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Corporate life cycle and share repurchases: Evidence from the Taiwan Stock Market

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This study investigated the relationship between corporate life cycle and the determinants of firms' repurchasing decisions. Our sample firms were gathered from the Taiwan Stock Market over the period 2000 to 2009. This study used the life cycle descriptors and cluster analysis to determine firm years' life cycle stages. The results showed that signaling information is the general reason for share repurchases, regardless of life cycle stages. In the growth stage, firms' repurchase decisions may mix different motivations, including undervaluation information signaling. In the mature stages, firms not only distribute excess cash flow to stockholders but also signal information that agency problem will be reduced by repurchases. In the stagnant stage, the reasons for repurchase decisions are not explicit.

Key words: Corporate life cycle, share repurchase, cluster analysis, logistic regression.

INTRODUCTION

In Taiwan, firms were permitted to implement share repurchase programs from August 2000. Until December 2009, half of the listed firms have bought back their own stocks from open markets. Open market share repurchases have gradually become an important financial policy for firms in Taiwan Stock Market. This study further examines the characteristics influencing firms to announce repurchasing programs.

There are many reasons for firms to announce repurchases. The two common reasons are signaling firms' undervalued information and to reduce the excess of cash flow, that is signaling information hypothesis and excess cash flow hypothesis (Vermaelen 1981, 1984; Nohel and Tarhan, 1998; Jagannathan and Stephens, 2003). These two reasons might be related to different corporate life cycle stages. Signaling information hypothesis emphasizes that repurchasing firms are undervalued and/or may have better future profitability. It seems to imply that repurchasing firms are possible in

growth stages. Excess cash flow hypothesis suggests that repurchasing firms lack investment opportunities and their excess cash flow induces agency problem. Such excess cash flow usually occurs during the mature stage.

Massa et al. (2007) suggest that share repurchases are mimicking behaviors for firms in more concentrated industry, which is known as mimicking behavior hypothesis. They suggest that, if a firm in the more concentrated industry announces its repurchasing programs and other firms within the same industry do not follow to announce the similar plans, the market will interpret negatively the non-repurchasing firms' economic prospects. Moreover, Chay and Suh (2009) find that cash flow uncertainty is important for firms' payout policy, including share repurchases, which is known as cash flow stability hypothesis. Guay and Harford (2000) find that firms choose dividend increases to distribute relatively permanent cash-flow shocks and repurchases to distribute more transient shocks. Firms at the mature stages generally have more stable cash flows than firms at the growth stages. Thus, cash flow uncertainty in different life cycle stages may have different influence on firms' repurchasing policy.

Firms inevitably evolve and transit from one stage to

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another stage. As seen above, one of the reasons for repurchases might be related to firms' life cycle. However, there is no consensus as to what relationship exists between share repurchases and corporate life cycle. This study investigates what reasons drive firms to repurchase during different life cycle stages. Adding corporate life cycle theory into the study, our result can contribute to growing repurchase literature by more distinctly understanding the motivation of share repurchases. It can also provide firms to supply or examine their financial policy, and provide investors to comprehend their investing target firms.

Our results show that signaling information is the general reason for share repurchases. In the growth stage, firms' repurchase decisions probably mix different motivations, including undervaluation information signaling. Abundant cash holdings are the important characteristics of repurchasing decision in this stage. In the mature stage, firms' repurchase reasons are to distribute excess cash flow to stockholders and to signal information that agency problem will be reduced by repurchases. Investment opportunity decrease and cash flow stability increase are the important characteristics of repurchasing firms in this stage. In the stagnant stage, the reasons for repurchasing firms are partially supported by signaling undervaluation information and partially by distributing cash flow to stockholders. Abundant cash holdings and low investment opportunity are the important characteristics of repurchasing decision in this stage.

The remainder of this study is organized as follows: Section 2 reviews literatures. Section 3 describes the data and methodologies. Section 4 reports the empirical results. Finally, section 5 concludes the study.

LITERATURE REVIEW

Corporate life cycle theory

Corporate life cycle theory has been applied in business literature since the 1960s. Firms in each life cycle stages face different environments, and have different strategies. The most common classification for a firm's development includes four stages: start-up, growth, mature and stagnant (Miller and Friesen, 1984; Anthony and Ramesh, 1992; Black, 1998). Firms face different kinds of environments, adopt different policies, and show different performances among life cycle stages. Most firms in start-up stage are not public-traded and financed by venture capital or bank. Firms in growth stage have more investment opportunities and need more external finan-cing. In the mature stage, growth opportunity is less than in the growth stages, but firms have more excess cash flow. When firms advance into stagnant stage, they have the limited growth opportunities and become less profitable. Some firms may regenerate by investing in new product lines and technology.

Firms generally face investment opportunities decrease and cash flow increase from growth to stagnant stages. The more investment opportunities, the more possibility of undervaluation firms' value is and the higher information asymmetry between firms and investors is (Myers, 1977; Dittmar, 2000). The more excess of cash flow firms have, the higher the conflict between firms and shareholders (Easterbrook, 1984; Jensen, 1986). Therefore, firms may have motives to reduce information asymmetry and/or excess of cash flow by announcing share repurchases.

Anthony and Ramesh (1992) use dividend payout, sales growth, capital expenditure, and age to investigate the relationship between corporate life cycle and stock market response. They find that a monotonic decline exists in the sales growth and capital investment from the growth to the stagnant stages. Using the ratio of retained earnings to equity as a proxy, DeAngelo et al. (2006) find that corporate life cycle can explain firms' dividend payout. Owen and Yawson (2010) find that there exist life cycle effects both in firms' seasoned equity offerings and takeover activities. Additionally, the degree of industrial concentration will vary in different life cycle stages and influence the speed of information dissemination. Chay and Suh (2009) suggest that cash flow uncertainty has impact on firms' payout policies. Firms' cash flow uncertainties are probably different among life cycle stages and may influence their repurchasing decisions.

Share repurchases

Firms do observe and react to the current market price of their traded shares (Bui and Jordan, 2009). Share repurchases, obviously, is a common way for firms to trade their own shares. The first motive of share repurchases is to distribute the excess cash flow, which is known as excess cash flow hypothesis. Jensen (1986) argues that, when firms' cash inflow exceeds the need of investment opportunities, distributing excess cash flow to shareholders can reduce agency cost and raise firms' value. Nohel and Tarhan (1998) show that firms use funds from asset sales to buy back their own stocks.

Signaling information hypothesis is the second common motive of share repurchases. Vermaelen (1981) suggests that management signals firms' future prospects by open market share repurchases. Batov (1991) finds that repurchasing firms signal firms' expected earnings increase. Dittmar (2000) provides evidences that repurchasing firms are undervalued.

Massa et al. (2007) find that information disseminates quicker in concentrated industry than in unconcentrated industry. As a firm repurchases, the market expects that the other firms within the same concentrated industry will also repurchase. If they do not, the market interprets that these firms lack better future prospects. It induces the other firms to repurchase. It implies that mimicking behavior is

an important motive of share repurchases. It is called mimicking behavior hypothesis.

The cash flow stability hypothesis is the last motive of share repurchases. Chay and Suh (2009) use worldwide firm-level data and find that cash flow uncertainty is an important determinant of corporate payout policy. Firms in the growth stage have more investment opportunities. They also face more cash flow uncertainties. When they advance into mature stage, cash flow and profitability generally become more stable. Thus, cash flow uncertainty has probable impact on share repurchases.

Each hypothesis mentioned above is related to corporate life cycle, but not distinct enough to show the impact of corporate life cycle on repurchasing decisions. In this study, we investigate the relationship between corporate life cycle and the determinants of firms' repurchasing decisions as well as testing hypotheses of share repurchases.

METHODOLOGY

Data and sample selection

In Taiwan, firms were permitted to implement share repurchase programs from August 2000. We are interested in the determinants of repurchasing decisions over the period 2000 to 2009. Our sample is based on the firms of Taiwan Stock Exchange and Over-the-counter markets. We exclude financial firms and the firms lacking enough information on Taiwan Economic Journal (TEJ) database. The share repurchase programs are from the Market Observation Post System of Taiwan Stock Exchange Corporation.

Clustering firms by life cycle stage

Anthony and Ramesh (1992) use dividend payout, sales growth, capital expenditure and firm's age as four descriptors to measure firms' life cycle stages. For each descriptor of a firm, they rank the descriptor by its value, partition into three groups, and give the same score for firms in the same group. Then, they sum the score for each firm and put it into adequate life cycle stage. DeAngelo et al. (2006) test the life cycle theory and find that firms' dividend payout ratios are positively related with their retained earnings/total equity ratios (RE/TE). In contrast to Anthony and Ramesh's (1992) method, RE/TE is just one of the life cycle factors. DeAngelo et al. (2006) do not suggest how to classify a firm into life cycle stage by RE/TE. Pashley and Philippatos (1990) use cluster analysis to determine which life cycle stage a firm belongs to. Cluster analysis uses one or multiple variables to maximize the homogeneity of firms within the clusters and to maximize the heterogeneity between the clusters. Compared with Anthony and Ramesh's (1992) method, cluster analysis is stricter in deciding a firm's life cycle stages. Thus, our study adopt four variables suggested by Anthony and Ramesh (1992) and cluster analysis.

Life cycle descriptors

The four classification variables are: (1) annual dividend as a percentage of income (DP), (2) percent sales growth (SG), (3) capital expenditure as a percentage of total value of the firm (CEV), and age of the firm (AGE); they are computed as follows:

$$DP_t = (DIV_t / IBED_t) \times 100$$
$$SG_t = [(Sales_t - Sales_{t-1}) / Sales_{t-1}] \times 100\%$$
$$CEV_t = (CE_t / Asset_t) \times 100\%$$

Where DIV is common dividends, $IBED$ is income before extraordinary items and discontinued operations, $Sales$ is net sales, CEV is capital expenditure, and $Asset$ is total assets, and the suffix t is the fiscal year.

The three financial variables are calculated for each year for each firm. Then, for each firm-year, mean values of the descriptors are computed by the prior five years data. We exclude the sample firm-year when it has less than 3 years' data in the prior five years. Firm age is computed as the difference between the current year and its foundation year. Anthony and Ramesh (1992) suggest the expectations for firm-specific of life cycle stages as described in Table 1.

Cluster analysis for firms' life cycle stages

In the cluster analysis, the first stage is to measure the distance of any two firms about the four life cycle descriptors in a given year. Euclidean Distance is the most general method to measure the distance of any two firms. For example, there are two sample firms' data, $A_i = (dp_i, sg_i, cev_i, age_i)$ and $A_j = (dp_j, sg_j, cev_j, age_j)$, then the distance of A_i and A_j is computed as follows:

$$d_{ij} = \sqrt{(dp_i - dp_j)^2 + (sg_i - sg_j)^2 + (cev_i - cev_j)^2 + (age_i - age_j)^2} \quad (1)$$

For simplifying the process of analysis, the Squared Euclidean Distance is always used to replace Euclidean Distance. The Squared Euclidean Distance is as follows:

$$d_{ij}^2 = (dp_i - dp_j)^2 + (sg_i - sg_j)^2 + (cev_i - cev_j)^2 + (age_i - age_j)^2 \quad (2)$$

Further, the Squared Euclidean Distance of any two firms is put into the Euclidean matrix:

$$\begin{bmatrix} 0 & d_{12} & d_{13} & \cdots & d_{1i} \\ d_{21} & 0 & d_{23} & \cdots & d_{2i} \\ d_{31} & d_{32} & 0 & \cdots & d_{3i} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ d_{i1} & d_{i2} & d_{i3} & \cdots & 0 \end{bmatrix} \quad (3)$$

The second stage is nonhierarchical procedure. In this procedure, the first task is to identify starting points, that is cluster seeds. In this study, we select cluster seeds in a random process. We use optimizing procedure and K-means to cluster these firms. Before proceeding in this procedure, we decide to partition the firms in any given year into three clusters growth, mature, and stagnant stages. Three cluster seeds are randomly selected from sample firms and calculate the distance among all firms and the three seeds.

Table 1. Expectations for firm-specific descriptors of life cycle stages.

Life cycle stages	Life cycle descriptors			
	DP	SG	CEV	AGE
Growth	Low	High	High	Young
Mature	Medium	Medium	Medium	Adult
Stagnant	High	Low	Low	Old

This table reports Anthony and Ramesh's (1992) descriptors of life cycle stages. Dividend payout ratio (DP) is the common dividend payout scaled by the income before extraordinary items and discontinued operations. Sales growth ratio (SG) is the net sales scaled by the net sales of previous year. Capital expenditure ratio (CEV) is the capital expenditure scaled by total assets. Firm age (AGE) is computed as the difference between the current year and its foundation year.

seeds. According to the distance of all firms with the three seeds, we partition all firms into three clusters. Then, for each cluster, the new seed is produced by finding the middle point in this cluster and the distances among all firms with the three seeds are re-computed. According to the distances, we re-cluster all firms into the three clusters. The same procedure is repeated until all firms are stably clustered in some cluster.

The third stage is to name the three clusters by life cycle stages. Simultaneously, it is necessary to test differences of four life cycle variables among the three clusters.

Variables related share repurchases selection

To examine the determinants of repurchasing decisions, we need to select the variables to proxy each hypothesis of share repurchases. The first is excess cash flow hypothesis. We include two variables to test this hypothesis *Cash ratio* and *FCF ratio* (Nohel and Tarhan, 1998; Dittmar, 2000). *Cash ratio* is the cash and marketable securities scaled by the average of beginning- and ending-period book value of total assets. *FCF ratio* is free cash flow ratio and is defined as the operating cash flow minus capital expenditure scaled by the average of beginning- and ending-period book value of total assets. Additionally, Dittmar (2000) suggests that the two variables should be controlled by *M/B ratio*, the ratio of market value of common equity to book value of common equity, which is utilized as the proxy of the investment opportunity.

The second hypothesis is signaling information hypothesis. If a firm is undervalued, it may have investment opportunities neglected by outside investors. Dittmar (2000) measures the undervaluation by *PreCAR*, which is the abnormal return in the calendar year prior to the repurchases. *PreCAR* is calculated by the equal-weighted cumulative abnormal returns estimated by market model in the previous calendar year of each firm-year. Besides, firms with more investment opportunities have more possibly undervalued (Myers, 1977; Dittmar, 2000; Black, 1998). Thus, we include *M/B ratio* and *PreCAR* to test such hypothesis.

For testing the third hypothesis, mimicking behavior hypothesis, we select *Herfindahl index* as proxy of the possibility of mimicking behavior (Massa et al., 2007). If *Herfindahl index* results in a positive effect on share repurchases, it implies that firms' repurchasing announcements may be mimicking behaviors. *Herfindahl index* is calculated as the sum of the squared market shares of the firms that operate a sub-industrial segment defined by Taiwan Economic Journal database.

For the forth hypothesis cash flow stability hypothesis, we want to test firms' cash flow uncertainties measured by *OCF volatility* (Chay and Suh, 2009). *OCF volatility* is the standard deviation of operating cash flow scaled by the average of beginning- and ending-period book value of total assets for the previous five years. If *OCF volatility* results in a negative effect on share repurchases, it implies that firms announce repurchasing programs when they have lower cash flow uncertainty.

We include firm size, leverage, and dividend payout as control variables. Dittmar (2000) finds that large firms are more probability to repurchase stocks. *Ln(Asset)*, the log of total assets, is utilized as the proxy of firm size. Hovakimian et al. (2001) argue that firms may use share repurchases to adjust their leverage ratio. *Leverage* is defined as the ratio of total debt to total assets. Grullon and Michaely (2002) evidence that firms gradually substitute repurchases for dividend. Dividend payout is represented by *Dividend ratio* which is the common dividend payout scaled by the income before extraordinary items and discounted operations in the previous year for each firm-year.

Logistic regression model

We test four hypotheses of share repurchases for life cycle stages discussed above with the following Logistic regression model:

$$Dummy\ of\ repurchase_{i,s}$$
$$= \beta_0 + \beta_1 Cash ratio_{i,s} + \beta_2 FCF ratio_{i,s} + \beta_3 M/B ratio_{i,s}$$
$$+ \beta_4 preCAR_{i,s} + \beta_5 Herfindahl\ index_{i,s} + \beta_6 OCF volatility_{i,s}$$
$$+ \beta_7 Ln(ASSET_{i,s}) + \beta_8 * Leverage_{i,s} + \beta_8 * Dividend ratio_{i,s}$$
$$+ \beta_y year indicators + \varepsilon_{i,s}$$

(4)

where *s* represents life cycle stages. When firms announce share repurchases, the dummy of repurchase is 1, otherwise 0.

RESULTS

Sample description

Our study is based on the firms, except financial firms, of Taiwan Stock Exchange (TSE) and Over-the-counter (OTC) markets over the period 2000-2009. Excluding firms without sufficient information in TEJ database, we have 10,434 firm-years as shown in Table 2. There are 1,860 firm-years with share repurchase programs. For a firm with several repurchase programs in a given year, it

Table 2. Annual distribution of the sample.

Year	Full sample firms	Repurchasing firms	Repurchasing firms/ Full sample firms (%)	Intended buyback ratio (%)		Actual/Intended buyback (%)	
				Mean	Median	Mean	Median
2000	730	149	20.41	4.39	3.53	63.63	68.39
2001	817	132	16.16	4.33	3.18	65.30	74.73
2002	941	110	11.69	4.70	3.28	63.70	71.10
2003	1,020	125	12.25	4.29	3.40	68.19	77.54
2004	1,085	279	25.71	4.63	3.99	72.32	81.62
2005	1,120	188	16.79	4.39	3.43	65.77	72.55
2006	1,142	155	13.57	3.67	3.03	67.88	75.00
2007	1,175	175	14.89	3.52	2.94	75.42	82.50
2008	1,183	451	38.12	4.71	3.81	65.02	68.03
2009	1,221	96	7.86	3.67	3.03	56.27	54.73
Total	10,434	1,860	17.83	4.33	3.48	67.00	72.69

This table reports the distribution of full sample firms and repurchasing firms on Taiwan Stock Exchange and OTC market over the period 2000 to 2009. Intended buyback ratio is the number of shares authorized for repurchase scaled by the number of shares outstanding at the time of the announcement. Actual buyback ratio is the number of actual buyback shares scaled by the number of shares outstanding.

is just considered as a firm-year and its intended and actual buyback ratio is summed for the several programs. Table 2 shows that the average proportion of repurchasing firms to total sample firms is 17.83%. The mean (median) of intended buyback ratio is 4.33% (3.48%). The mean (median) proportion of actual buyback to intended buyback is 67.00% (72.69%).

Life cycle descriptors

We use four life cycle descriptors- dividend payout (DP), sales growth (SG), capital expenditure (CEV), and firm age (AGE)- and cluster analysis to group firms into the growth, the mature, and the stagnant stages in a given year. Table 3 shows the means and medians of the life cycle descriptors and the differences in means and medians between the growth and the mature stages and between the mature and the stagnant stages.

There are 3,425, 3,313, and 3,623 firm-years in the growth, the mature, and the stagnant stages, respectively. The means and medians of DP and AGE (SG and CEV) increase (decrease) monotonously from the growth to the stagnant stages. And the differences of means and medians between the growth and the mature stages and between the mature and the stagnant stages are statistically significant at the 1% level. The results are consistent with the expectations for firm-specific descriptors of life cycle stages shown in Table 1. We can further analyze firms' repurchasing decisions according to the results.

Proxy and control variables and corporate life cycle

We choose different variables to proxy each reason of share repurchases, including *Cash ratio* and *FCF ratio* for excess cash flow hypothesis,

M/B ratio and *PreCAR* for signaling information hypothesis, *Herfindahl index* for mimicking behavior hypothesis, and *OCF volatility* for cash flow stability hypothesis. Additionally, we also choose firm size, leverage, and dividend payout ratio to be control variables. These variables may be different for firms in different life cycle stages. Therefore, we can compare these variables among the growth, mature, and stagnant stages.

Table 4 shows the means and medians of these variables and their differences among life cycle stages. *Cash ratio* is higher in the growth and mature stages than in the stagnant stages. *FCF ratio* is higher in the mature and stagnant stages than in the growth stages. Holding more cash holdings, firms in the growth stages may be related to their more investment opportunities. But the more cash holdings of firms in the mature stage should be from their higher excess cash flow. *M/B*

Table 3. Statistics of life cycle descriptors.

Life cycle stage	Growth [1]		Mature [2]		Stagnant [3]		[2] − [1]		[3] − [2]	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
N	3,425		3,313		3,623					
Life cycle descriptor										
DP (%)	14.20	1.72	19.45	8.08	37.32	30.76	5.25***	6.36***	17.87***	22.68***
SG (%)	34.26	21.84	24.43	15.08	11.96	8.26	-9.83***	-6.76***	-12.47***	-6.82***
CEV (%)	6.32	3.58	5.48	3.16	3.45	2.29	-0.84***	-0.42***	-2.03***	-0.87***
AGE	19.99	17.00	22.51	20.00	27.74	27.00	2.52***	3.00***	5.23***	7.00***

This table reports the means and medians of the life cycle descriptors and the differences in means and medians among life cycle stages. The sample firms are on Taiwan Stock Exchange and OTC market over the period 2000 to 2009. Dividend payout ratio (DP) is the common dividend payout scaled by the income before extraordinary items and discontinued operations. Sales growth ratio (SG) is the net sales scaled by the net sales of previous year. Capital expenditure ratio (CEV) is the capital expenditure scaled by total assets. For each firm-year, DP, SG, and CEV are the average of the prior five years data. Firm age (AGE) is computed as the difference between the current year and its foundation year. The significance levels of the means (medians) are based on a two-tailed t-test (two-tailed Wilcoxon rank test). The symbols *, **, and *** denote the significance at the 10, 5 and 1% levels, respectively.

ratio (*Ln(asset)* and *Dividend ratio*) decreases (increases) monotonously from growth to stagnant stages. These are consistent with the arguments of corporate life cycle theory. According to Myers (1977), firm value has two components: assets in place and growth opportunities. Firm value in the growth stage has larger proportion from growth opportunities, so they have more possibility to be undervalued. The results of *PreCAR* are consistent with this argument, that is, *PreCAR* in the growth stage is significantly lower than that in the growth and stagnant stages. The *Herfindahl index* (*OCF volatility*) increases (decreases) along with life cycle stages. They imply that the industry is by degrees more concentrated and the cash flow uncertainty declines step by step from the growth to stagnant stages.

In sum, the results of these proxy and control variables in the growth, mature, and stagnant stages are consistent with corporate life cycle theory. We need to further analyze the relationship between these variables and share repurchases.

Univariate analysis

We further use two steps to investigate what characteristics drive firms to repurchase in different life cycle stages. First is to test whether the variables used in estimated share repurchase likelihood are significantly different between repurchasing and non-repurchasing firms for each life cycle stages. The results are shown in Table 5 and discussed in this section. Second is to examine which variables are important determinants in repurchasing decisions.

Table 5 shows that *Cash ratio* and *Ln(Asset)*(*PreCAR* and *Leverage*) of repurchasing firms are significantly higher(lower) than those of non-repurchasing firms regardless of the life cycle stages. Repurchasing firms need to use cash to buy back their stocks from stock market, so they should have higher cash holdings. However, firms may keep higher cash holdings for other purposes, e.g. investment opportunities. Additionally, *FCF ratio* is not higher for repurchasing firms in all life cycle stages. Thus, excess cash flow hypothesis is not the common reason of repurchase decisions. Nevertheless, signaling undervaluation information, proxied by *PreCAR*, seems to be the general reason of share repurchases. As to control variables, repurchasing firms have larger size and lower leverage. These are consistent with the findings of Dittmar (2000) and Hovakimian et al. (2001). Repurchasing firms' larger size represents that large firms have more flexible financial policy. And firms with lower leverage have more possibility to adjust their target leverage ratio by share repurchases.

We go ahead to analyze the specific characteristics of repurchasing firms in every life cycle stages. In the growth stage, *FCF ratio* and *Dividend ratio* of repurchasing firms are also significantly higher than those of non-repurchasing firms. Higher *Cash ratio* and *FCF ratio* of repurchasing firms indicate that firms in this stage may distribute excess cash flow to stockholders by share repurchases. However, repurchasing firms' investment opportunities, proxied by *M/B ratio*, are not lower than those of non-repurchasing firms. It is not consistent with excess cash flow hypothesis. Furthermore, repurchasing firms have higher *Dividend ratio* at the same time. It implies that repurchasing firms have higher payout policy and simultaneously distribute cash to stockholders by dividends and repurchases, that is, share repurchases are the substitution of dividends. It is consistent with the findings of Grullon and Michaely (2002).

In the mature stage, *FCF ratio* and *Dividend ratios* of repurchasing firms are significantly higher than those of non-repurchasing firms, and their *M/B ratio* and *OCF volatility* are significantly lower. It represents that repurchasing firms in this stage face investment opportunity decrease and they also have more stable and abundant

Table 4. Variables related to share repurchases.

Life cycle stages	Growth [1]		Mature [2]		Stagnant [3]		[2] [1]		[3] [2]	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
N	**3,425**		**3,313**		**3,623**					
Variable related to share repurchase										
Cash ratio	0.099	0.059	0.099	0.058	0.078	0.047	0.000	-0.001	-0.021***	-0.012***
FCF ratio	0.030	0.027	0.038	0.031	0.039	0.034	0.008***	0.004***	0.001	0.003*
M/B ratio	1.669	0.986	1.421	0.935	1.185	0.812	-0.248***	-0.051**	-0.236***	-0.123***
PreCAR	-18.571	-13.425	-13.757	-11.216	-11.990	-7.470	4.814***	2.209***	1.767	3.746*
Herfindahl index	0.141	0.080	0.155	0.102	0.178	0.133	0.014***	0.022***	0.022***	0.031***
OCF volatility	0.086	0.069	0.074	0.058	0.064	0.050	-0.012***	-0.011***	-0.010***	-0.008***
Control variable										
Ln(asset)	14.950	14.803	15.069	14.902	15.209	15.037	0.119***	0.100***	0.141***	0.135***
Leverage	0.209	0.198	0.217	0.200	0.194	0.179	0.007*	0.003	-0.023***	-0.021***
Dividend ratio	0.209	0.000	0.326	0.000	0.595	0.303	0.117***	0.000***	0.269***	0.303***

This table reports the means and medians of the variables used in estimated share repurchase likelihood and the differences in means and medians among life cycle stages. The sample firms are on Taiwan Stock Exchange and OTC market over the period 2000 to 2009. Cash ratio is the cash and marketable securities scaled by the average of beginning- and ending-period book value of total assets. FCF ratio is the operating cash flow minus capital expenditure scaled by the average of beginning- and ending-period book value of total assets. M/B ratio is the ratio of market value of common equity to book value of common equity. PreCAR is the equal-weighted cumulative abnormal returns estimated by market model in the calendar year prior to the given year. Herfindahl index is calculated as the sum of the squared market shares of the firms that operate a sub-industrial segment. OCF volatility is the standard deviation of operating cash flow scaled by the average of beginning- and ending-period book value of total assets for the previous five years. Ln(Asset) is the log of total assets. Leverage is the ratio of total debt to total assets. Dividend ratio is the common dividend payout scaled by the income before extraordinary items and discounted operations in the previous year for each firm-year. The significance levels of the means (medians) are based on a two-tailed t-test (two-tailed Wilcoxon Rank Test). The symbols *, **, and *** denote the significance at the 10, 5 and 1% levels, respectively.

abundant cash flow, which induce more serious agency problem and market's negative valuation. These firms reduce excess cash flow and agency cost by repurchases and dividends. This is consistent with excess cash flow hypothesis. The lower OCF volatility is not consistent with cash flow stability hypothesis, which emphasizes that repurchases are better methods to distribute cash to stockholders when firms face higher cash flow volatility. However, combining higher Dividend ratio and lower OCF volatility exhibit that repurchases not only signal their information of

cash flow stability, but also enhance the effect of reducing excess cash flow.

Furthermore, the lower Herfindahl index of repurchasing firms indicates that the repurchases are not to mimic the behaviors of other firms in the same industry, that is, this result is not consistent with mimicking behavior hypothesis.

In the stagnant stage, Herfindahl index of repurchasing firms is significantly lower than that of non-repurchasing firms. Firms' repurchases in this stage are not mimicking behaviors. Except signaling undervaluation information, the results in

this stage are not consistent with any other hypothesis.

The results of logistic regression model

Following the univariate analysis, we further examine the determinants of firms' repurchasing decisions by logistic regression model. The results are shown in Table 6. For the three life cycle stages, Ln(Asset) has significantly positive effects on repurchase decisions, and Leverage has

Table 5. Univariate analysis.

		Growth			Mature			Stagnant		
		Repurchasing firms	Non-repurchasing firms	Difference	Repurchasing firms	Non-repurchasing firms	Difference	Repurchasing firms	Non-repurchasing firms	Difference
N		629	2,795		511	2,802		716	2,906	
Cash ratio	Mean	0.113	0.096	0.017***	0.113	0.097	0.016***	0.099	0.073	0.026***
	Median	0.078	0.057	0.021***	0.073	0.056	0.017***	0.060	0.044	0.016***
FCF ratio	Mean	0.034	0.020	0.014***	0.040	0.027	0.013**	0.041	0.041	0.000
	Median	0.036	0.024	0.012***	0.040	0.027	0.013**	0.039	0.039	0.000
M/B ratio	Mean	1.803	1.899	-0.096	1.264	1.552	-0.288***	1.222	1.245	-0.023
	Median	1.140	1.104	0.036	0.938	0.996	-0.058**	0.878	0.821	0.057**
PreCAR	Mean	-17.916	-8.151	-9.765***	-8.710	6.593	-15.303***	-8.643	3.455	-12.098***
	Median	-14.584	-7.461	-7.123***	-10.003	3.136	-13.139***	-8.819	1.546	-10.365***
Herfindahl index	Mean	0.140	0.141	-0.001	0.147	0.157	-0.010*	0.166	0.180	-0.014***
	Median	0.077	0.084	-0.007	0.090	0.103	-0.013*	0.119	0.140	-0.021***
OCF volatility	Mean	0.080	0.087	-0.007**	0.067	0.075	-0.008***	0.066	0.064	0.002
	Median	0.068	0.070	-0.002	0.053	0.059	-0.006**	0.053	0.049	0.004**
Ln(Asset)	Mean	15.245	14.883	0.362***	15.225	15.041	0.184***	15.364	15.172	0.192***
	Median	15.083	14.733	0.350***	15.065	14.869	0.196***	15.219	14.998	0.221***
Leverage	Mean	0.174	0.217	-0.043***	0.176	0.224	-0.048***	0.173	0.199	-0.026***
	Median	0.164	0.205	-0.041***	0.163	0.210	-0.047***	0.162	0.183	-0.021***
Dividend ratio	Mean	0.319	0.175	0.144***	0.439	0.337	0.102*	0.739	0.686	0.053
	Median	0.168	0.000	0.168***	0.055	0.000	0.055*	0.354	0.288	0.066**

This table reports the means and medians of the variables used in estimated share repurchase likelihood and the differences in means and medians between repurchasing firms and non-repurchasing firms for each life cycle stages. The sample firms are on Taiwan Stock Exchange and OTC market over the period 2000 to 2009. Cash ratio is the cash and marketable securities scaled by the average of beginning- and ending-period book value of total assets. FCF ratio is the operating cash flow minus capital expenditure scaled by the average of beginning- and ending-period book value of total assets. M/B ratio is the ratio of market value of common equity to book value of common equity. PreCAR is the equal-weighted cumulative abnormal returns estimated by market model in the calendar year prior to the given year. Herfindahl index is calculated as the sum of the squared market shares of the firms that operate a sub-industrial segment defined by Taiwan Economic Journal database. OCF volatility is the standard deviation of operating cash flow scaled by the average of beginning- and ending-period book value of total assets for the previous five years. Ln(Asset) is the log of total assets. Leverage is the ratio of total debt to total assets. Dividend ratio is the common dividend payout scaled by the income before extraordinary items and discounted operations in the previous year for each firm-year. The significance levels of the means (medians) are based on a two-tailed t-test (two-tailed Wilcoxon rank test). The symbols *, **, and *** denote the significance at the 10, 5 and 1% levels, respectively.

significantly negative effects. It means that larger and/or lower-leverage firms are prone to repurchase. *Herfindahl index* is also an important determinant and has negative effects on repurchasing decisions. It implies that mimicking behavior hypothesis cannot be evidenced by our sample firms. Specifically, *PreCAR* has not significant effects on repurchasing decisions, although it is higher for repurchasing firms than non-repurchasing firms, regardless of life cycle stages. It means that repurchases are overwhelmed by other motivations, although firms face more undervaluation.

For firms in the growth stage, *Cash ratio*, which is a proxy of cash holdings, is an important determinant on repurchase decisions. However, *FCF ratio* and *PreCAR* do not have significant effects, although the two variables of repurchasing firms are significantly higher than non-repurchasing firms. It emphasizes that repurchasing firms in this stages should have sufficient cash holdings. Specifically, signaling information is not the most important reason of repurchases. There may be other reasons encouraging firms to repurchase.

For firms in the mature stage, although *Cash ratio* and *FCF ratio* of repurchasing firms are significantly higher than those of non-repurchasing firms, only *M/B ratio* has significantly effect on repurchasing decisions. It means that investment opportunity decrease is more important for firms' repurchase decisions in this stage. It still supports excess cash flow hypothesis. Furthermore, *OCF volatility* has significantly negative effects on repurchasing decisions, and *Dividend ratio* has significantly positively effects. Table 5 has showed that *OCF volatility* of repurchasing firms is significantly lower than that of non-repurchasing firms, and *Dividend ratio* of repurchasing firms is significantly higher. These results further confirm that repurchasing firms in the mature stage have higher payout policy and simultaneously use dividends and repurchases to distribute cash, and they do not use repurchases to substitute dividends.

For firms in the stagnant stage, *Cash ratio* has a significantly positive effect on repurchasing decisions and Table 5 shows that *Cash ratio* of repurchasing firms is significantly higher than that of non-repurchasing firms. However, *FCF ratio* does not have significant effect and *FCF ratio* of repurchasing firms is not significantly higher. Additionally, *M/B ratio* has a significantly negative effect on repurchasing decisions, although *M/B ratio* of repurchasing firms are not significantly lower than that of non-repurchasing firms. These imply that high cash holdings are important for firms' repurchasing decisions, but the results of investment opportunity and excess cash flow do not completely support excess cash flow hypothesis. According to corporate life cycle theory, some firms in this stage may regenerate by investing in new product lines and technology. Some firms with regenerating investment plan may signal information by repurchases, but other firm without investment plan may distribute cash to stockholder by repurchases for the reasons of liquidating dividends or reducing agency cost. Thus, firms' repurchasing reasons in this stage include partial signaling information hypothesis and partial excess cash flow hypothesis.

DISCUSSION

This study investigates the relationship between corporate life cycle and the determinants of firms' repurchasing decisions. Our sample firms are from Taiwan Stock Exchange and Over-the-Counter Market over the period 2000 to 2009. We select dividend payout, sales growth, capital expenditure, and firm age as the life cycle descriptors, which are suggested by Anthony and Ramesh (1992). We adopt cluster analysis to determine firm-years' life cycle stages because this method is stricter. The four descriptors vary x Taiwan Stock Exchange and Over-the-Counter market over the period 2000 to 2009. We select dividend payout, sales growth, capital expenditure, and firm age as the life cycle descriptors, which are suggested by Anthony and Ramesh (1992). We adopt cluster analysis to determine firm-years' life cycle stages because this method is stricter. The four descriptors vary monotonously from growth to stagnant stages. It is consistent with the expectations of corporate life cycle theory.

We examine the determinants of repurchases by four hypotheses-excess cash flow, signaling information, mimicking behavior, and cash flow stability hypotheses. We find that signaling information is the general reason for share repurchases, although it is not necessary to be the most important reason. In the growth stage, except signaling information, firms probably have other important motivations to repurchase. Abundant cash holdings are the important characteristics of repurchasing decision in this stage. In the mature stage, firms' repurchase reasons are distributing excess cash flow to stockholders. Investment opportunity decrease and cash flow stability increase are the important characteristics of repurchasing firms in this stage. In the stagnant stage, the reasons of repurchasing firms are partially supported by signaling information and distributing cash flow. Abundant cash holdings and investment opportunity decrease are the important characteristics of repurchasing decision in this stage.

Our study finds that firms in different life cycle stages have different reason to repurchase stocks, and the reasons of share repurchases in the mature stage are the most distinct. In the growth stage, share repurchases may mix different motivations, including signaling information. In the stagnant stage, the reasons of share repurchases are not explicit. It is related to firms'

Table 6. Logistic regression models for life cycle stages.

Variable	Life cycle stages		
	Growth	Mature	Stagnant
Cash ratio	0.876*	0.702	1.313**
FCF ratio	-0.366	0.045	-0.733
M/B ratio	0.023	-0.102**	-0.137***
PreCAR	-0.055	0.085	-0.065
Herfindahl index	-1.196***	-1.186***	-0.942***
OCF volatility	-1.083	-3.262***	-0.542
ln(Asset)	0.223***	0.160***	0.174***
Leverage	-1.363***	-1.870***	-0.936***
Dividend ratio	0.091	0.227***	0.052
Year-indicator variables	Yes	Yes	Yes
Intercept	-5.002***	-3.826***	-4.103***
N	3,425	3,313	3,623

This table reports the relation between repurchasing decision and related decision variables. The sample firms are on Taiwan Stock Exchange and OTC market over the period 2000 to 2009. Cash ratio is the cash and marketable securities scaled by the average of beginning- and ending-period book value of total assets. FCF ratio is the operating cash flow minus capital expenditure scaled by the average of beginning- and ending-period book value of total assets. M/B ratio is the ratio of market value of common equity to book value of common equity. PreCAR is the equal-weighted cumulative abnormal returns estimated by market model in the calendar year prior to the given year. Herfindahl index is calculated as the sum of the squared market shares of the firms that operate a sub-industrial segment defined by Taiwan Economic Journal database. OCF volatility is the standard deviation of operating cash flow scaled by the average of beginning- and ending-period book value of total assets for the previous five years. Ln(Asset) is the log of total assets. Leverage is the ratio of total debt to total assets. Dividend ratio is the common dividend payout scaled by the income before extraordinary items and discounted operations in the previous year for each firm-year. The significance levels of the means (medians) are based on a two-tailed t-test (two-tailed Wilcoxon Rank Test). The symbols *, **, and *** denote the significance at the 10, 5 and 1% levels, respectively.

discrepancy of future development, that is, some firms have regeneration plans, but other firms do not. In sum, evidence from this study recognizes that corporate life cycle theory can make the motivations of repurchases more clearly.

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