceived risk

5.References

Antonella Silvestri and Stefania Veltri . 2012. A Test of the Ohlson Model on the Italian Stock Exchange. Accounting & Taxation, Vol. 4, No. 1, p. 83, 2012 Antonella Silvestri.

Kathryn E. Easterday , Pradyot K. Sen and Jens Stephan . Another Specification of Ohlson's ‗Other Information‘ Term for the Earnings/Returns Association: Theory and Some Evidence . Journal of Business Finance & Accounting, Vol. 38, Issue 9-10, pp. 1123-1155, 2011.

Ohlson, J. A. 1995. Earnings, book values, and dividends in equity valuation. Contemporary Accounting Research 11 (2): 661-87.

Ohlson, J. A., and B. Jeuttner-Nauroth. 2005. Expected EPS and EPS growth as determinants of value. Review of Accounting Studies 10 (2-3): 349-65.

Yeh, chao-hui. 2001. A study on non-linear residual income valuation model, doctoral dissertation, National Sun Yat-sen University.

The Research of Influential Factors of High Vacancies in Taiwanese Residential Industry: A Dynamic Perspective

Henry H. Y. Hsieh

Assistant professor

Department of Business Administration

National Ping Tung University of Science and Technology

Tel: +886-8-7703202 Ext 7694

Email: henry@npust.edu.tw

ABSTRACT

Vacancy is influenced by developer behavior and exacerbated by regional development. Little research involves this issue. Yet it is growing important due to high vacancies of 1.56 million revealed by the 2010 residence and population survey (DGBAS 2010). The influential factors of vacancies are examined by constructing a developer behavior model and a dynamic vacancy model to examine the crucial factors of vacancies. A multiple regression model of developer behavior is built by a pooled cross-sectional time-series of 23 cities and counties in Taiwan during 1999-2010. A sample of 276 observations is tested. Further a dynamic vacancy model is constructed by two stage least square method (2SLS). The empirical results indicate that high level of group irrationality in developers and consumers. Region develops separately shaping different residential industrial life cycle. Structural vacancies contribute to high vacancies. However inequality of house ownership and group irrationality exacerbate the already existed vacancies. We suggest that government should frequently release more measurable indicators and updated information and make them available and accessible to improve individual cognition and rationality. Individual developer should adopt differentiation in design, services, quality, or value activity to reduce group conformity. By differentiation developer can increase group rationality widening rational window in order to reduce ineffective vacancy.

Key Words: *Residential Construction Industry, Vacancies, Developer Behavior, Regional Development, Group Irrationality, Rational Window.*

1. Introduction

A growing vacancy indicates oversupply in the residential construction industry in Taiwan. Vacancies increased nearly 328,000 units and 27% growth during 1990-2010 (Table 1). Vacancies vary in regions. Northern area of Taiwan has highest vacancies of 740,000 units, the fastest growth (Figure 1). Although its high vacancies the housing price in this area is the dearest in Taiwan. The paradox of vacancy is inconclusive. High vacancies do not imply low price or less construction. In addition regional difference may not be the reason to explain the vacancy or housing price. Vacancy needs to be examined by a more holistic and dynamic view.

Table 1 Vacancies and vacancy rate survey

	1980		*1990*		*2000*		*2010*	
Region	*Vacancies (Unit)*	*Rate (%)*	*Vacancies (Unit)*	*Rate (%)*	*Vacancies (Unit)*	*Rate (%)*	*Vacancies (Unit)*	*Rate (%)*
North	*219241*	*14.47*	*320683*	*13.85*	*564266*	*17.6*	*741855*	*19.6*
Central	*121605*	*13.12*	*149933*	*12.83*	*310504*	*18.9*	*365408*	*19.6*
South	*124657*	*11.36*	*183635*	*12.73*	*316315*	*16.2*	*406775*	*18.4*
East	*14336*	*11.36*	*20066*	*13.58*	*37713*	*21.0*	*42275*	*21.7*
Taiwan	*479839*	*13.09*	*674317*	*13.29*	*1228798*	*17.6*	*1556313*	*19.3*

Source: Peng and Chang 1995, *Journal of Housing Studies No.3:* p68; DGBAS，2000,

http://www.dgbas.gov.tw/census~n/six/lue5/cen8904.rtf ; DGBAS，2010 Residence and population survey

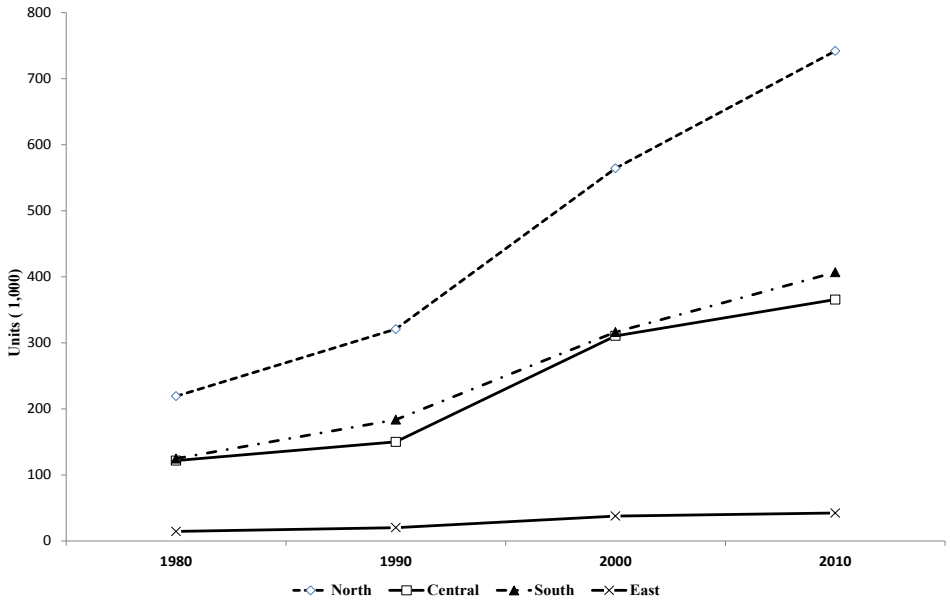


Figure 1 Regional vacancies

2. Literature review and research model

The researches of vacancy mostly focus on the field of demand and supply, market, economy, sociology, and regulation mechanism. Namely they emphasize external environment and performance dimensions. Very little research of vacancy underlies regional difference and industrial behavior. The most popular research of vacancy comes from the supply and demand analysis. Under market mechanism oversupply causes vacancy and declining price. There are two types of market theory of the construction industry, supply model or demand model. The supply model means demand did not change but supply increased largely (Figure 2). On the other hand demand model stands for the growth of demand without increase of the supply (Figure3). In supply model the price declined and the supply increased implying oversupply causing decline of the price. If the price were not to fall, then inventory will surely occur. The condition is opposite in demand model while the demand increase the price will rise which precipitates the supply. Price depends on these two forces to decide up or down. Both supply and demand increase during the boom will cause the increase of completions but also price will increase depending on the strength of the degree of supply and demand expansion. When supply expand are greater than demand expansion the price will decline vice versa. However the price is raised to a higher degree will cause oversupply as indicated in the Figure 4. This means that supplier encouraged by higher market price will keep a larger production than demand. However the price is more than consumer expected or affordability resulting in oversupply.

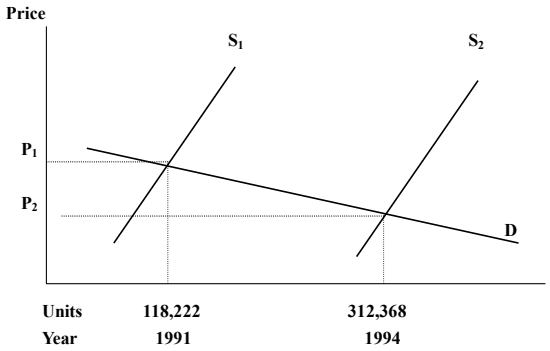


Figure 2 A Supply Side Model in Residential Construction

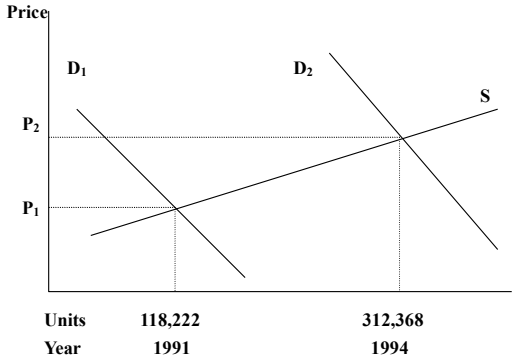


Figure 3 A Demand Side Model of Residential Construction

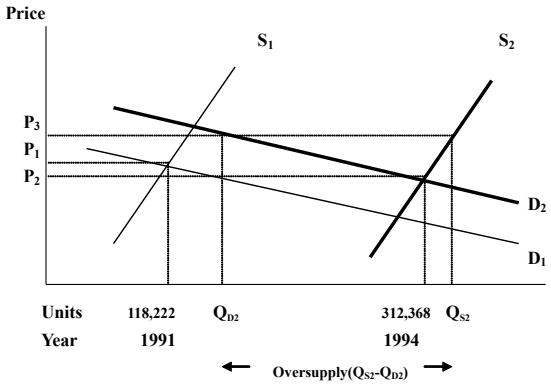


Figure 4 Both Supply Pull and Demand Push Model in Residential Construction

Regional development is considered as an important factor to the development of a region. A broader perspective a region can be an economic region composed of states with similar economic nature such as emerging countries collaborating each other to make progress of economy. In a small scale different city and county will form specific region and development. This is because regional development derives from regional economic growth and employment structure. The migration of worker will shape the demand of housing and amenities. Therefore regional development causes different housing demand and supply, such as Taipei City requiring more house units than any other city or county in Taiwan. Hence housing price rises in a growth region while other regions are still declining. Accordingly demand and supply of regions may develop separately. Some research indicates that due to infrastructure causing regional change. In particular Pei I tunnel in northern Taiwan facilitates I Lang County‘s growth both in employment structure and housing demand (Chen, 2010). Different characteristic of region like event will cause the growth of region influencing house demand, supply, vacancy and price. This research examining vacancy from regional development and

behavior is a pioneering research, manifesting that regional features and industrial behavior being critical factors to vacancy. A developer behavior model is constructed rendered as a platform for further dynamic analysis.

In fact the demand and supply is influenced by external factors such as event, macro factors, population growth and vacancies etc. Those factors can be categorized into demand and supply side in order to construct developer behaviour model. Developer represents supply side providing skill, capitals, and management to build residential units. Home buyer and investor represent demand side purchasing the housing units for residence or investment. The general model of developer behaviour including those factors is illustrated in Figure 5. However a further examination of construction performance and its effects of vacancy and housing price based on this model will be explored in a dynamic market model.

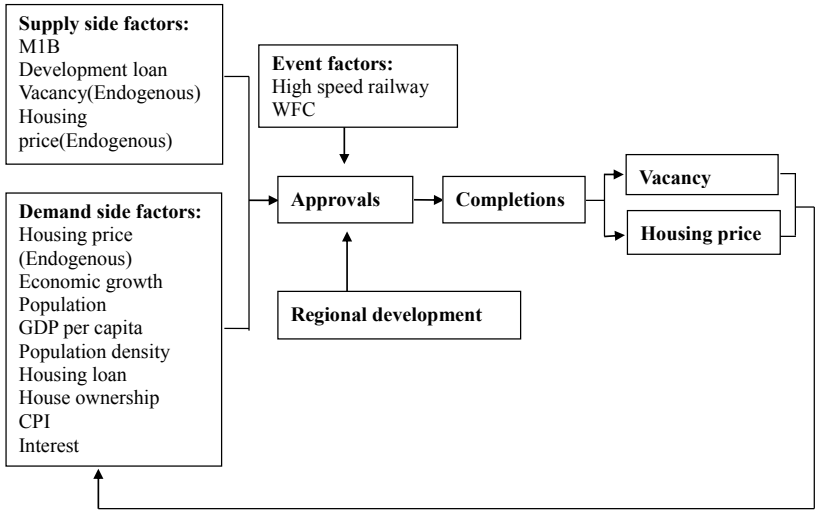


Figure 5 Research framework

The supply side of the model includes money supply of country (M1B), loans for developer (development loan), vacancy (unsold or unoccupied housing units seen as housing stock), and housing price (high housing price encouraging more supply). Vacancies and price are also endogenous factors to developer behaviour in the dynamic model. In the demand side of the model there are housing price (low price stimulating house buying), economic growth (economic growth increasing the employment and GDP precipitating purchasing power), population (creating demand for accommodation), GDP per capita (proxy of consumer purchasing power), population density (indicating the degree of demand for housing in cities), housing loan (facilitating home buyer affordability of housing), house ownership (a metaphor of the discrepancy of demand and supply), CPI(high inflation rate encouraging demand for real estate or durable goods), and interest(low interest rate relieving the burden of housing loan and development loan in both demand and supply sides). In residential construction industry internal event of infrastructure in particular high speed rail saves the travel time hence

improves the development of farther regions. External event of world financial crisis identified in the period of 2007-2008 is suspected causing negative impact on developers. In addition, regional development creates employment and subsequently increases demand for housing. Developers surely will be affected by those factors. They will decide to apply approvals (Approvals). If they decide to construct and complete the buildings the completions will increase the housing supply which consequently causes price and vacancies to change. Theoretically if demand equals supply then price will be stable and vacancy will equal zero. If supply is greater than demand then price will decline and vacancies increase. However in the real world high price is accompanied with high vacancy. The model renders a platform to investigate the influence of developer behaviour and regional development on the price.

3. Empirical study

This research examines the influence factors of developer‘s behavior from supply and demand sides. In addition developer‘s behavior also causes performance and vacancy. The variation of variables is reduced by using larger measuring scale. The relation between dependent and independent variables may not be linear. We transform each variable to natural logarithm. Though we undertake linear ordinary least square regression the model will be non-linear to increase the accuracy of model. The developer behavior model is constructed by a simple regression model as a platform of further vacancy research. In addition this research uses two stage least square method to examine the influence factors of vacancy.

3.1 The developer behavior model

Factors involved in both demand and supply sides of residential construction are used to establish the model. In Figure 5, residential approvals (Ln(Approval)) were influenced by supply and demand factors. Supply factors include development loans (Ln(Develop loan)), interest rate (Ln(Interest)), housing price(Ln(Price)), and consumer‘s purchasing power (Ln(GDP per)). Population (Ln(Population)) in each city and county is used as a local market scaling factor. Higher population density in city/county (Ln(Density)) is expected to have an impact on approvals. The greater the density, the greater the expected impact on approvals.

Residential approvals were also expected to be influenced by demand factor such as consumer purchasing power (Ln(GDP per)) , consumer housing loans (Ln(Housing loan)), interest, price, and vacancy (Ln(Vacancy unit)). Population in each city and county reflected the scale of demand.

$$Ln(Approval) = Lnb_0 + b_1Ln(M1b) + b_2Ln(Development\ loan) + b_3Ln(Vacancy) + b_4Ln(Price) + b_5Ln(growth) + b_6Ln(Population) + b_7Ln(GDP\ per) + b_8Ln(Density) + b_9Ln(Housing\ loan) + b_{10}Ln(Ownership) + b_{11}Ln(CPI) + b_{12}Ln(Interest) + b_{13}(High\ speed\ railway) + b_{14}(WFC) + b_{15}(North) + b_{16}(Central) + b_{17}(South) + e$$

The relation of the completion with the relevant factors in the model was expected to be as follows,

$b_0 \neq 0$,

$b_1, b_2, b_5, b_6, b_7, b_8, b_9, b_{11}, b_{13} > 0$;

$b_3, b_{10}, b_{12}, b_{14} < 0$;

$b_4, b_{15}, b_{16}, b_{17}$ are unknown.

The variables are summarized in Table 2.

Table 2 Summary of the variables

Dependent variable：Approval (Floor space)

Coefficient	Variable	Scale
	Supply side variables：	
b_1	Ln(M1b)：Outstanding money supply daily	NT$10B
b_2	Ln(Development loan):Outstanding balance of development loan	NT$10B
b_3	Ln(Vacancy)：Vacancies in 23 cities and counties	Unit
	Demand side variables：	
b_5	Ln(Growth):Annual economic growth	%
b_6	Ln(Population)：Population in 23 cities & counties	1000 person
b_7	Ln(GDP per): GDP per capita	NT$1000
b_8	Ln(Density)：Population density in 23cities & counties	Person/KM^2
b_9	Ln(Housing loan): Housing loan	NT$10B
b_{10}	Ln(Ownership):Housing ownership in 23 cities & counties	%
b_{11}	Ln(CPI)：Consumer price index	%
	Both supply & demand sides variable：	
b_4	Ln(Price)：Housing price in 23 cities & counties	NT$10000/Ping
b_{12}	Ln(Interest): Central bank‘s rediscount rate	%
	Event variables：	
b_{13}	High speed railway: The station of high speed railway	Dummy
b_{14}	WFC:The year of world financial crisis	Dummy
	Regional development variables：	
b_{15}	North: Northern region	Dummy
b_{16}	Central: Central region	Dummy
b_{17}	South: Southern region	Dummy

The behavior of developer is the focus of this research, estimation with approvals as dependent variable by ordinary least square regression (OLS) is first examined. A pooled cross sectional time series of 23 cities and counties during 1999-2010 and 276 observations are tested. However dependent variables of M1b, development loan, vacancies, populations, GDP per capita, housing loans, CPI, rediscount rate indicating multi-collinearity (VIF>10, Tolerance<0.1). We remove high correlation variables by Person correlation analysis. The results of developer behaviour model are in Table 3 with R^2=0.711 and F being significant.

Table 3 Coefficients of the improved completion model

Dependent：Ln(Approval)

Model	*Unstandardized*		*Standardized*			*Collinearity*	
	B	*Std. Err.*	*Beta*	*t*	*Sig.*	*Tolerance*	*VIF*
Constant	*-8.956*	*4.673*		*-1.917**	*.028*		
Ln(Development loan)	*-1.407*	*.301*	*-.478*	*-4.674****	*.000*	*.105*	*9.517*
Ln(Vacancy)	*.943*	*.057*	*.703*	*16.635****	*.000*	*.615*	*1.626*
Ln(Price)	*.716*	*.194*	*.201*	*3.697****	*.000*	*.370*	*2.700*
Ln(Density)	*-.046*	*.046*	*-.061*	*-.991*	*.162*	*.292*	*3.430*
Ln(Housing loan)	*2.411*	*.447*	*.556*	*5.393****	*.000*	*.103*	*9.689*
Ln(Ownership)	*-.276*	*.949*	*-.014*	*-.290*	*.386*	*.489*	*2.044*
Ln(Interest)	*.761*	*.129*	*.289*	*5.878****	*.000*	*.453*	*2.208*
High speed railway	*.227*	*.145*	*.066*	*1.568†*	*.059*	*.611*	*1.636*
WFC	*-.407*	*.112*	*-.161*	*-3.616****	*.000*	*.556*	*1.800*
North	*.245*	*.204*	*.103*	*1.199*	*.116*	*.149*	*6.696*
Central	*.292*	*.185*	*.117*	*1.578†*	*.058*	*.200*	*5.012*
South	*.368*	*.181*	*.160*	*2.025**	*.022*	*.176*	*5.668*

*Note：***, P<0.001；**, P<0.01；*, P<0.05；†, near 0.05 Sig.*

*R^2=0.711，F=53.963***，N=276, Single tailed*

In order for the model to be valid, the requirements of regression are analyzed and tested (Keller et al. 1990:676~677)

1. Normality: the standard residuals of the dependent variable completion must be normally distributed. The histogram of standardized residual indicates a normal distribution as does the P-P plot of the dependent variable.

2. Zero Mean of Residuals: the mean of the distribution of residuals is nearly zero.

3. Heteroscedasticity: the variance of dependent variable around the regression plane is constant. A diagram of the residuals (e) against the predicted value (Y) is plotted and indicates a constant variance of the residual variable (Keller et al 1990:768).

4. Autocorrelation (Independent): values of dependent variable are mutually independent, which also means that residual variable values are independent. The residual variable values against cross-sectional time-series indicate no specific pattern (Keller et al 1990:769).

5. Collinearity: The Tolerances of all variables are greater than 0.1 and VIF of all variables are smaller than 10, indicating no collinearity (Peng and Chang 1995:69).

The constant term has to be considered while undertaking pooled data of cross sectional time series. Hsieh (2002) suggests that using population of cities and counties can effectively reflect the constant term in pooled data while the large observations are large. Accordingly we use each city and county as separate independent dummy variable to regress on dependent variable population density of cities and counties. The R^2 nearly equal 1, indicating population density can effectively represent each city and county. In addition from the comparison of actual value of developer behavior with the prediction of the regression model demonstrates goodness of fit, indicating constant term being considered in the model.

3.1.1 Interpreting the behaviour Model

The model of Table 3 indicates a high level of statistical explanation of the behaviour of residential construction. Most importantly it has sufficient empirical validity to allow an examination of the relation of both developer behaviour and regional development to vacancy in this industry.

Vacancy has high positive relation to developer‘s behaviour (t=16.635***, p=.000), implying that developer‘s irrationality of continuing construction under high vacancies. In addition housing price has positive relation to approvals (t=3.697***, p=000), implying that developer‘s behaviour being motivated by high housing price. It is true in Taipei city with high approvals coexisting high housing price and high vacancy. Regional development has influence on developer but varies in different region. Central region has positive relation to developer behaviour (t=1.578†, p=.058). Similarly Southern region is positively related to approvals (t=2.025*, p=.022). However Northern area is insignificant to approvals indicating regional influence to developer behaviour.

High housing loan facilitates consumer affordable to buy house, hence it shows positive relation to approvals (t=5.393***, p=.000). Surprisingly low interest rate did not encourage approvals indicating positive relation (t=5.878***, p=.000). Also development loan illustrates negative relation to approvals (t=-4.674***, p=.000), indicating that developer‘s expansion did not rely very much on debts but equity. Developer rely more on its own capital rather than debts.

Some demand factors are not the main consideration to developer, such as density and ownership being insignificant to the approvals. However events and infrastructure did affect developer. World financial crisis as expected casts negative influence on approvals (t=-3.616***, p=.000). However high speed rail is growing importance to residential construction industry due to its convenience and distance shortening. High speed rail has positive relation to approvals (t=.066†, p=.059) as expected.

In summary, the influence of most variables on developer‘s behavior is consistent with the expected results (Table 4). The behavior model of developer is valid and reliable. Base on the behavior model we further undertake a dynamic market model by two stage lease square method (2SLS) to examine the influence factors of vacancy. Construction industry is influenced by market and external environment. The market is dynamic implying that variables are interacting each other, hence we use dynamic model to examine the vacancy interacting with developer behavior, performance and price.

Table 4 Developer behavior analysis

Dependent variable：Approvals

Variable	Positive or negative	Expected result
Development loan	Negative	Inconsistent
Vacancy	Positive	Inconsistent
Housing price	Positive	Consistent
Population density		
Housing loan	Positive	Consistent
House ownership		
Interest	Positive	Consistent
High speed railway	Positive	Consistent
WFC	Negative	Consistent
North		
Central	Positive	Consistent
South	Positive	Consistent

3.2 The dynamic vacancy model

This section uses dynamic market model of residential construction industry to examine the influence of developer behavior and regional development casting on vacancy. Vacancy is influenced by completions, housing price, reciprocally as member of supply and demand sides t it also affects approvals, then completions illustrated in Figure 6. The dynamic nature of those variables truly reflects the reality of market mechanism. Hence it is more realistic to examine vacancy under dynamic model (2SLS) than static developer behavior model (OLS). However a static developer behavior model renders a platform for further dynamic examination.

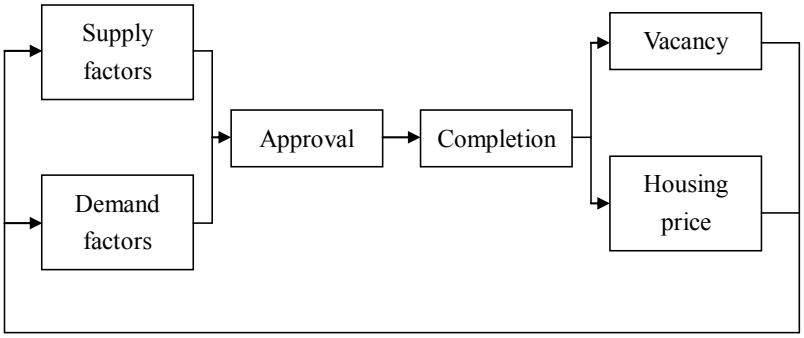


Figure 6 Dynamic market model

We use two stage least square method to examine vacancy under dynamic market structure. Two stage least square method emphasizes on the relationship and explanation of the dependent and independent variables rather than prediction. According to the dynamic model we construct the variables of vacancy model indicated in Table 5. The empirical results of the vacancy model is illustrated in Table 6

Table 5 Variables of the vacancy model under 2SLS

Dependent	Explanation	Exogenous
Vacancy	**Completion，**Housing price Population density，Housing loan，Housing ownership，Interest，High speed railway，WFC，North，Central，South	Population density，Housing loan，Housing ownership，Interest，M1B，Development loan，Economic growth，Population，GDP per capita，CPI，High speed railway，WFC，North，Central，South

Note：**Endogenous variable

Table 6 The vacancy model

Dependent variable：Ln(Vacancy)

Model	Unstandardized		Beta	t	Sig.
	B	Std. Err.			
Constant	-21.660	9.983		-2.170	.061
Ln(Approval)	.750	.080	1.008	9.318***	.000
Ln(Price)	2.743	1.139	1.034	2.408**	.009
Ln(Density)	-.211	.098	-.374	-2.144*	.017
Ln(Housing loan)	.198	.249	.061	.795	.214
Ln(Ownership)	3.446	1.806	.231	1.908*	.029
Ln(Interest)	-.427	.123	-.218	-3.477***	.000
High speed railway	-.494	.238	-.194	-2.074*	.020
WFC	.090	.137	.048	.656	.257
North	-1.082	.414	-.609	-2.615**	.005
Central	-.337	.246	-.181	-1.372	.086
South	-.206	.226	-.120	-.910	.182

***, P<0.001；**, P<0.01；*, P<0.05

R^2 =0.532，F =27.233，N=276，Single tail

The empirical results of vacancy model indicate that vacancies are significantly influenced by completions decided by approvals (t=9.318***, p=.000). This is consistent with expectation since completions increase house supply and eventually caused more vacancies. Vacancies vary in different region. Vacancies are negative to north (t=-2.615***, p=.005), indicating that northern region with less vacancies. As expected Taipei City and neighbourhood region with high population tend to have less vacancy. However at the same time other regions have more vacancies.

Housing price as expected has positive relation to vacancies (t=2.408***, p=.009), implying that high housing price will hinder the consumer‘s affordability but attract more construction and housing supply. High home ownership causes high vacancies (t=1.908*, p=.029). High ownership implies that demand is growing saturated and fewer houses are required. In addition high ownership also stands that consumers may own more than one house causing house idle and vacant.

As expected interest rate is negatively related to vacancy (t=-3.477***, p=.000), indicating that low interest rate causes high vacancy. This may influence both supply side and demand side. From the supply side low interest rate will favor developer lowering development loan interests, hence more construction is encouraged. From demand side it may lower housing loan interest facilitating some consumers to own more than one house eventually causing high ownership and high vacancies.

Infrastructure causes negative relation to vacancies (t=-2.074*, p=.020), consistent with what expected. High speed railway improves the amenity of nearby area and more people willing to move in. Consequently the vacancy around the infrastructure is low.

In summary the vacancy dynamic model is consistent with what we normally expected. What is most concerned is that high vacancy accompanied with high approvals and completions, a contradictory phenomenon. Normally, developer will evade the risk by reducing the construction under high vacancies. Surprisingly the behavior shows that more construction being approved and completed during high vacancy. This can be seen from the empirical results of static and dynamic developer behavior models illustrated in table 7. Both models indicate that vacancy is positively related to approvals. The paradox of vacancy will be discussed and explained in the next section.

Table 7 Developer behavior model：Static and dynamic models

Developer behavior model (OLS)			*Dynamic developer behavior model (2SLS)*		
Variables	*t*	*Sig.*	*Variables*	*t*	*Sig.*
Ln(Development loan)	*-4.674****	*.000*	*Ln(Development loan)*	*-3.586****	*.000*
Ln(Vacancy)	*16.635****	*.000*	*Ln(Vacancy)*	*13.984****	*.000*
Ln(Price)	*3.697****	*.000*	*Ln(Price)*	*-1.024*	*.154*
Ln(Density)	*-.991*	*.162*	*Ln(Density)*	*1.252*	*.106*
Ln(Housing loan)	*5.393****	*.000*	*Ln(Housing loan)*	*4.065****	*.000*
Ln(Ownership)	*-.290*	*.386*			
Ln(Rediscount rate)	*5.878****	*.000*	*Ln(Rediscount rate)*	*5.250****	*.000*
High speed rail	*1.568*	*.059*	*High speed rail*	*2.069**	*.020*
WFC	*-3.616****	*.000*	*WFC*	*-3.540****	*.000*
North	*1.199*	*.116*	*North*	*2.031**	*.022*
Central	*1.578*	*.058*	*Central*	*1.037*	*.151*
South	*2.025**	*.022*	*South*	*1.056*	*.146*

****, P<0.001；**, P<0.01；*, P<0.05*

4 Discussion and managerial implication

From empirical results we found that independent regional development causing distinct feature of supply and demand. Vacancy is influenced by regions. Structural vacancies consisting obsolete and unwanted housing units exist. Both developer and consumers do not consider structural vacancies relevant to decisions exacerbating high vacancies. Significantly developer‘s behaviour demonstrates group irrationality although individual developer believes him rational.

4.1 Independent regional development

From the empirical results we found that regional development is independent. Therefore they will have different influence on vacancy, behaviour and prices. The theory differs from normal conjecture of real estate development cycle stressing that one region follow another region. The pattern of one region development can be predicted by another preceding region illustrated in Figure 7, denoting that B region will follow A region to decline later and C region will follow B region to decline. Taiwan will be one region and every district will be in a same residential construction industrial life cycle. Hence the difference of vacancy, developer behaviour and price is due to the different stage of real estate life cycle.

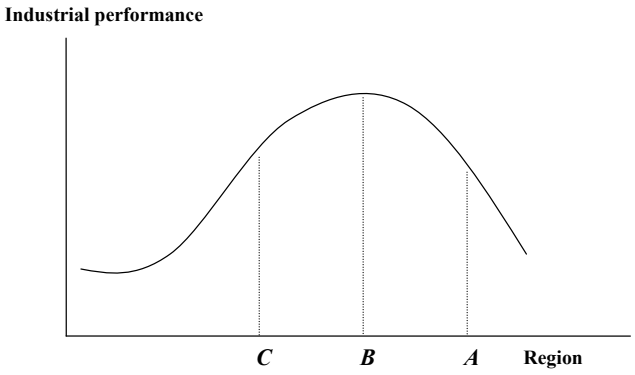


Figure 7 Dependent regional development

However the empirical shows that regional vacancies differ at the same time. In addition the patterns represent regional performance and behaviour of developer differ each other illustrated in Figures 8 &9. Hence the development of residential construction industry is inclined to develop separately due to regional demand diversities. The specific demand features such as population, density and consumer behaviour form different demand intensity in industrial life cycle, in particular some stay in demand growth stage but some are in decline stage illustrated in Figure 10. These two perspectives are crucial for decision making of government policy and developer. They have to consider their decision based on different region features and draw different regional strategies. Vacancies are incurred both by demand (region) and supply (behaviour). However vacancy in northern area is much smaller and more significant than other regions, implying that consumer moving to more vacant region to

ameliorate high housing price in low vacancy region is possible. In addition, although infrastructure improvement did increase construction it incurred less vacancy, indicating flexible and more efficient movement between regions being possible. Consumers can make use of this inequality of vacancies precipitated by regions in order to improve their housing affordability without sacrificing living quality of high financial burden in particular high housing loan.

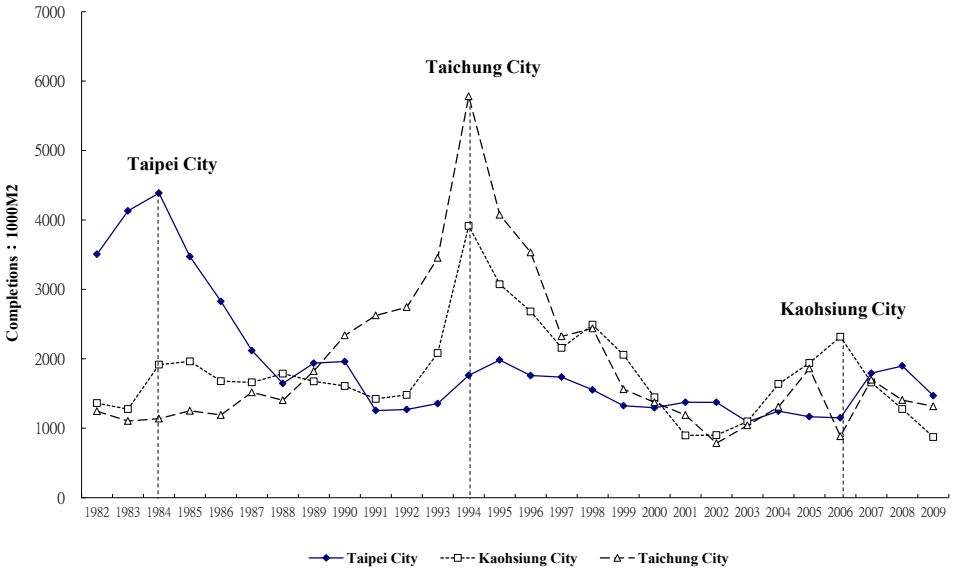


Figure 8 Regional completions of residential construction

Source：CPA, 2011

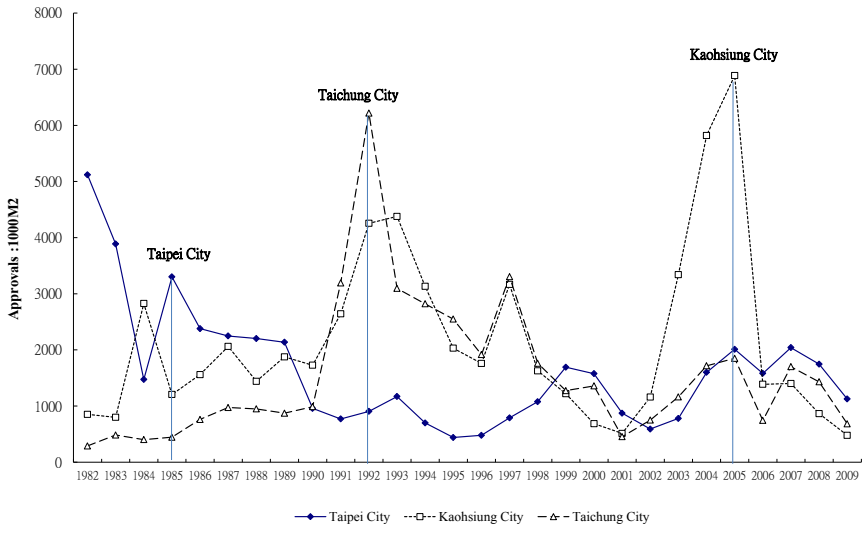


Figure 9 Regional approvals of residential construction

Source：CPA, 2011

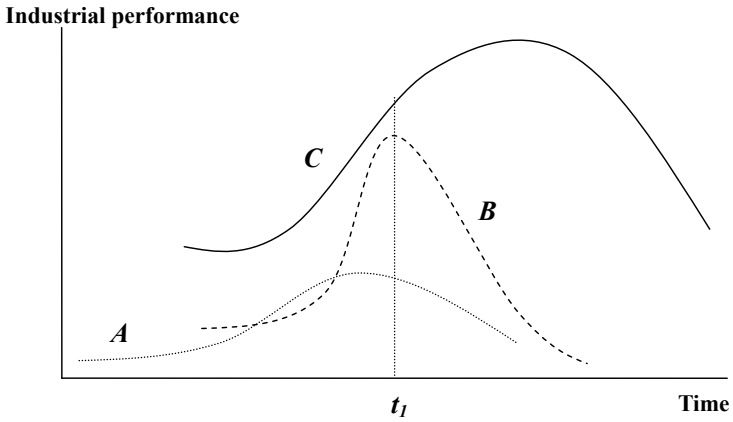


Figure 10 Independent regional development

4.2 Structural vacancies

Vacancies may relate to structural vacancies due to obsolete and inconsistent with demand. During 1990s floor space of housing unit declined but vacancies inclined (Figure 11). Average floor space per unit declined to 40 pings in 1997, however it increased to 54 pings in 2000 and 56 pings in 2010, indicating that consumer requires larger and comfortable housing unit. Yet small units or obsoleted units led to huge vacancies.

Figure 11 Floor space of housing unit

4.3 Multi-house ownership

In addition inequality of house ownership also leads to high vacancies. The Construction Planning and Administration Bureau (2005) estimated that there were 1,029,876 vacancies in Taiwan in 2005 (Table 8) assuming each new household requiring one house unit. Accordingly estimated vacancies will be 886,227 units in 2010. On the contrary actual vacancies were 1,556,313 in 2010 (DGBAS**,** 2010). The discrepancy between estimation and actual vacancy were 670,086 units, indicating very high idle housing units unoccupied (Figure 12). This is caused by multi-house ownership and house ownership inequality. Some owns more than one unit and leave them vacant, whereas some actually need the house but cannot afford one. This should be addressed.

Table 8 Vacancy estimation

Region	*1980 Vacancy survey*	*1990 Vacancy survey*	*2000 Vacancy survey*	*2005 Estimation by CPA*[a]	*2010 Estimation*
North	*219241*	*320683*	*564266*	*386481*	*352136*
Central	*121605*	*149933*	*310504*	*284882*	*232145*
South	*124657*	*183635*	*316315*	*303899*	*251716*
East	*14336*	*20066*	*37713*	*54614*	*50230*
Taiwan	*479839*	*674317*	*1228798*	*1029876*	*886227*

Source: Peng and Chang 1995, *Journal of Housing Studies No.3:* p68; DGBAS, 2000, http://www.dgbas.gov.tw/census~n/six/lue5/cen8904.rtf； DGBAS，2010, residence & population survey; [a]：CPA, 2005.

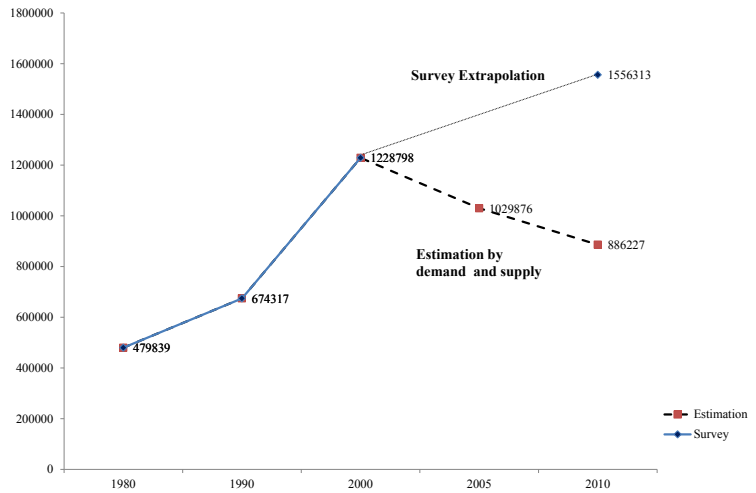


Figure 12 The vacancy gap between estimation and survey

4.4 Group irrationality of regional developer

Regional vacancies and vacancy rate grow consecutively since 1980. Vacancy rates increased 5.1% in northern region, 6.4% in central region, 7% in southern region during 1980-2010 (Table1), implying the existence of group irrationality in regions. Both developer and consumer have group irrationality. Though vacancies are high, developers still undertake construction more and fast. Consumers also bought more than one house unit for investment. These all make vacancy high accompanied with high construction activity and growing vacancies under declining population growth. This group irrationality does not imply irrational individual decision. On the contrary individual rationality occurs in both supply and demand sides. The question is their rational activities being uniform and proceeding simultaneously.

5. Conclusion

We have presented the empirical results of the research and also support evidence to explain the phenomenon. Some conclusions are drawn from this research.Vacancy is influenced by region independently. Though vacancies are high both developers and consumers are enthusiastic in residential construction and investment resulting more construction and vacancy. Most strikingly many owns more than one units. Developer‘s behaviour characterizes group irrationality but individual rationality implying he decides independently without following others‘ behaviour. The question lies in everyone takes same action simultaneously causing herding effect pushing up housing price and vacancies.

The rational window of developer will be obscured due to information disparity illustrated in Figure 13. In the figure I_1 represent individual cognition and G_1 stands for group cognition. The rational window will be opened unless both individual and group cognition lines were widened. This is exactly true when a rational decision is made possible only by providing adequate information, otherwise one can just follow other‘s action.

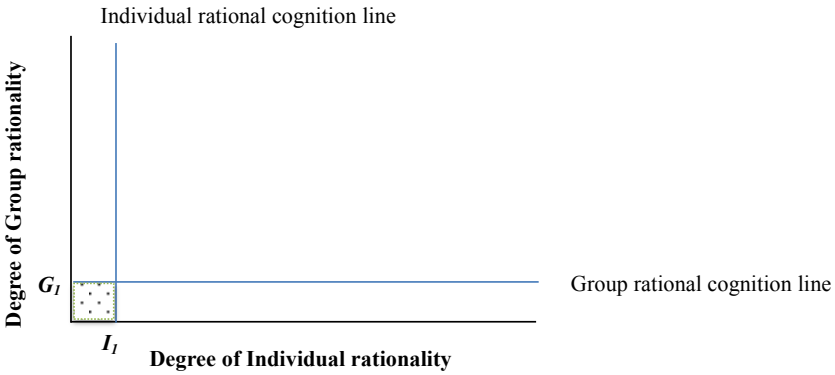


Figure 13 Original developer rational window

We suggest that increasing both individual rationality and group rationality to widen the rational window illustrated in Figure 14. The individual cognition (I_2) can be achieved by providing adequate and instant market information of vacancy, price, approvals and completions to circumvent individual irrationality, namely following other's action without analysing information. This can be improved by providing more measurable indicators and increasing the release frequency of updated information. Accordingly individual cognition line will move to right hand side widening individual cognition window. To increase group rationality developer should avoid group conformity but search for innovation and differentiation. The differentiation underpins design, construction quality, services, and other value activities, making developer's decision differential and distinct. Less conformity causes group rationality and widens the group cognition line (G_2). Vacancy in region just reflects the irrational behaviour of individual and group in this industry which is exacerbated by regional unequal development.

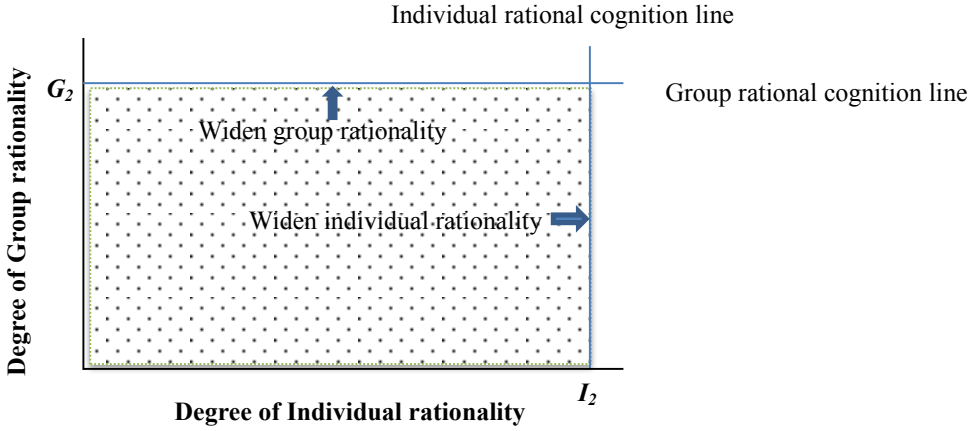


Figure 14 Widened developer rational window

References

Chen, Y.C. and Chen, P.Y. (1998) ‗The research on the effect of vacancy tax—an adjustment simulation of residential market pricing model', Proceeding of the Chinese Society of Housing study 7th Conference, Taipei, August, 93-113.

Chung Hua Credit Investigation Institute (CHCII) (1994), Taiwan Industrial Yearbook-Real Estate Industry, Chung Hua Credit Investigation Institute, Taipei

Construction and Planning Administration (CPA) (1998), Construction and Planning Statistical Yearbook of Taiwan and Fuchien Area, Republic of China 1997, CPA.

Construction and Planning Administration (CPA) (1999), ‗Construction permit and occupancy permit of housing and store in Taiwan and Fuchien area'. 〔online〕. Available:http://www.cpami.gov.tw/yuann/ph/house/ph881130.htm

Construction and Planning Administration (CPA) (1999), Housing Information Quarterly 1st Quarter 1999, CPA, Taipei, June.

Construction and Planning Administration (CPA) (2000) October 10. Monthly ‗Residential approvals floor space and units'.〔email〕to Hui-Yuan Hsieh 〔Monthly construction permit 1989-1996〕.

Construction and Planning Administration (CPA) (2001) Monthly Report of Construction and Planning Affair Indicator, Taiwan and Fuchien Area, Republic of China July 2001, 238, CPA, October.

Construction and Planning Administration (CPA) (1999) Construction and Planning Statistical Yearbook of Taiwan and Fuchien Area Republic of China 1998, Construction and Planning Administration, Ministry of Interior, ROC, Taipei, July.

Construction and Planning Administration (CPA) (1999), Residential information quarterly, 1st Quarter, The Construction and Planning Administration, Taipei, June.

Construction and Planning Administration (CPA) (2004), Residential information quarterly, 1st Quarter, The Construction and Planning Administration, Taipei, June.

Construction Planning and Administration (1994) Construction and Planning Statistical Yearbook of Taiwan and Fuchien Area, Republic of China 1993 , CPA.

Construction Planning and Administration (1996) Construction and Planning Statistical Yearbook of Taiwan and Fuchien Area, Republic of China 1995, CPA.

Construction Planning and Administration (CPA) (1995) Construction Planning and Administration Statistical Yearbook of Taiwan and Fuchien Area 1994, CPA.

Directorate-General of Budget, Accounting and Statistics (DGBAS) (2001) Monthly Statistics of The Republic of China, 422, DGBAS, March.

Directorate-General of Budget, Accounting and Statistics (DGBAS) (1993) The Report on 1991 Industrial and Commercial Census Taiwan-Fukien Area, The republic of China- Construction Volume 5, DGBAS, December.

Directorate-General of Budget, Accounting and Statistics (DGBAS), Executive Yuan, Republic of China (1993), Report on The Housing Status Survey in Taiwan Area Republic of China 1993, Directorate-General of Budget, Accounting and Statistics, Taipei, December.

Directorate-General of Budget, Accounting and Statistics (DGBAS), Executive Yuan, Republic of China

(2001) Quarterly National Economic Trends, Taiwan Area, The Republic of China, 94, Directorate-General of Budget, Accounting and Statistics, August.

Directorate-General of Budget, Accounting and Statistics, (DGABS) (1993) The Report on 1991 Industrial and Commercial Census, Taiwan-Fukien Area, The Republic of China- Finance, Insurance and Real Estate Volume 8, DGBAS, December.

Directorate-General of Budget, Accounting and Statistics, (DGABS) (1990), Monthly Statistics of the Republic of China, DGBAS, Taipei, December.

Directorate-General of Budget, Accounting and Statistics, (DGABS) (1985), Monthly Statistics of the Republic of China, DGBAS, Taipei, December.

Directorate-General of Budget, Accounting and Statistics, (DGABS) (1983), Monthly Statistics of the Republic of China, DGBAS, Taipei, December.

Directorate-General of Budget, Accounting and Statistics, (DGABS) (1984), Monthly Statistics of the Republic of China, DGBAS, Taipei, December.

Directorate-General of Budget, Accounting and Statistics, (DGABS) (1986), Monthly Statistics of the Republic of China, 252, DGBAS, Taipei, December.

Directorate-General of Budget, Accounting and Statistics, (DGABS) (1987), Monthly Statistics of the Republic of China, 264, DGBAS, Taipei, December.

Directorate-General of Budget, Accounting and Statistics, (DGABS) (1988), Monthly Statistics of the Republic of China, DGBAS, Taipei, December.

Directorate-General of Budget, Accounting and Statistics, (DGABS) (1989), Monthly Statistics of the Republic of China, DGBAS, Taipei, December.

Dornbusch, R. and Fischer, S. (1990) Macroeconomics, 5th ed, McGraw-Hill, Singapore.

Economic Research Department, The Central Bank of China (1985), Financial Statistics Monthly, Taiwan District, The Republic of China, The Central Bank of China, December.

Economic Research Department, The Central Bank of China (1986), Financial Statistics Monthly, Taiwan District, The Republic of China, The Central Bank of China, December.

Economic Research Department, The Central Bank of China (1987), Financial Statistics Monthly, Taiwan District, The Republic of China, The Central Bank of China, December.

Economic Research Department, The Central Bank of China (1991) Financial Statistics Monthly, Taiwan District, The Republic of China, The Central Bank of China, December.

Economic Research Department, The Central Bank of China (1994) Financial Statistics Monthly, Taiwan District, The Republic of China, The Central Bank of China, March.

Economic Research Department, The Central Bank of China (1997) Financial Statistics Monthly, Taiwan District, The Republic of China, The Central Bank of China, February.

Economic Research Department, The Central Bank of China (1998) Financial Statistics Monthly, Taiwan District, The Republic of China, The Central Bank of China, January.

Economic Research Department, The Central Bank of China (1998) Financial Statistics Monthly, Taiwan District, The Republic of China, The Central Bank of China, November.

Economic Research Department, The Central Bank of China (2000) Financial Statistics Monthly, Taiwan

District, The Republic of China, The Central Bank of China, August.

Economic Research Department, The Central Bank of China (2000) Financial Statistics Monthly, Taiwan District, The Republic of China, The Central Bank of China, September.

Eyiah, A.K. (2001) ‗An integrated approach to financing small contractors in developing countries: a conceptual model', Construction management and economics, 19, 511-518.

Forster, J. (1999) ‗The creation, maintenance and governance of public goods and free goods', in Osborne, S. (ed) Public Management: An International Journal of Research an Theory, 1(3), Taylor & Francis Group, London, September 1999, 313-327.

Four Seasons Report Spring 1999-Listed companies (Si Chi Pao) Shang Hsun Culture, Taipei, January.

Giaccotto, C. and Sfiridis, J.M. (1996) ‗Hypothesis testing in event studies: The case of variance changes', Journal of Economics and Business, 48, 349-370.

Grajdanzev, A.J. (1942) Formosa Today; An Analysis of The Economic Development and Strategic Importance of Japan's Tropical Colony, Institute of Pacific Relations, New York, 1942

Griffith, A. and Phillips, N. (2001) ‗The influence of the Construction (Design and management) Regulations 1994 upon the procurement and management of small building works', Construction Management and Economics, 19, 533-540.

Haddad, A., Mathur, I., Rangan, N. and Tadisina, S. (1993)'Examining the market reactions to regulatory accounting events', Journal of Applied Business Research, 9(3), Summer, 36-45.

Henderson Jr.,G.V.(1990) ‗Problems and solutions in conducting event studies', Journal of Risk and Insurance, 57(2), June,282-307.

Henson, S. and Mazzocchi, M. (2002) ‗Impact of Bovine Spongiform Encephalopathy on agribusiness in the United Kingdom: results of and event study of equity prices', American Journal of Agricultural Economics, 84(2), May, 370-387.

Hirshleifer, D. (1995) ‗The blind leading the blind-social influence, fads, and informational cascades', In Tommasi, M. and Lerulli, K. (eds) The New Economics of Human Behavior, Cambridge University Press, Cambridge, 188-215.

Ho Wang Construction Co. Ltd.(1997), The prospectus of initial public offering, Ho Wang Construction Co. Ltd. Kaohsuing, December.

Howton, S.D., Howton, S.W. and Perfect, S.B. (1998) ‗The market reaction to straight debt issues: the effects of free cash flow', Journal of Financial Research, 21(2), Summer, 219-228.

Hsiao, C.H. (2000) ‗A going concern housing development strategy', Space Magazine, 125/126, January, 120-128.

Hsieh, H.C. (1997) Housing market in Hong Kong, 4thed, Shang Wu Press, Hong Kong, October.

Hsieh, H.Y. (2002), The Taiwanese residential construction Peak in the 1990s: Interpreting industry and developer behaviour. Unpublished PhD, Griffith University, Australia.

Hsieh, H.Y. (2005), ―The 1990s Taiwan residential construction boom: a supply side interpretation", Construction Management and Economics, March 23, 265-284.

Hsieh, L.Y. (1991) ‗Financial innovation deregulation and monetary policy', Taiwan Economy and

Finance Monthly, 27(1), January, 15-23.

Hsieh, T.Y. (1998) ‗Impact of subcontracting on site productivity: Lessons Learned in Taiwan', Journal of construction engineering and management, March-April, 91-100.

Hua, C.C. and Chang, C.O. (1997) ‗Housing fluctuation patterns between transaction price and volume', Journal of Housing Studies, 5, January, 1-15.

Huang, L.H. (1999) ‗Raising quality and future prospect', Space Magazine, 113, Taipei, January, 83-84.

Ingram, M.A. and Ingram, V.C. (1993) ‗Consistent estimation of residual variance in regulatory event studies', The Journal of Financial Research, 16(2), Summer, 151-160.

Jen Hsiang Construction Co. Ltd. (1995) The prospectus of initial public offering, Jen Hsiang Construction Co. Ltd. Kaohsiung, January.

Judge, G.G., Hill, R.C., Griffiths, W.E., Lutkepohl, H. and Lee, T.C. (1982) Introduction to the Theory and Practice of Econometrics, 2nd ed, John Wiley & Sons, New York.

Kale, S. and Arditi, D. (2001) ‗General contractors' relationships with subcontractors: a strategic asset', Construction management and economics, 19, 541-549.

Kalu, T.C. (1990)'New approach to construction management', Journal of Construction Engineering And Management, 116(3), September, 494-513.

Kan C.C. (1992) The Development and Administration of Hong Kong Housing Market, Chung Hua, Hong Kong.

Kaohsiung City Government (1993) ‗Announcement of volume rate and shade rate standard at each block of land in city plan area', Document No. 37352. Kashsiung City Government, November 29.

Keller, D., Warrack, B. and Bartel, H. (1990) Statistics for Management and Economics: A Systematic Approach, 2nd ed, Wadsworth, Belmont.

Kim, J.C., Kim, D.H., Kim, J.J., Ye, J.S. and Lee, H.S. (2000) ‗Segmenting the Korean housing market using multiple discriminant analysis', Construction management and economics, 18, 45-54.

Kritzman, M.P. (1994) ‗What practioners need to know····about event studies', Financial Analysts Journal, November-December, 17-20.

Kulkarnii, S.P. and Heriot, K.C. (1999) ‗Transaction costs and information costs as determinants of the organizational form: A Conceptual Synthesis', American Business Review, June, 43-52.

Kuo, L.C. (1991) ‗Financial deregulation and globalization- An example of Japan', Taiwan Economy and Finance Monthly, 27(7), July.

Kuo, S.W. (1992) ‗Key factors for high growth with equity—The Taiwan experience,1952-1990', in Klein, L.R. and Yu, C.T. (eds) Economic Development of ROC and The Pacific Rim in The 1990s and Beyond, World Scientific, Singapore, 1994, 1-17.

Kuo, W.J. (1980) Microeconomics, San Ming, Taipei, June.

Kwan, A.Y. and Ofore, G. (2001) ‗Chinese culture and successful implementation of partnering in Singapore's construction industry', Construction management and economics, 19, 619-632.

Lamdin, D.J. (2001) ‗Implementing and interpreting event studies of regulatory changes', Journal of Economics and Business, 53, 171-183.

Li, M.M. (1991) ‗The research of financial institute mergers and acquisition', Taiwan Economy and

Finance Monthly, 27(9), September, 1-9.

Li, S.L. (1999) October 28. ‗High rise building rely on steel structure to prevent earthquake damages', Industrial and Commercial Times, P.6.

Li, Y.C. (2000) ‗Volume control brings calamity to the country', Space magazine 125/126, Taipei, January 58-59.

Li, W.D. (1998) Housing in Taiwan—Agency and Structure? Ashgate, England.

Lin, C.Y. (1991) ‗A brief of financial deregulation and administration', Taiwan Economy and Finance Monthly, 27(8), August 16-20.

Lin, H.H. (1999) October 28. ‗Producing earthquake endurable steel materials form iron triangle', Industrial and Commercial Times, Taipei, p16.

Lin, I.H. (1990) ‗The necessary improvements of financial supervisory mechanism after financial deregulation', Taiwan Economy and Finance Monthly, 26(1), January.

Lin, Y.H. (1999) ‗Current housing issues and policies', Journal of housing studies, 8, Taipei, August, 91-96.

Lin, Y.H. (1999) ‗Housing policy present and future direction', Space Magazine, October, 49-50.

Liu, C.Y. (1993) ‗Financial policies in a maturing Taiwan economy', in Chung-Hua Institution for Economic Research (ed) Conference On The Evolution Of Taiwan Within A New World Economy Order, No.25, Taipei, May 28-29, 138-186

London, K.A. and Kenley, R. (2001) ‗An industrial organization economic supply chain approach for the construction industry: a review', Construction management and economics, 19, 777-788.

Mackinlay, A.C. (1997) ‗Event studies in economics and finance', Journal of Economic Literature, 35(1), March, 13-39.

McBeath, G.A. (1998) Wealth and Freedom: Taiwan's New Political Economy, Ashgate, Aldershot, 1998

McCloskey, D.N. (1991) ‗Continuity in economic history', In Eatwell, J., Milgate, M. and Newman, P. (eds), The World of Economics, The Macmillan press, London, 143-154.

McMillan, J. (1992) Games, Strategies and Managers, Oxford University Press, New York.

McWilliams, A. and Siegel, D. (1997) ‗Event studies in management research: Theoretical and empirical issues', Academy of Management Journal, 40(3), June, 626-657.

MEA (Ministry of Economic Affair) (1982, 1985, 1990, 1999, 2000, 2004), Industrial production statistics monthly, Taiwan area, the Republic of China, 155, 192, 248, 359, 376, Taipei: Ministry of Economic Affair.

Miller, R. (1999) ‗A holistic approach to keeping clients (benefits of customer) relationship management', Marketing, July, 22-24.

Morgan, N.A., Clark, B.H. and Gooner, R. (2002) ‗Marketing productivity, marketing audits and systems for marketing performance assessment: integrating multiple perspectives', Journal of Business Research, 55(5), May, 363-375.

Nunnally, S.W. (1993) Construction Methods and Management, 3rd ed, Prentice Hall Career & Technology, Englewood.

Pacific Housing Co. (1999) ‗Is steel structure stronger than others?', Space Magazine, 123, November,97-98.

Pang, C.K. (1992) The State and Economic Transformation: The Taiwan Case, Garland, New York, 1992.

Peng, C.W. and Chang, C.O. (1995) ‗An analysis of housing vacancy rate phenomenon and reasons in Taiwan', Journal of housing studies, 3, January, 45-71.

Peng, C.W. and Chang, C.O. (2000) ‗The influence of macroeconomic variables on real estate cycles in Taiwan', Proceedings of the National Science Council, Republic of China, 10 (3) Taipei, July, 330-343.

Pindyck, R.S. and Rubinfeld, D.L. (1991) Econometric Models and Economic Forecasts, 3rd ed, McGraw-Hill, New York.

A Study of Applying FMEA in Preventive Maintenance Program Developing

Chee-Cheng Chen, Wen-Ying Cheng

Associate Professor

Department of Business Administration, National Pingtung University of Science and Technology, Taiwan, R.O.C

TEL: +886-8-7703202, Ext. 7679, E-Mail: carl2004@mail.npust.edu.tw

ABSTRACT

Since 1971 Total Productive Maintenance (TPM) has been developed and phased into many manufacturing firms in Japan to promote productivity and competitiveness. Autonomous preventive maintenance (APM) systems are very special. The fundamental pillar of TPM includes a series of important systematical first line direct labors activities. The technical cost, human resources, and management issues are all considered. Failure Modes and Effects Analysis (FMEA) and Fault Tree Analysis (FTA) are the most popular failure analytical methods widely adopted over different industries. They are often used to examine the potential problems in the design and manufacturing phase; discovering possible failure causes before product design and manufacturing finalization. This study integrates the FTA and FMEA of techniques to establish an APM system that meets the company‘s goal of reducing manufacturing costs, and promoting employee and equipment productivity. The major contribution of this study is constructing potential equipment failure modes and their Risk Priority Number (RPN) through FTA and FMEA integration transformed into a selection of items and their APM maintenance frequencies. A strategy for deploying employee technical capability upgrade through effective training is developed. This study uses the S company – a key manufacturer of Semiconductor material – as a case study to verify the model‘s applicability and suitability.

Key Words: *FMEA, FTA, TPM, APM.*

1. Introduction

The market environment is characterized by an increase in technological advancements and rapid economic changes. This transition to global competition forces companies to improve their competitiveness by enhancing their manufacturing performance. One major improvement program in the field of production and operations management is Total Productive Maintenance (TPM) (Ahuja and Khamba, 2008). The main objective of TPM is to achieve a reliable manufacturing system, accomplished by maximizing the overall equipment effectiveness so that plant and equipment productivity is increased. The most commonly cited TPM practices in the literature are autonomous preventive maintenance (APM), preventive maintenance (PM), equipment technology emphasis, as well as cross-functional approaches to

training and employee involvement (Konecny and Thun, 2011). In the approach of most industries APM and PM actions are performed on an item at a scheduled time regardless of its actual condition. Because the schedule is often drawn up on the supplier‘s recommendation, but made with either staff knowledge of the actual use conditions or from past experience, it is seldom an optimal procedure (Eti et al., 2006). Failure Modes and Effect Analysis (FMEA) is known to be a systematic procedure for the analysis of a system to identify the potential failure modes and their causes and effects on system performance. The analysis is successfully performed preferably early in the development cycle so that removal or mitigation of the failure mode is most cost effective (Cassanelli et al., 2006). In order to identify faults in terms of where they are located in a system and how serious their consequences are, a risk priority analysis should be a prerequisite to any operation. The development of FMEA-aided APM and its operation system described in this article is based on our work with an international electronics firm (S Company). In addition to describing the system, the process used to develop such an approach is reviewed, and application conclusions are drawn.

2. Literature review

The literature on FTA, FMEA, TPM and autonomous preventive maintenance is varied. In this section, literature that closely relates to the topic of interest is reviewed, leading to the development of our research focus.

2.1 FTA and FMEA

FTA is a flexible technique equally applicable to quantitative and qualitative analysis that is easy to use and understand. FTA is a deductive technique, which means it works from the top down – assuming the system has failed and then trying to work out why it failed. This is done by working backwards to determine what possible combinations of events might have caused it. The system failure then becomes the top event of the fault tree and the individual component failures form the basic events. They are all combined using a network of logical gates. FMEA, by contrast, is an inductive technique that works from the bottom up – assuming a component failure has occurred, and then assessing the effects of that initial event on the rest of the system. The end result is a table of failures and their effects on the system, which provides the analyst with an overview of the possible faults. Usually, these effects are evaluated according to a number of criteria, such as severity (O), occurrence (O) and detect-ability (D). Often these criteria are then combined into an overall estimate of risk. All of this data are then presented in the form of a table which allows the analyst to quickly see what the effects of each failure mode are. They are useful methods that we can use to identify potential faults in a system, so that we can then use that information to correct or prevent those faults (Papadopoulos et al., 2011).

2.2 TPM and autonomous preventive maintenance

TPM can be regarded as an improvement program establishing a comprehensive productive-maintenance system throughout the entire life of the equipment, encompassing all equipment-related fields, and with the participation of all employees, to promote productive maintenance through motivation or voluntary team-based activities (Konecny and Thun, 2011). TPM calls for operator care and involvement in maintaining equipment, and particularly its functional capability. Some call this autonomous maintenance. Here, operators take care of the equipment (e.g., tighten, lubricate, clean, and work to avoid defects and failure modes, or as appropriate to monitor them, so that their consequence can be minimized) (Nakajima, 1988). Through the 1980s, in the USA and Japan, the developed corporate maintenance strategies involved significant paradigm shifts, such as uptime maintenance, inter-trade flexibility within the maintenance workforce, as well as an amalgamation of the roles of plant operators and front-line maintenance personnel. This paved the way for the introduction of autonomous preventive maintenance (APM), a key element of TPM, cultivating a sense of ownership in the operator by introducing autonomous maintenance (Eti et al., 2006). TPM emphasizes improving maintenance efficiency and effectiveness, that is, you must understand your defects or failure modes, and work proactively to avoid them and/or detect them early enough to minimize their consequence. In order to identify faults in terms of where they are located in a system and how serious their consequences are, a risk analysis should be a prerequisite to any major operation.

3. Method

A strategy of leading people to do the right thing lead S company to develop the FMEA-aided APM and its operation system is discussed in this paper. A case study is given to verify the application feasibility of this approach.

The main FMEA-aided APM analysis steps and establishment techniques are as follows.

Step 1: Choosing a piece of equipment to be studied and forming a multidisciplinary team to build the fault trees.

Step 2a: Performing FMEA, including identifying failure modes, determining the potential effect of each failure mode, ranking the severity (S) and/or class of failure mode effects, listing the causes for each failure mode and ranking the probability of occurrence (O). Listing the prevention, design validation/ verification, or other activities which will assure the design adequacy for the failure mode and/or cause / mechanism under consideration. Ranking the detect-ability (D) of each failure mode, calculating RPN for each failure mode, developing ―What actions need to be taken to prevent the Failure Mode?", assigning appropriate individual, area, function or team and setting a realistic target for completion could be established by development program. Listing the results of the actions taken, and reassessing severity (S), probability (O), detect-ability (D) and RPN.

Step 2b: Creating a "required APM" column with OAM(operator autonomous maintenance) and EPM (Engineer preventive maintenance) sub-columns in FMEA table, developing the required APM actions and performing interval/frequency correspondingly that are used to update the PM working instructions separately as well.

A RPN versus (transformed to) APM interval mechanism can be developed by the multidiscipline FMEA team. The analysis of the past records, considerations of effectiveness and cost are necessary. The mechanism of RPN versus APM interval can be very different for plants with different product-lines. The FMEA team members may be charged with reviewing performance data periodically to assess how much improving the cost of quality has become since implementing the system. The mechanism of S Company is established as Table 1:

TABLE 1. RPN VERSUS FREQUENCY OF OAM, EPM (S COMPANY)

RPN	Severity<8		Severity>=8	
	OAM	EPM	OAM	EPM
451<RPN	2 hours	1 day	1 hour	12 hours
351<RPN≦450	12 hours	5 days	5 hours	2 days
251<RPN≦350	1 day	2 weeks	10 hours	5 days
151<RPN≦250	1 week	3 weeks	1 day	1 week
51<RPN≦150	2 weeks	1 month	3 days	2 weeks
1<RPN≦50	none	none	1 week	3 weeks

Step 3: implementing actions and monitoring performance. The operation manager and FMEA-aided APM project team members are charged with reviewing performance data periodically to assess how much improvement the equipment has obtained since implementing the project. The improvement cycle from step 1 to step 3 will be endless. The required APM and its intervals will be updated dynamically to meet requirements of prevention all the time.

4. Case Study

We selected a case study involving an RTDC taping machine from S company to illustrate the proposed method. The main function of this machine is attaching tape onto the lead-frame (L/F) precisely. The FTA and FMEA are performed. The RTDC machine FTA analysis chart is graphical representations of logical combinations of failures of RTDC machine, and show the relationship between a failure or fault and the events that cause them as Figure 1 showed briefly. The Table II is part of the FMEA table of RTDC machine. One of 3 possible failures and 2 causes of this failure in Figure 1 are picked up to calculate their RPN, 108 and 216 respectively as showed in Table II. Referring to Table 1, the required APM frequencies, including the interval of OAM and EPM for the 2 causes of failures with RPN, 108 and 216 respectively can be determined are showed in Table III. Very significant improvement, average 20% improvement for each performance indicator of lead-frame manufacturing plant of S company, for instance, productivity, overall equipment effectiveness (OEE) and quality has been obtained after phase-in this system one year.

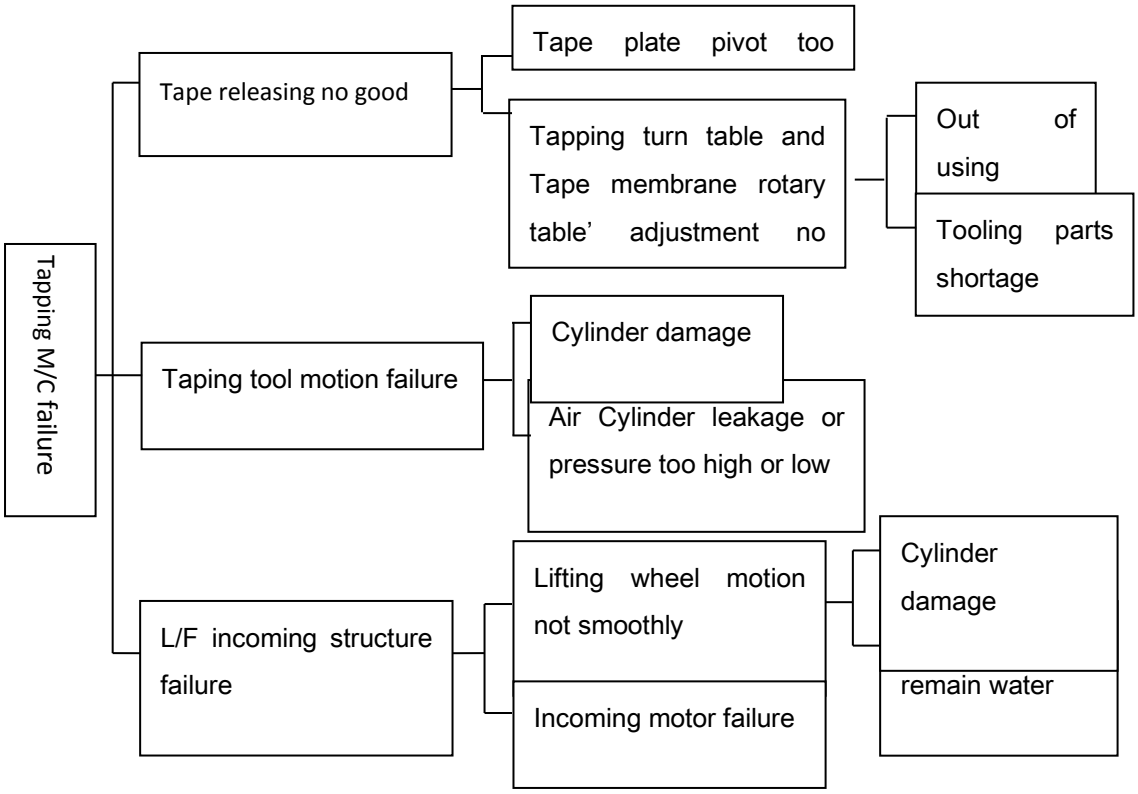


Figure1. RTDC machine FTA analysis chart

FMEA process		Action results		Required APM	
Project and function	to attach tape on L/F precisely	**Actions taken**	Check the tape turn table	**EPM**	(2)
Failure Mode	Tape releasing no good	**Severity (S)**	6	**OAM**	(1)
Failure Effect	to effect the tape incoming	**Occurrence (O)**	6		
Severity (S)	6	**Detect-ability (D)**	3		
Cause of failure	Tapping turn table axle too loose	**RPN**	108		
Occurrence (O)	8	**Responsibilities/ date**	Tapping Operator/ 20100923		
Prevention methods	Enough Parts/Tool	**Corrective action**	Confirm the tape turn table status		
detection methods	Adjustment by condition	**RPN**	288		
Detect-ability (D)	6				
		Actions taken	Check transparent table	**EPM**	(4)
		Severity (S)	6	**OAM**	(3)
		Occurrence (O)	6		
		Detect-ability (D)	6		
		RPN	216		
Project and function		**Responsibilities/ date**	Tapping Dept. Operator		
Failure Mode		**Corrective action**	Confirm transparent table status		
Failure Effect		**RPN**	384		
Severity (S)	6				
Cause of failure	Table adjustment no good				
Occurrence (O)	8				
Prevention methods	Enough Parts/Tool				
detection methods	Adjustment by condition				
Detect-ability (D)	6				
RPN	288				

TABLE 2. FMEA TABLE OF RTDC MACHINE

TABLE 3. REQUIRED APM FREQUENCY OF RTDC MACHINE

Failure mode	cause for failure mode	prevention methods	detection methods	RPN	Required APM	
					OAM	***EPM***
Tape releasing no good	Tapping turn table axle too loose	1.Conducting the training 2.Sufficient Parts/Tool	Check the tape turn table	108	(1) 2 weeks	(2) 1 month
	Table adjustment no good	1.Conducting the training 2. Sufficient Parts/Tool	Check transparent table	216	(3) 1 week	(4) 3 weeks

References

Ahuja, I. P. S., Khamba, J. S., 2008, "Assessment of contributions of successful TPM initiatives towards competitive manufacturing", Journal of Quality in maintenance Engineering, vol.14(4), pp. 356-374.

Cassanelli, G., Mura, G., Fantini, F., Vanzi, M. and Plano, B., 2006, "Failure analysis-assisted FMEA", Microelectronics Reliability, vol. 46, pp. 1795-1799.

Eti, M. C., Ogaji, S. O. T., and Probert, S. D., 2006, "Development and implementation of preventive-maintenance practices in Nigerian industries", Applied Energy, vol. 83, pp. 1163-1179.

Konecny, P. A., Thun, J. H., 2011, "Do it separately or simultaneously – an empirical analysis of a conjoint implementation of TQM and TPM on plant performance", in press.

Nakajima, S., 1988, "Total Productive Maintenance. Productivity Press, London.

Papadopoulos, Y., Walker, M., Parker, D., Rude, E., Hamann, R., Uhlig, A., Gratz, U. and Lien, R., 2011, "Engineering failure analysis and design optimization with Hip-HOPS", Engineering Failure Analysis, vol. 18, pp. 590-608.

A Measure of Service Quality for Taxi Company in Hanoi, Vietnam: Some Empirical Findings for Future Marketing Strategy

Tsung-Hao Chen[1*], Hui-Chin Chu [2], Ngo Ngoc Vi [3]

[1,2] Assistant Professor, Department of Business Administration, Shu-Te University, Taiwan, R.O.C.

[3] Graduate student, Graduate School of Business and Administration, Shu-Te University, Taiwan, R.O.C. and graduate student, Vietnam Education University, Hanoi, Vietnam.

TEL: +886-7-6158000-3100 E-Mail:* Corresponding author: thchen@stu.edu.tw

ABSTRACT

Businesses must themselves seek for different ways to compete with their rivals. Since service quality appears, the stage for the assessment by the clients begins. Many researchers and experts have tried to identify measure and manage the quality of the services. Specifically, the quality is significantly more important in taxi services. Higher development of social life results in higher need for the taxi service. A large number of taxi companies have been established, thus the competitive pressure in the industry is considerably huge. As a result, in order to survive, compete and develop, the taxi companies must improve the quality of their services.

The aims of the study are to test the SERVQUAL scale in measuring the quality of taxi transportation service, to discover the components of quality of taxi transportation service, and to find out the effects of service quality on the customer satisfaction and the differences in service quality evaluation. The research results point out that satisfaction is affected by assurance and empathy of staff, tangibles and responsiveness. In particular, the assurance and empathy of staff is the largest affecting factor, followed by responsiveness and tangibles. That is, people in Hanoi city, Vietnam ignored the taxi company reliable in providing service. They care about better and newer taxi, they hope taxi driver helpful and capable of providing service towards customers and has to experience client's feelings in very heavy traffic of Hanoi city.

Key Words: *Customer Satisfaction, SERVQUAL Model, Taxi Transportation Service.*

1. Introduction

Today, along with the opening of trading market there are being many goods and diversified services. In particular, public passenger transport by taxi appears. The service when launched is considered a luxury, only for the elite. However, when economic development and people_s demand is higher and higher. Taxi service has now become a convenient vehicle to serve the needs of all traveling. With the diversified price and quality range, anyone can use this service.

In recent years, taxi services have gradually become the need of the majority of the people, the big advantage is easy to contact, and the waiting time for the service is less, payment procedures are simple. Taxi service has become a safe, convenient and fast transport which is immediately preferred by businessmen, especially in trade and work. Besides, many people have the habit of using taxi to do weddings, funerals, parties, and emergency transport for patients ... However, service quality, utility and variety of payment, ability to meet the needs is still restricted. Taxi service has not proved its superiority on other types of transport service, economy, flexibility, time and method of payment.

Passenger transport by type of taxi is now subject to competitive pressure, though. Because this is an area in which the service dominates a key position. So, at what quality taxi services will best create superior competitiveness, can win the hearts of customers then win a solid share in the market. My Dinh Taxi Company, since inception up to now has a well-developed process. However, the assessment and measuring the service quality performance of the firm is coming up against difficulties. What factors are needed in service quality, what factors are based on to gauge the quality of service that is not a simple problem? To accomplish this firm can apply the model SERVQUAL to assess the new service quality to help taxi My Dinh assess their services quality, so as to take measures to improve their services.

From the research result of economists, top service, by understanding the actual service quality in Vietnam. The author found that the use SERVQUAL model to assess the service quality is most suitable for Vietnam market. Since then, with its own characteristics during operation, company size and form of assessment and market share, the author has chosen taxi My Dinh, Hanoi as research, evaluation science units of patterns.

2. Literature review

In general, any taxi service firm has a separate management policies, taxi management is a very difficult and a matter to debate not only in business but even for management agencies in Hanoi is very difficult as well. So, every business must have a separate management, a separated plan to provide services more efficiently.

According to Parasuraman, Zeithaml & Berry (1985), any service, quality of service and customer satisfaction can be divided into ten parts (Trust, Response, Ability to serve, Accessibility, Calendar, Information, Reliability, Safety, Understanding customers, Tangible means). Ten of these components also have a relationship with nature in size and direction of the 5 gaps. Ten components of quality of services mentioned above have the advantage of covering most aspects of a service. However, this model has disadvantages as complicated to measure. Furthermore this theoretical model may be multiple components of service quality models without worth distinguishing.

So the researchers repeatedly tested this model and concluded that perceived service quality consists of five basic components. Model of service quality, SERVQUAL includes 5 independent components include variable component of reliability, response, assurance, empathy and tangibles and a dependent variable satisfactory. Many researchers and experts have tried to identify measure and manage the quality

of the services (Parasuraman, Zeithaml & Berry, 1988, 1993, 1994; Cronin and Taylor,1992,1994;Howcroft,1993; Vandamme and Leunis,1993; Blanchard and Galloway,1994).

Service quality model SERVQUAL expressed as follows:

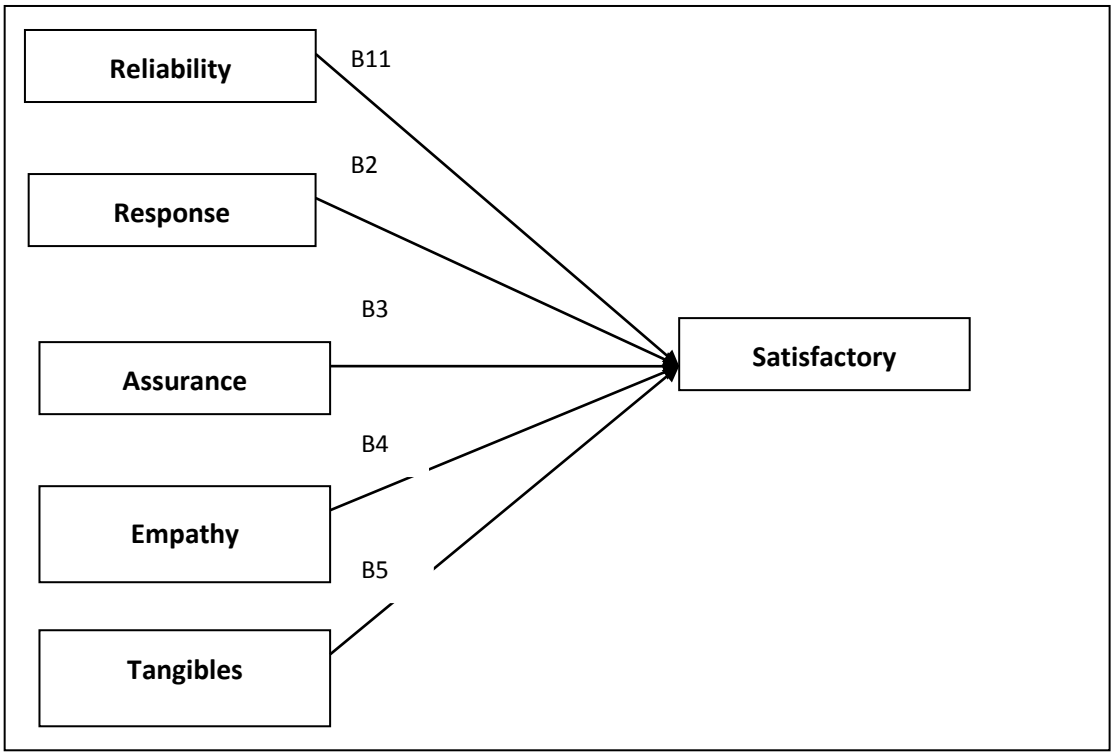


Figure 2.1 - Service quality Models - SERVQUAL

The quality model SERVQUAL: B1, B2, B3, B4, B5, respectively, as follows: if increasing the reliability or responsiveness, or ability to serve or sympathy or tangible means will increase customer satisfaction, including 22 observed variables (Parasuraman, Zeithaml & Berry,1985). The scale has been tested and adjusted by authors several times and concluded that it is a suitable scale for all types of services.

Moreover in the context of the observed variables that describe the content in the service quality components are also different between sectors. For this sector this could be the best variable to evaluate observer but for others it is not appropriate. So it is hard to give a standard scale which is consistent with all the variety of service companies.

The ways of approaching to improve and measure services may not necessarily like the service, but purely due to particular characteristics of specific business services that require a suitable service quality scale. Then, applying the scale SERVQUAL in specific business environment needed to be careful because several factors may change(Carman, 1990, Dabholkar, Thorpe & Rentz, 1996; Brady & Cronin, 2001, Yoon & Suh, 2004; Alzola & Robaina, 2005).

3. Methodology

3.1 Research model

The taxi service quality supplied by taxi My Dinh is measured through customer appreciation of the factors mentioned above. My Dinh taxi's group of customers is the units and individuals living in Hanoi. Visitors, staff - employees who travel to Hanoi are using the taxi service.

The quality model SERVQUAL: H1, H2, H3, H4, H5, respectively, as follows: if increasing the reliability or responsiveness, or ability to serve or sympathy or tangibles will increase customer satisfaction, including 26 observed variables. The scale has been tested and adjusted by authors several times and concluded that it is a suitable scale for all types of services.

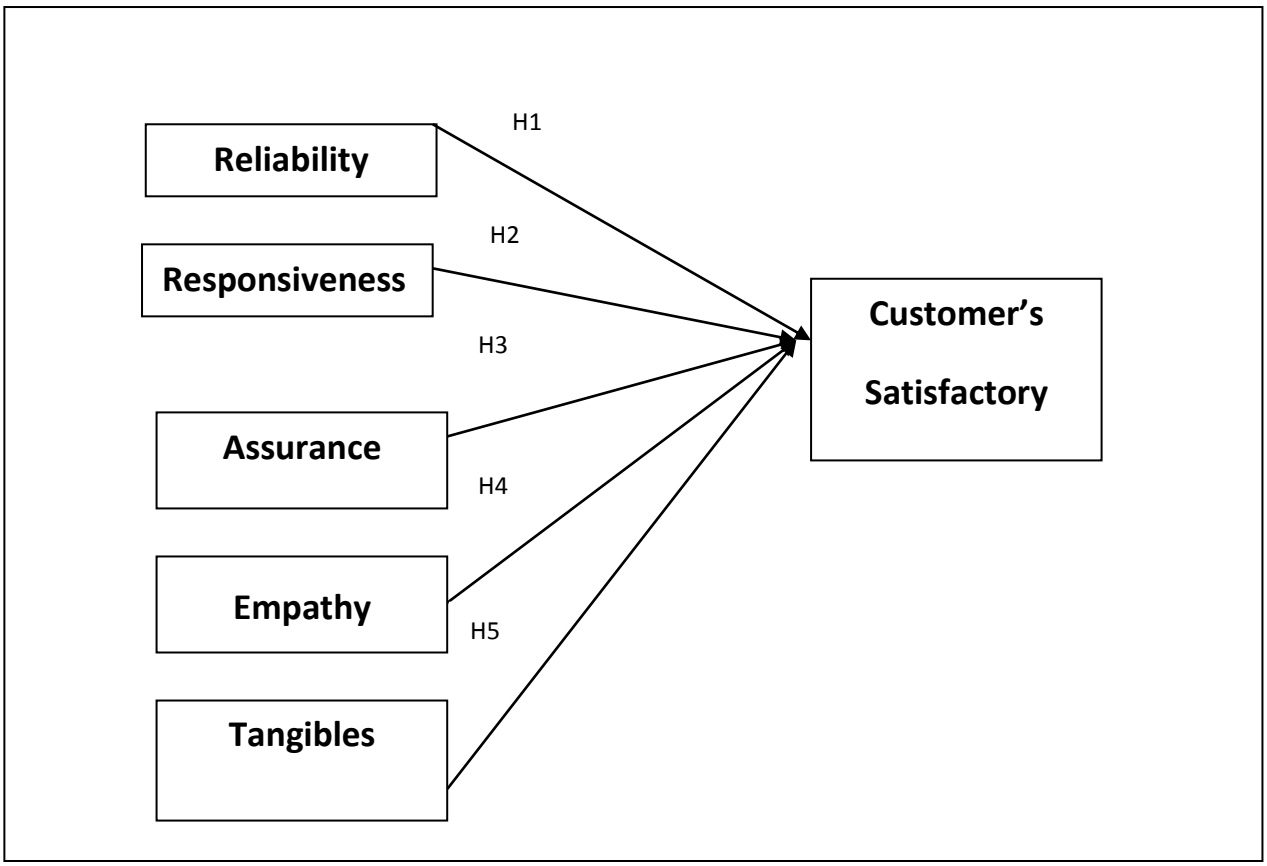


Figure 3.1 – Research model –SERVQUAL

3.2 The questionnaire

The questionnaire is designed to include 26 variables which observe SERVQUAL scale (Table 3.2) and 5 variables to scale satisfaction expressed on a point scale Likert from point 1 (completely disagree) to point 5 (completely agree). With such a designed questionnaire, the client will indicate the feeling of mobile telecommunications services quality by circling the appropriate number. This way will quantify the opinion of the investigation and use Likert to statistically test and analyze multivariate data.

Customers who are using the services of three main taxi service providers in the taxi market as Hanoi My Dinh, Ha Noi and Mai Linh Taxi are sent questionnaires to collect information The products and services for their clients are quite similar in many ways, and finally, here are three taxi service providers who are holding the major share in Hanoi.

Initially data will be encrypted, cleaned, and then analyzed with the main components. By assessing the reliability (coefficient of reliability -the Cronbach‘s Alpha) and finding the value (factor loading). Then, with EFA (Exploratory Factor Analysis) testing theoretical models (multivariate regression, testing the conformity, and testing the hypotheses). Specifically as follows:

The scales are assessed through coefficient of reliability – Cronbach‘s Alpha. In which variables correlate with general variable (<0.3) are excluded and the scale is accepted when coefficient of satisfactory – Cronbach‘s Alpha (> 0.6). EFA factor analysis is used to test the value of the concept of scale. The observed changes are accepted as Factor loading is the greatest (> 0.5) and the scale is accepted when the variance extracts the need (> 50%)(Pardeo, 2006; .Pallant, 2007; Yockey, 2008)

Table 3.2 – The revised SERVQUAL scale

Tangibles	1	Tan.1	Use new and modern vehicles
	2	Tan.2	pretty eye-catching colorful cover
	3	Tan.3	clean, nice, neat layout, reasonable interior
	4	Tan.4	Good AC, pleasant fragrance, well-working cassette players
	5	Tan.5	Staff with polite costumes
	6	Tan.6	Decal, logo, phone number, roof lights are easily recognized
Reliability	7	Rel.1	Accurately metered set
	8	Rel.2	Inform customers correctly
	9	Rel.3	Inform customers in a timely manner
	10	Rel.4	This is a reputable taxi firm
	11	Rel.5	Using the taxi can reduce traffic accidents
	12	Rel.6	Transportation process will make you feel safe and comfortable
	13	Rel.7	Provide services on time as promised
Responsiveness	14	Res.1	The My Dinh Taxi "Safety Anytime - Anywhere"
	15	Res.2	Provides a wide range of value-added services
	16	Res.3	Provide the difference types of services
	17	Res.4	Many advantages when you are using this types of added service
	18	Res.5	Easily call the switchboard
	19	Res.6	Customer care settle complaints, respond to customers quickly
Assurance	20	Ass.1	Customer care brings you trust
	21	Ass.2	Customer care have good communication skills, strong technical knowledge
	22	Ass.3	Employees of the taxi firm has good communication skills, polite, courteous and inspire the customer
Empathy	23	Emp.1	Staff is dedicated to help you when you're having trouble
	24	Emp.2	Information must always be recognized and satisfy customer
	25	Emp.3	Customer care is interested in each customer's preferences
	26	Emp.4	Customer care always know and understand the needs of customers

4. Results

4.1Samples and information samples

The survey was conducted in the area of Hanoi city, after releasing 250 samples, obtained results of 217 valid samples.

Table 4.1 - Information sample

		Taxi Mai Linh		Taxi Mỹ Đình		Ha Noi taxi		Total	
		N	%	N	%	N	%	N	%
Use form	In the city	54	77.1	54	71.1	53	74.6	161	74.2
	Out of the city	16	22.9	22	28.9	18	25.4	58	25.8
Total		70	100	76	100	71	100	217	100
Sex	Male	28	40	37	48.7	29	40.8	94	43.3
	Female	42	60	39	51.3	42	59.2	123	56.7
Total		70	100	76	100	71	100	217	100
Use frequency	Never	6	8.6	10	13.2	21	29.6	37	17.1
	Seldom	6	8.6	15	19.7	18	25.4	39	18
	Frequently	58	82.9	51	67.1	32	45.1	141	65
Total		70	100	76	100	71	100	217	100
Qualification	No formal education	0	0	0	0	0	0	0	0
	primary education	0	0	0	0	0	0	0	0
	Secondary education	2	2.9	3	3.9	0	0	5	2.3
	High education	8	11.4	2	2.6	0	0	10	4.6
	Intermediate / Vocational Training	8	11.4	11	14.5	16	22.5	35	16.1
	University / College	50	71.4	56	73.7	54	76.1	160	73.7
	Post graduate	2	2.9	4	5.3	1	1.4	7	3.2
Total		70	100%	76	100%	71	100%	217	100%

4.2 Assessment scale- Cronbach's Alpha Reliability

4.2.1 Customer's Satisfaction

Satisfaction measurement scale was tested by using reliability and factor analysis. Reliability was assessed by Cronbach's Alpha, and if the coefficients of Cronbach's Alpha if item deleted are greater than the average value of Cronbach's Alpha, the variable will be eliminated (since the reliability is not guaranteed). The Cronbach's Alpha coefficient is equal or greater than 0.6 and the correlation coefficient is greater than 0.3.

Statistical results provided in the table above shows that the satisfaction scale with 4 variables have Cronbach's Alpha coefficient of 0.799, and the satisfaction variables do not exceed 0.799. Therefore, there are no variables that are excluded and the satisfaction scale is accepted.

Table 4.2 Cronbach's Alpha Reliability- Customer's Satisfaction (4 variables)

Cronbach's Alpha = 0.799, N= 4			
Customer's Satisfaction	Average scale if eliminating the variables	Average variances extracted	Cronbach's Alpha if eliminating the variables
Sat-1	10.53	0.680	0.728
Sat-2	10.64	0.642	0.736
Sat-3	10.71	0.599	0.755
Sat-4	10.71	0.578	0.783

4.2.2 SERVQUAL scale

In theory, the SERVQUAL scale is multi- dimensional with five components as described in the theoretical basis chapter. In this section, the scale will be tested similar to the test of satisfaction scale. From Table 4.3, it is illustrated that all three variables observed in the tangibles scale (Tan), Responsiveness (Res) and Empathy (Emp) were excluded because they have higher Cronbach's Alpha coefficient than that of the measure scale corresponding to the observed varibles: Tan-6 (0.808> 0.767), Res-8 (0.789>0.780), Emp-3 (0.699> 0.627).

Table 4.3 The preliminary reliability of Cronbach's Alpha - five components

Tangibles		Reliability		Responsiveness		Assurance		Empathy	
Cronbach's Alpha **0.767** N=6	Cronbach's Alpha if eliminating the variables	Cronbach's Alpha **0.830** N=7	Cronbach's Alpha if eliminating the variables	Cronbach's Alpha **0.763** N=8	Cronbach's Alpha if eliminating the variables	Cronbach's Alpha **0.769** N=3	Cronbach's Alpha if eliminating the variables	Cronbach's Alpha **0.672** N=3	Cronbach's Alpha if eliminating the variables
Tan-1	0.733	Rel-1	0.806	Res-1	0.704	Ass-1	0.736	Emp-1	0.372
Tan-2	0.701	Rel-2	0.806	Res-2	0.718	Ass-2	0.661	Emp-2	0.399
Tan-3	0.726	Rel-3	0.799	Res-3	0.717	Ass-3	0.671	Emp-3	0.699
Tan-4	0.687	Rel-4	0.81	Res-4	0.711			Emp-4	0.434
Tan-5	0.728	Rel-5	0.814	Res-5	0.74				
Tan-6	0.808	Rel-6	0.814	Res-6	0.773				
		Rel-7	0.8						

After extracting the variables, Cronbach's Alpha coefficient of Tan, Res, Emp scales are re- determined as Table 4.4. After the variables are eliminated, reliability is defined and it satisfies all the requirements and no more additional variables were excluded.

Table 4.4 The revised reliability of Cronbach's Alpha - five components

Tangibles		Reliability		Responsiveness		Assurance		Empathy	
Cronbach 's Alpha **0.808** N=6	Cronbach 's Alpha if eliminating the variables	Cronbach 's Alpha **0.830** N=7	Cronbach 's Alpha if eliminating the variables	Cronbach 's Alpha **0.773** N=8	Cronbach 's Alpha if eliminating the variables	Cronbach 's Alpha **0.769** N=3	Cronbach 's Alpha if eliminating the variables	Cronbach 's Alpha **0.799** N=3	Cronbach 's Alpha if eliminating the variables
Tan-1	0.796	Rel-1	0.806	Res-1	0.725	Ass-1	0.736	Emp-1	0.573
Tan-2	0.754	Rel-2	0.806	Res-2	0.736	Ass-2	0.661	Emp-2	0.537
Tan-3	0.778	Rel-3	0.799	Res-3	0.717	Ass-3	0.671	Emp-4	0.704
Tan-4	0.744	Rel-4	0.81	Res-4	0.724				
Tan-5	0.784	Rel-5	0.814	Res-5	0.754				
		Rel-6	0.814						
		Rel-7	0.8						

4.3 Exploratory Factor Analysis

After adjusting the variables, the variables of the five elements have been sent to the factor analysis process. Exploratory factor analysis technique has been widely used in this study to distract and gather the observed variables into a more significant factor, but smaller number of variables for future use of regression analysis. We come up with a table of analysis after the rotation as follow:

From Table 4.5, it is illustrated that for each variable in one line, one maximum loading Factor is obtained. The largest factor loading must be ≥ 0.5 as standard.

After the variables assurance and empathy are integrated, reliability is defined and it satisfies all the requirements and no more additional variables were excluded. Thus, the Cronbach's Alpha coefficient of assurance and empathy (0.843) are great than each (0.769, 0.799). The result of four factors was shown as Table 5, and there are no more observed variables being eliminated.

After the SERVQUAL scale is applied to assess the service quality of the telecommunications sector (through the three major mobile networks: Vinaphone, Mobifone and Viettel), there obtain changes in the component of quality service, from five components initially to only four and changes the name, definition and notation.

After the new scale with four components (Staff, Credibility, Tangibles and added services and convenience) is examined, it meets the required level of reliability and distinction and is ready to be used for further analysis.

	Component			
	1	2	3	4
Tan-1			0.681	
Tan-2			0.769	
Tan-3			0.599	
Tan-4			0.718	
Tan-5			0.695	
Rel-1		0.673		
Rel-2		0.782		
Rel-3		0.735		
Rel-4		0.601		
Rel-5		0.445		
Rel-6		0.463		
Rel-7		0.540		
Res-1				0.500
Res-2				0.758
Res-3				0.738
Res-4				0.563
Res-5				0.519
Ass-1	0.581			
Ass-2	0.760			
Ass-3	0.790			
Emp-1	0.677			
Emp-2	0.618			
Emp-4	0.545			

Table 4.5: SERVQUAL factor analysis

Table 4.6 The revised reliability of Cronbach's Alpha - four components

Tangibles		Reliability		Responsiveness		Assurance and Empathy	
Cronbach's Alpha 0.808 N=6	Cronbach's Alpha if eliminating the variables	Cronbach's Alpha 0.830 N=7	Cronbach's Alpha if eliminating the variables	Cronbach's Alpha 0.773 N=8	Cronbach's Alpha if eliminating the variables	Cronbach's Alpha 0.843 N=6	Cronbach's Alpha if eliminating the variables
Tan-1	0.796	Rel-1	0.806	Res-1	0.725	Ass-1	0.829
Tan-2	0.754	Rel-2	0.806	Res-2	0.736	Ass-2	0.801
Tan-3	0.778	Rel-3	0.799	Res-3	0.717	Ass-3	0.804
Tan-4	0.744	Rel-4	0.81	Res-4	0.724	Emp-1	0.813
Tan-5	0.784	Rel-5	0.814	Res-5	0.754	Emp-2	0.822
		Rel-6	0.814			Emp-4	0.833
		Rel-7	0.8				

4.2 Adjustment of research model

Due to the changes in the components of the SERVQUAL scale, the research model is adjusted and will be used to test two hypotheses as follow.

H1: The assurance and empathy *are positively related to the Satisfaction.*

H2: The Reliability *is positively related to the Satisfaction.*

H3: The tangible means *are positively related to the Satisfaction.*

*H4: The r*esponsiveness *are positively related to the Satisfation*

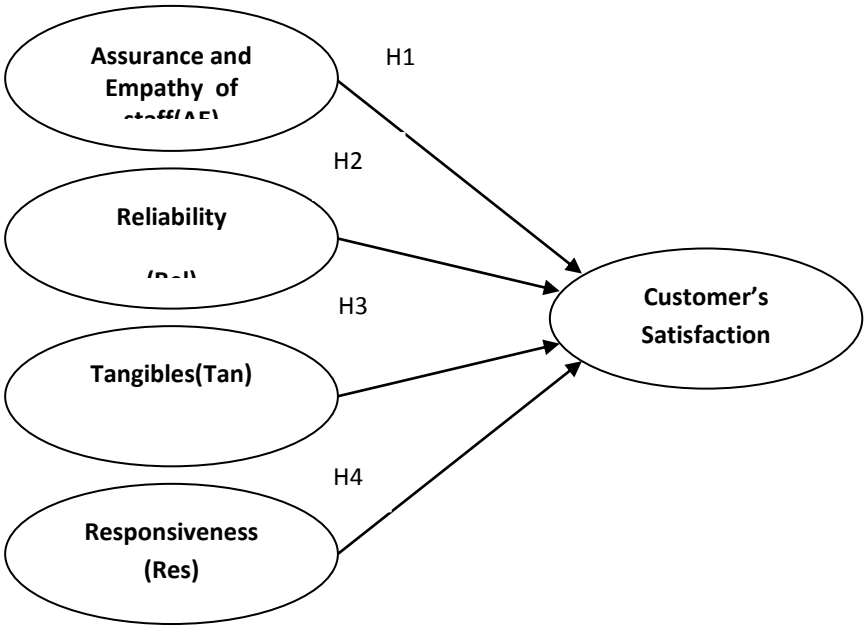


Figure 4.1 - Adjustment of Research model

4.3 Regression analysis

Before regression analysis, we take the average of Likert scores of observed variables as new factors on the database. To test the suitability of the model, the correlation matrix between the variables which are five components of SERVQUAL are established. Based on the correlation coefficient at 0.01 significant levels, here shows the results of correlation analysis as the Pearson coefficient. Correlation matrix expresses that the satisfaction closely correlated with the four components of the SERVQUAL and fourth components are themselves correlated closely with each other. Thus, four components are considered as independent variables in the next regression model.

Table 4.7 Correlation matrix: Sat – Sta, Rel, Tan, Ser

	AE	Rel	Tan	Res	Sat
AE	1				
Rel	0.599(**)	1			
Tan	0.520(**)	0.560(**)	1		
Res	0.666(**)	0.572(**)	0.494(**)	1	
Sat	0.502(**)	0.391(**)	0.399(**)	0.485(**)	1
** correlation at 0.01 significance level					

Regression result (Table 4.8) shows only three independent variables that reach significance level. Other testings (via the charts) point out that the regression assumptions are not violated. The phenomenon of multi-collinearity does not be violated , with VIF 1.967, 1.900 and 1.448.

Thus the multiple regression model following are characterized to the theoretical model that is consistent with market data.

Customer's Satisfaction = 0.794+0.329 * AE + 0.263 * Resr + 0.168 * Tan

According to regression results in Table 4.8 and 4.9, it can be concluded that satisfaction is positively influenced by components assurance and empathy (AE), responsiveness (Res), and the tangibles (Tan). This means that higher assurance and empathy, responsiveness, and the tangibles can increase the customer's satisfaction. Thus, the hypothesis H1, H3 and H4 were accepted and hypothesis H2 was rejected. That is, people in Hanoi city, Vietnam ignored the taxi company reliable in providing service. They care about better and newer taxi, they hope taxi driver helpful and capable of providing service towards customers and has to experience client's feelings in very heavy traffic of Hanoi city.

Table 4.8 Model Summary(d)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.502(a)	0.252	0.248	0.49875
2	0.541(b)	0.293	0.286	0.48614
3	0.554(c)	0.307	0.297	0.48243

a Predictors: (Constant), AE
b Predictors: (Constant), AE, Res
c Predictors: (Constant), AE, Res, Tan
d Dependent Variable: Sat

Table 4.9 Multiple regression: Sat = f(AE, Tan, Ses)

Model		Unstandardized coefficient		Standardized coefficient	t	Sig.	VIF
		B	Standard deviation	Beta			
1	(Constant)	0.794	0.294		2.697	0.008	
	AE	0.329	0.096	0.273	3.413	0.001	1.967
	Res	0.263	0.089	0.232	2.955	0.003	1.900
	Tan	0.168	0.081	0.142	2.073	0.039	1.448

5. Conclusion

5.1 Results of the research

The research results point out that satisfaction is affected by assurance and empathy of staff, tangibles and responsiveness. In particular, the assurance and empathy of staff is the largest affecting factor, followed by responsiveness and tangibles.

This may be explained by the fact that the staffs regularly contact with the customers, answer questions and resolve the customer‘s complaints. Through the scale, the customers evaluate the staff from many different aspects, which are communication skills, knowledge, attitude and consideration to customers. It is essential to improve knowledge, attitudes, working styles and professional ethics for employees.

In regard of the responsiveness factor, the impact of this factor to the satisfaction is reasonable. The greater the responsiveness of the service, the lower the cost and time needed, thus increase the customer satisfaction. In term of tangibles, this is the element of the facilities that are presented to the external appearance.

5.2 Implication to the service administrators

The research results have come up with the conclusion that, to enhance customer satisfaction, service quality should be improved. The first and foremost thing to concern is strong attention of staffs to customers. The service providers should set up policies and organize training courses to improve the staff quality. The employees should raise concern and awareness about the correct and suitable attitudes and work ethics.

Second, drivers should be trained to be professional and dedicated. The attitude of the drivers have a huge impact on the quality of the services, thus creates the perception of quality service for the company.

Third, providing additional value-added services to serve customers is urgent and crutial. However, in addition to providing value-added services, the suppliers should also have appropriate marketing policies to advertise its services to the customers. The customers then can gain better understanding and knowledge of the the services.

Fourth, investment in upgrading infrastructure and equipment should be well supported. When using the taxi service, customers always require the convenience, comfort and safety. Therefore, the convenience and the modern of the taxi are essential. It strongly requires the maintenance policies to guarantee the safety of the car. This is a significant factor that may affect the quality of corporate services.

Last but not least, the professional of the entire company should be taken into account, since it involves in the satisfaction of customer service.

References

Alzola, L.M., and Robaina, V.P., 2005, SERVQUAL: Its applicability in electronic commerce B2C, *The quality management journal*, 12(4): 46-57.

Blanchard, R. and Galloway, R., 1994, Quality in retail banking, *International Journal of Service Industry Management*, 5(4): 5-23.

Brady, M.K. and Crinin, J.J., 2001, Some new thoughts on conceptualizing perceived service quality: A hierarchical approach, *Journal of Marketing,* 65(3): 34-49.

Carman, J., 1990, Consumer perceptions of service quality: An assessment of the SERVQUAL dimensions. *Journal of Retailing*, 65 (1): 33-55.

Cronin, J. and Taylor, S, 1992, Measuring service quality: a reexamination and extension. *Journal of Marketing*, 6: 55-68.

Cronin, J. and Taylor, S., 1994, SERVPERF versus SERVQUAL:Reconciling performance-based and perceptions-minus-expectations measurement of service quality, *Journal of Marketing*, 58: 125-131.

Dabholkar, P.A., Thorpe, D.I. and Rentz, J.O., 1996, A measure of service quality for retail stores: Scale development and validation, *Journal of the Academy of Marketing Science*, 24(1): 3-16.

Howcroft, B.,1993, Staff perceptions of service quality in a UK clearing Bank: Some empirical findings, *International Journal of service industry management*, 4: 5-24.

Pallant, J., 2007, SPSS Survival manual, Mcgraw-Hill, New York.

Pardeo, I., 2006, Applied regression modeling: a business approach, Jone Wiley & Sons, Canada.

Parasuraman, A., Zeithaml, V. and Berry, L. L., 1985, A conceptual model of service quality and its implications for future research, Journal of marketing, 49 (1): 41-50.

Parasuraman, A., Zeithaml, V. and Berry, L. L.,1988, SERVQUAL: A multiple item scale for measuring consumer perceptions of service quality, *Journal of Retailing*, 64(1): 13-40.

Parasuraman, A., Zeithaml, V. and Berry, L. L., 1993, The nature and determinants of customer expectations of service, *Journal of academy of marketing science*, 21: 1-12.

Parasuraman, A., Zeithaml, V. and Berry, L. L.,1994, Reassessment of expectations as a comparison standard in measuring service quality: Implications for future research, *Journal of Marketing*, 58(4): 111-124.

Vandamme, R and Leunis, J., 1993, Development of a multiple-item scale for measuring hospital service quality, *International Journal of Service Industry Managemen* , 4(3): 30-49.

Yockey, R. D., 2008, SPSS Demystified: A step-by-step guide to successful data analysis, Pearson education, London.

Yoon, S. and Suh, H., 2004, Ensuring IT consulting SERVQUAL and user satisfaction: A modified measurement tool, *Information Systems Frontiers*, 6(4): 341-351.

A Note for Submission

1. The YMC Management Review is hosted by the Young Men Business Club ROC. Articles about management, practical discussionsand management cases are all welcomefor submission. Three areas are especially encouraged for the paper:
   - The discussion and innovation about management thinking.
   - The discussion about practical management.
   - A case study about the management.
2. The YMC Management Review publishes two numbers each year. The first number publishes the cooperationof holding the iFAIRS conference. The second number, discussed mainly in Chinese, publishes topics about practical management.
3. There is a limit of 20 pages for the manuscript.Please type in a Word 2000 document or alater version. Please submit your paper to ymcmr@yahoo.com.tw.
4. Once you submit your paper it will be blind reviewed by two referees.According to the international conventions, all papers published are not to be paid when your paper is accepted.
5. Your paper should contain:a topic, abstract, article, reference, and appendix. The first page should contain the author’s name(s), titles, address, phone number, and e-mail address only.
6. The abstract of your submission should contain:the research topic, the purpose, methodology, and main finding.(Limited to 300 words, with only five key words at the most)

青年企業管理評論
Ymc Management Review

Publisher and Chairman: CHEN, Chong-Hsian
Editor-in –Chief: CHANG, Kung-Hsiung
Editor-in-Executive: TSAI, Chan-Wei,CHEN, Tsung-Hao, and HSU, Wen-Hsi Lydia

Publisher: Young Men Business Club of R.O.C.
Address: 3F/3 Lane 1041 Ta-Hsuen 1st Rd. Gue-Sun Dist. Kaohsiung 804 TAIWAN
Phone: +886-7-5525715
E-Mail: ymcmr@yahoo.com.tw
Website: www.ymcmr.org

Press: Hung Kuan Digital PressCo.
+886-5-5315351 http://www.pod.com.tw

ISSN 2073-0888
Publishing Volume: Volume 5 No.1
Publishing date: 1 October2012
Price: US $ 100

Print in TAIWAN
2012@All copyright reserved.