Chapter 14

Could the Stock Return be a Leading Indicator of the Economic Growth in the Depression? Analysis Based on Nonlinear Dynamic Panel Model

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Additional information is available at the end of the chapter

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Abstract

This chapter examines whether the stock return can be a leading indicator of economic growth in the depression. A nonlinear dynamic panel data model is constructed with the use of the new current depth of recession (NCDR) indicator as the regime switched factor. Our findings show that in the recession period, the stock return can significantly explain the economic growth. As to the impact of a country's development level and business cycle stages, the stock return can serve as a leading indicator of the economic growth in the Asian emerging markets in the recovery subperiod.

Keywords: stock returns, economic growth, dynamic panel data model, recession period, business cycle

1. Introduction

Fluctuations of stock returns are highly correlated with economic activities. Generally speaking, the reason why the stock market is called the economy showcase is that the current-period stock return could be viewed as a leading indicator of the economic growth in the future. To some extent, most stock markets are efficient. In an efficient stock market, the current stock price reveals the discounted value of future dividends and capital returns. The current stock price also reflects the investors' expectations of the future of the economy. Therefore, from the macroeconomics view point, the stock market reveals the economic trend of the country. On the field studying the relationship between the stock return and economic growth, in the beginning, most researches use countries such as United States [1, 2], Canada [3, 4], or G7 countries [5, 6] as samples. Later on, members of European Union, members of the Organization for Economic Cooperation and Development (OECD), or the Asian emerging markets (such as Singapore, Korea, the Philippines, Malaysia, Indonesia, and Taiwan) are included as sample countries as well. Research examples include in [7–11]. Most of these studies find that the relationship between the stock return and economic growth is statistically significant.

The main focus of this study is to investigate whether the relationship between the stock return and economic growth would be the same for countries with different development levels in the depression and recovery subperiods.[1] This study employs a 26-country sample; the sample period is from the first quarter of 1982 to the fourth quarter of 2009, longer than that of [9].[2] The new current depth of recession (NCDR) indicator proposed by Bradley and Jansen [12] is used here as the switched factors to capture the subperiods in the recession period.

In researches using the nonlinear model to study the relationship between the stock return and economic growth, authors often construct two regimes to divide the business cycle into two periods, the expansionary and recession periods. For example, Henry et al. [9] argue that output is characterized by asymmetry—the so-called bounce-back effect.[3] In that chapter, the CDR is used as a proxy variable to examine the significance of the bounce-back effect and to divide between the expansionary and recession periods for the nonlinear panel data model. The changes of the relationship between the stock return and output growth in the expansionary and recession periods are used to examine whether the relationship would be impacted by the business cycle.

However, no study has touched the topic whether the recession period contains other important information that can be used to examine the relationship between the stock return and economic growth. Domain and Louton [2], Henry and Olekalns [13], and Henry et al. [9] find that the relationship is significantly positive only in the recession period, but the authors do not explain the reasons for this outcome. Beaudry and Koop [14], Henry and Olekalns [13], and Henry et al. [9] argue that in the recession period, there is the bounce-back effect that contributes to the significance of the relationship; however, the authors do not further investigate the bounce-back effect. The empirical study of [2] finds that there is the nonlinear threshold effect in the relationship between the stock return and real economic activities. Henry et al. [9] find that when the economy is in the expansionary stage, the stock return cannot predict the output growth, while in the recession period, the stock return could well predict the output growth.

Does the recession period contain information that would impact the relationship between the stock return and economic growth? The answer can be found in **Figure 1**.[4] During a business cycle, the economy experiences peak, recession, depression, trough, and recovery and then

[1] None study has touched the topic whether the recession period contains other important information that can be used to examine the relationship between the stock return and economic growth.

[2] Most of OECD members are industrial or developed countries.

[3] Friedman [15] after the economy passes the bottom of the business cycle and enters a recovery period, the output will return to the original growth trend, is called the Friedman-type asymmetry. The bounce-back effects are one of the Friedman-type asymmetry.

[4] In **Figure 1**, the CDR and new CDR (NCDR) criteria are used to divide different stages of the business cycle, which is different from the criterion listed in most textbooks.

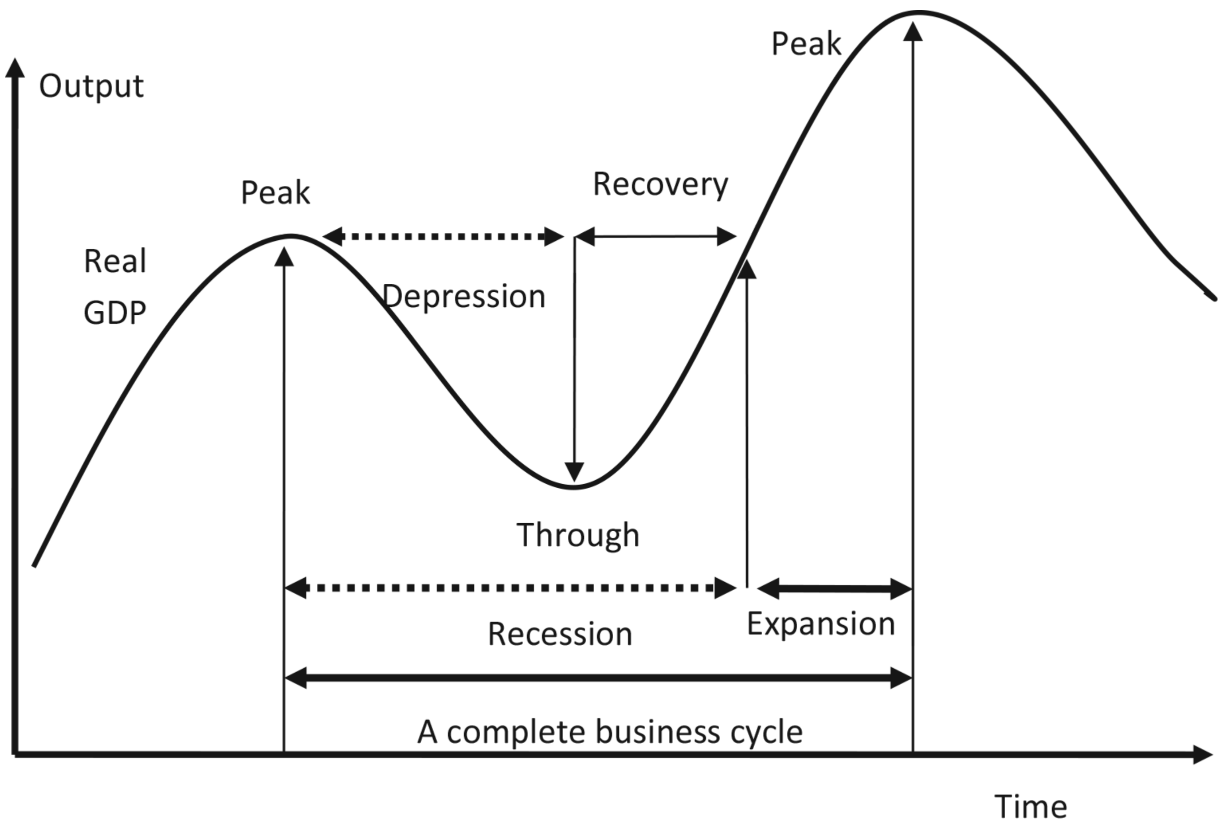

Figure 1. Business cycle process. Note: The CDR and new CDR criteria are adopted to divide the different stages of the business cycle in this figure, which is different from the criterion listed in most textbooks.

moves to another peak and completes a cycle. The recession period actually contains the depression and recovery subperiods. Depression is defined as a period that the economic situation still deteriorates and there is no sign of improvement. Recovery is defined as a period that the economy has already passed the trough; there are signs of improvement, but the economy has not returned to the original growth path. Although both the depression and recovery subperiods are within the recession period, people would have different expectations toward the future in the two different subperiods. In addition, since the stock market always reveals people's expectations of economic growth in advance, the relationship between the stock return and economic growth may differ in the two subperiods.

As to the research method on this field, previous studies often employ the time series data and the linear model; examples include in [16–19]. It is well known that the time series data structure suffers from the following two problems. First, there may not be enough observations in each subperiod, if one divides the sample period into several subperiods. Second, applying individual country data into a multicountry analysis, one may ignore the impact from the economic integration, which may cause the testing power inefficient problem. There are some problems associated with the use of the cross country data as well, for example, ignoring the impact from the time. To avoid these problems, many researches employ the panel data. This data structure has both the time and the section dimensions; therefore, the empirical result can capture the difference among sample countries and the dynamic changes from time to time. In addition, the two dimensional characteristic also increases the observation numbers, which enhances the degree of freedom.

In the present chapter, the empirical model is modified from the dynamic panel data model (DPDM) of [9]. For the DPDM, if one uses the traditional fixed effect method to estimate the model, it may lead to biased estimation results, because of the correlation between the lagged explained variables and the residual, a problem not addressed in [9]. One way to conquer this problem is to estimate the DPDM with the generalized method of moment (GMM) estimation proposed by Arellano and Bond [20].

The empirical results of this study show that in the recession periods, the stock return significantly impacts the economic growth. In addition, in some of the Asian emerging markets, the stock return is the leading indicator of the economic growth only in the recovery subperiod. As to the developed countries, the stock return is the leading indicator of the economic growth only in the depression subperiod. The empirical results have the following implications and contributions. First, for the international companies, the results can be used to avoid the misunderstandings of the recession process and the relationship between the stock return and economic growth. Second, for the investment organizations and the financial professionals, the results can help them better understand the business cycle and teach the investors the true meaning of the CDR. Third, this study contributes to the filed by further investigate the recession periods with well-established research methods.

This chapter is organized as follows. Section 1 is the introduction. Section 2 discusses and analyzes the data. The research methodology is listed in Section 3. Section 4 shows the empirical results. Section 5 is the conclusion.

2. Data analysis

The data set of this chapter contains quarterly data of stock index, Gross Domestic Product, and consumer price index (CPI) (or Gross Domestic Product deflator) of 26 countries, including the G7 countries (The USA, UK, Canada, France, German, Italy, and Japan), five Asian countries (the Philippines, Singapore, Hong Kong, Korea, and Taiwan), 12 OECD countries (Australia, Austria Belgium, Denmark, Finland, Mexico, the Netherlands, New Zealand, Norway, Spain, Sweden, and Switzerland), Israel, and South Africa. In addition, we divided the sample countries into three groups, one can see the impact of the development level on the relationship between the stock return and economic growth. Group A has five Asian countries; group B has the G7 countries; group C is contains the 12 OECD members. All the data come from the International Financial Statistics (IFS) database of International Monetary Fund (IMF) and the AREMOS database. The longest sample period is from the first quarter of 1982 to the fourth quarter of 2009. Please refer to Appendix A for detailed descriptions of the data.

The two major variables of this chapter are the economic growth rate (*ry*) and the stock return (*rs*):

$$ry_{it} = \Delta \log(GDP_{it}) \times 100, \quad rs_{it} = \Delta \log(ST_{it}) \times 100,$$

where GDP_{it} is the real GDP, ST_{it} is the stock index, ry_{it} is the economic growth rate, and rs_{it} is the stock return; *i* indicates the country and *t* the time; "Δ" denotes the first difference.

3. Research methodology

Beaudry and Koop [14] propose the CDR indicator to capture the stages of business cycle:

$$CDR_{i,t} = \max\{Y_{i,t-s}\}_{s\geq 0}^{t} - Y_{i,t} \geq 0 \tag{1}$$

where $Y_{i,t}$ is the output of period t. Eq. (1) tells that the CDR is the output difference between the largest output of period $t-s$ and the output of period t.[5] Although the CDR is very sensitive at capturing the recession period, the indicator can only differentiate between the expansionary and recession periods.

Bradley and Jansen [12] argue that the recession period captured by CDR > 0 is a mixed, rather than a pure, recession period; therefore, the authors proposed a new CDR, the NCDR, to capture the pure recession period. Utilizing the output growth rate (ΔY_t), the NCDR divides the mixed recession period into two subperiods, the depression period where the economy is approaching the trough and the recovery period where the economy is approaching the next peak. Bradley and Jansen [12] name the NCDR established the CDR1 > 0 for the depression subperiod and the CDR2 > 0 for the recovery subperiod. The CDR1 and CDR2 indicators are specified as follows:

$$CDR1_{i,t} = \max\{Y_{i,t-s}\}_{s\geq 0}^{t} - Y_{i,t} \geq 0 \quad if\ \Delta Y_{i,t} < 0, \tag{2a}$$

$$CDR2_{i,t} = \max\{Y_{i,t-s}\}_{s\geq 0}^{t} - Y_{i,t} \geq 0 \quad if\ \Delta Y_{i,t} \geq 0. \tag{2b}$$

In the case that $CDR1 = 0$ and $CDR2 = 0$, it indicates that the economy is in the expansionary period, same as the case that CDR = 0 in [14]. Because the NCDR has the benefits of capturing the pure recession period, in the empirical model of this chapter, the NCDR is employed to divide business cycle stages.

[5] If the CDR > 0, that mean the economy is entering the recession period. With the same rationale, if a country is in the expansionary period, then the CDR = 0.

Using the *CDR* as the switched factor to identify the business cycle periods, Henry et al. [9] construct the single-variate nonlinear panel data model:

$$ry_{i,t} = \begin{cases} \alpha_i + \sum_{j=1}^{4} \beta_{1,j} ry_{i,t-i} + \sum_{j=1}^{4} \pi_{1,j} rs_{i,t-j} + \varepsilon_{1i,t} & CDR_{i,t-1} = 0 \\ (\alpha_i + \phi) + \sum_{j=1}^{4} \beta_{2,j} ry_{i,t-j} + \sum_{j=1}^{4} \pi_{2,j} rs_{i,t-j} + \varepsilon_{2i,t} & CDR_{i,t-1} > 0 \end{cases}, \tag{3}$$

where $ry_{i,t}$ denotes the economic growth rate; $rs_{i,t}$ is the stock return; α_i, φ, β_{kj}, and δ_{kj} are coefficients; ε_{kit} is the error term. k = 1, 2. Substituting the CDR of Eq. (3) with the NCDR specified in Eqs. (2a) and (2b) and defining $\Delta Y_{i,t} < 0$ the depression subperiod and $\Delta Y_{i,t} \geq 0$ the recovery subperiod, one can revise the model of Henry et al. [9] as

$$ry_{i,t} = \begin{cases} \alpha_i + \sum_{j=1}^{4} \beta_{1,j} ry_{i,t-i} + \sum_{j=1}^{4} \pi_{1,j} rs_{i,t-j} + \varepsilon_{1i,t} \quad \text{if } CDR1_{i,t-2} = CDR2_{i,t-2} = 0 \\ (\alpha_i + \phi) + \sum_{j=1}^{4} \beta_{2,j} ry_{i,t-j} + \begin{cases} (\sum_{j=1}^{4} \delta_{1,j} rs_{i,t-j}) \times DV1 & \text{if } CDR1_{i,t-2} > 0 \\ (\sum_{j=1}^{4} \delta_{2,j} rs_{i,t-j}) \times DV2 & \text{if } CDR2_{i,t-2} > 0 \end{cases} + \varepsilon_{2i,t} \end{cases}, \tag{4}$$

where $ry_{i,t}$ denotes the economic growth rate; $rs_{i,t}$ denotes the stock return; α_i, φ, β_{kj}, and δ_{kj} are the coefficients; ε_{kit} is the error term; *CDR*1 and *CDR*2 are the switched factors; DV$k(\cdot)$ is the dummy variable, where DVk = 1 if the condition inside the parenthesis holds, DVk = 0, otherwise. K = 1~2. Eq. (4) is the primary empirical model of this chapter.

The readers might be curious why not to construct a three-regime DPDM. The primary reason is that a three-regime DPDM would lead to many differences from the model of [9] to compare the empirical findings. In addition, the three-regime model costs lots of degrees of freedom. Because of these two reasons, what is done here is to derive the depression and recovery subperiods from the recession period, rather than specifying three regimes.

To estimate the nonlinear DPDM, it will be too complicated if one considers the nonlinearity and the dynamic panel data characteristic at the same time in the estimation.[6] A better way to do is to use the two-step method to estimate the nonlinear DPDM. First, the exogenously given switched factors (the CDR or NCDR) are employed to divide the regimes; in the meantime, the dummy variable can reveal the nonlinear relationship between the variables. Second, the

[6] In this paper, the model is a linear panel data model with the characteristic of nonlinearity given by the dummy variables. Therefore, the GMM estimation still can be used to estimate the DPDM and the heteroskedastic residual problem can be avoided.

GMM estimation, named AB-GMM afterward, is utilized to deal with the "dynamic" panel data characteristic that is caused by the inclusion of the lagged dependent variable in the regressors. When one estimates Eq. (4) with AB-GMM estimation, since the variables will be first differenced, the constant term will disappear.

4. Empirical results and analyses

To avoid the spurious regression problem, one should examine whether the panel data are stationary by conducting the unit root test.[7] The result of the panel data unit root test is shown in **Table 1**, shows that the variables are stationary.

	ry		**rs**	
Method	**value**	**p-value**	**value**	**p-value**
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-9.48***	(0.00)	-44.25***	(0.00)
Breitung t-stat	-1.11	(0.13)	-25.93***	(0.00)
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-24.39***	(0.00)	-39.21***	(0.00)
ADF - Fisher Chi-square	631.40***	(0.00)	1072.45***	(0.00)
PP - Fisher Chi-square	949.10***	(0.00)	1069.31***	(0.00)

Notes: The "*ry*" is the economic growth rate, and "*rs*" is the stock return. The above five types of panel unit root tests: Levin et al. [22], Breitung [23], Im et al. [24], Fisher-type tests using ADF and PP tests (Maddala and Wu [25] and Choi [26])."*", "**", and "***" denote the 1% significant level.

Table 1. Panel unit-root test.

At this moment, the CDR (or NCDR) is employed as the switched factor in the nonlinear model to divide between the expansionary and recession periods. The switched factor has been chosen and the switched point has been determined. The lagged period is 4,[8] same as the setting of [9]. The only thing that is adjustable here is the delay period. We find the 1 and 2 periods delay CDR are well, which indicates that it is appropriate to use the delay CDR as the switched factor. In this chapter, the delay period is set to 2 to meet the 5% significant level condition. Because of this, if an economy has a sequence of negative economic growth rates in two seasons, then the economy could be viewed as entering the recession period.[9]

[7] For the spurious regression problem, please refer to Ref. [21].

[8] There is reason to choose four lagged periods. Because the data are quarterly data, so four lagged periods could cover the whole year and capture the seasonal characteristics.

[9] The way to identify whether an economy is entering a recession period is to see whether GDP is decreasing in sequentially two seasons. If it is, then this economy is said to experience recession.

Whole Sample	**(Expansionary period)**			**(Recession period)**	
	$CDR_{i,t-2}$=0			**$CDR_{i,t-2}$>0**	
Variable	**Coefficient**	**p-value**	**Variable**	**Coefficient**	**p-value**
Obs.	**1245**		**Obs.**	**1449**	
A	**0.04**	**(0.87)**	$\alpha + \varphi$	**2.37*** **	**(0.00)**
$ry_{i,t-1}$	-0.92***	(0.00)	$ry_{i,t-1}$	-0.88***	(0.00)
$ry_{i,t-2}$	0.02	(0.67)	$ry_{i,t-2}$	-0.17**	(0.02)
$ry_{i,t-3}$	0.63***	(0.00)	$ry_{i,t-3}$	-0.23**	(0.02)
$ry_{i,t-4}$	-0.25**	(0.03)	$ry_{i,t-4}$	0.03	(0.44)
$rs_{i,t-1}$	0.04**	(0.04)	$rs_{i,t-1}$	0.06**	(0.03)
$rs_{i,t-2}$	0.01	(0.61)	$rs_{i,t-2}$	0.11**	(0.05)
$rs_{i,t-3}$	-0.01	(0.61)	$rs_{i,t-3}$	0.05**	(0.05)
$rs_{i,t-4}$	0.01	(0.41)	$rs_{i,t-4}$	-0.09	(0.23)
	$\sum_{p=1}^{4} \pi_{1p}$ =0.05			$\sum_{p=1}^{4} \pi_{2p}$ =0.13	
Wald Test	$H_0: \pi_{11} = \pi_{12} = \pi_{13} = \pi_{14} = 0$			$H_0: \pi_{21} = \pi_{22} = \pi_{23} = \pi_{24} = 0$	
Chi-square	8.39*		Chi-square	13.38***	
p-value	(0.08)		p-value	(0.01)	

Notes: The "*ry*" is the economic growth rate, and "*rs*" is the stock return; *i* indicates the country and *t* the time. "CDR" is abbreviated from current depth of recession that proposed by [14]. The "Obs" is observation number. "*", "**", and "***" denote the 10%, 5%, and 1% significant levels.

Table 2. Dynamic panel data OLS estimation with CDR switched factor.

After all the parameters have been decided, one can proceed to estimate Eq. (3). For comparison, both the OLS and AB-GMM estimations are performed and the results are listed in **Tables 2** and **3**, respectively. For the coefficient joint test result, in the expansionary period, the stock return cannot explain the economic growth in **Table 3**, which is conflict with the result in **Table 2**. In the recession period, the stock return can significantly explain the economic growth in both **Tables 2** and **3**. Please note that the estimation result in **Table 3** is more consistent with what are found in the literatures (including [9]). In addition, the result in **Table 3** is obtained with the AB-GMM estimation, which can avoid the biased estimation caused by the OLS estimation.[10]

[10] When there are lagged dependent variables in the regressor, the model becomes the DPDM. If one still estimates the model with the OLS estimation, then there would be biased estimation results.

whole sample	(Expansionary period)			(Recession period)	
	$CDR_{i,t-2}$=0			$CDR_{i,t-2}$>0	
Obs.	**1231**		**Obs.**	**1437**	
Variable	**Coefficient**	**p-value**	**Variable**	**Coefficient**	**p-value**
$ry_{i,t-1}$	-0.87***	(0.00)	$ry_{i,t-1}$	-1.23***	(0.00)
$ry_{i,t-2}$	0.30***	(0.00)	$ry_{i,t-2}$	-0.45**	(0.02)
$ry_{i,t-3}$	1.18***	(0.00)	$ry_{i,t-3}$	-0.68***	(0.00)
$ry_{i,t-4}$	0.14	(0.32)	$ry_{i,t-4}$	-0.11	(0.37)
$rs_{i,t-1}$	0.02	(0.14)	$rs_{i,t-1}$	0.04	(0.24)
$rs_{i,t-2}$	0.02	(0.12)	$rs_{i,t-2}$	0.13***	(0.00)
$rs_{i,t-3}$	0.00	(0.97)	$rs_{i,t-3}$	0.12***	(0.00)
$rs_{i,t-4}$	-0.01	(0.50)	$rs_{i,t-4}$	0.02	(0.51)
	$\sum_{p=1}^{4} \pi_{1p} = 0.03$			$\sum_{p=1}^{4} \pi_{2p} = 0.31$	
Wald Test	$H_0: \pi_{11} = \pi_{12} = \pi_{13} = \pi_{14} = 0$			$H_0: \pi_{21} = \pi_{22} = \pi_{23} = \pi_{24} = 0$	
Chi-square	4.89		Chi-square	21.86***	
p-value	(0.30)		p-value	(0.00)	
Instrument rank	104		Instrument rank	204	
J-statistic	110.41		J-statistic	220.20	
p-value	(0.15)		p-value	(0.11)	

Notes: When one estimates Eq. (3) with AB-GMM estimation, since the variables will be first differenced, the constant term will disappear. The "*ry*" is the economic growth rate, and "*rs*" is the stock return; *i* indicates the country and *t* the time. "CDR" is abbreviated from current depth of recession that proposed by [14]. The "Obs" is observation number. Under the null hypothesis that the over-identifying restrictions are valid, the reported *J*-statistic is simply the Sargan statistic, χ^2_{p-k}, where *k* is the number of estimate coefficients and *p* is the instrument rank. "*", "**", and "***" denote the 5%, and 1% significant levels.

Table 3. Dynamic panel data AB-GMM estimation with CDR switched factor.

The AB-GMM method is used to estimate Eq. (4). **Table 4** reports the full sample estimation result. In the recession period, in the depression or the recovery subperiods, the coefficient joint test result is significant, which indicates there is no difference between the two subperiods and that the stock return can significantly explain the economic growth in two subperiods.

whole sample	(Expansionary period)			(Recession period)	
	CDR1$_{i,t-2}$=0	**CDR2$_{i,t-2}$=0**		**CDR1$_{i,t-2}$>0**	**CDR2$_{i,t-2}$>0**
Obs.	**1231**		**Obs.**	**1389**	
Variable	Coefficient	p-value	Variable	Coefficient	p-value
$ry_{i,t-1}$	-0.87***	(0.00)	$ry_{i,t-1}$	-1.37***	(0.00)
$ry_{i,t-2}$	0.30***	(0.00)	$ry_{i,t-2}$	0.78**	(0.02)
$ry_{i,t-3}$	1.18***	(0.00)	$ry_{i,t-3}$	0.37	(0.29)
$ry_{i,t-4}$	0.14	(0.32)	$ry_{i,t-4}$	0.28*	(0.06)
				$DV1(CDR1_{t-2} > 0)$	
$rs_{i,t-1}$	0.02	(0.14)	$rs_{i,t-1} * DV1$	0.38*	(0.07)
$rs_{i,t-2}$	0.02	(0.12)	$rs_{i,t-2} * DV1$	0.07	(0.52)
$rs_{i,t-3}$	0.00	(0.97)	$rs_{i,t-3} * DV1$	0.16	(0.20)
$rs_{i,t-4}$	-0.01	(0.50)	$rs_{i,t-4} * DV1$	0.28**	(0.02)
				$DV2(CDR2_{t-2} > 0)$	
			$rs_{i,t-1} * DV2$	0.00	(0.99)
			$rs_{i,t-2} * DV2$	0.26*	(0.09)
			$rs_{it-3} * DV2$	0.05	(0.81)
			$rs_{i,t-4} * DV2$	-0.34**	(0.03)
	$\sum_{p=1}^{4} \pi_{1p} = 0.03$			$\sum_{p=1}^{4} \delta_{1p} = 0.89$	$\sum_{p=1}^{4} \delta_{2p} = -0.03$
Wald Test	$H_0: \pi_{11} = \pi_{12} = \pi_{13} = \pi_{14} = 0$			$H_0: \delta_{11} = \delta_{12} = \delta_{13} = \delta_{14} = 0$	
Chi-square	4.89		Chi-square	10.27**	
p-value	(0.30)		p-value	(0.04)	
				$H_0: \delta_{21} = \delta_{22} = \delta_{23} = \delta_{24} = 0$	
			Chi-square		11.19**
			p-value		(0.02)
Instrument rank	104		Instrument rank	112	
J-statistic	110.41		J-statistic	117.85	
p-value	(0.15)		p-value	(0.11)	

Note: The NCDR proposed by Bradley and Jansen [12] is employed as the switched factor in the model.
"*" and "***" denote the 10% and 1% significant levels.

Table 4. Dynamic panel data AB-GMM estimation with NCDR switched factor.

In the following, the estimation method of **Table 4** is repeated on the estimation of groups A to C. The estimation result of group A to C is combined listed in **Table 5** (divide into three part), group A in the upper, group B in the middle, and group C in the lower.

	(Expansionary period)			**(Recession period)**	
	$CDR1_{i,t-2}$=0	**$CDR2_{i,t-2}$=0**		**$CDR1_{i,t-2}$>0**	**$CDR2_{i,t-2}$>0**
Upper part	**group A**				
	$\sum_{p=1}^{4} \pi_{1p} = 0.05$			$\sum_{p=1}^{4} \delta_{1p} = 0.15$	$\sum_{p=1}^{4} \delta_{2p} = 0.63$
Wald Test	$H_0: \pi_{11} = \pi_{12} = \pi_{13} = \pi_{14} = 0$			$H_0: \delta_{11} = \delta_{12} = \delta_{13} = \delta_{14} = 0$	
Chi-square	5.19		Chi-square	2.15	
p-value	(0.27)		p-value	(0.71)	
				$H_0: \delta_{21} = \delta_{22} = \delta_{23} = \delta_{24} = 0$	
			Chi-square		10.80***
			p-value		(0.03)
Middle part group B					
	$\sum_{p=1}^{4} \pi_{1p} = 0.03$			$\sum_{p=1}^{4} \delta_{1p} = 0.09$	$\sum_{p=1}^{4} \delta_{2p} = 0.04$
Wald Test	$H_0: \pi_{11} = \pi_{12} = \pi_{13} = \pi_{14} = 0$			$H_0: \delta_{11} = \delta_{12} = \delta_{13} = \delta_{14} = 0$	
Chi-square	1.18		Chi-square	16.37***	
p-value	(0.88)		p-value	(0.00)	
				$H_0: \delta_{21} = \delta_{22} = \delta_{23} = \delta_{24} = 0$	
			Chi-square		3.00
			p-value		(0.56)
Lower part group C					
	$\sum_{p=1}^{4} \pi_{1p} = 0.23$			$\sum_{p=1}^{4} \delta_{1p} = 1.54$	$\sum_{p=1}^{4} \delta_{2p} = 0.58$
Wald Test	$H_0: \pi_{11} = \pi_{12} = \pi_{13} = \pi_{14} = 0$			$H_0: \delta_{11} = \delta_{12} = \delta_{13} = \delta_{14} = 0$	
Chi-square	22.53***		Chi-square	8.66*	
p-value	(0.00)		p-value	(0.07)	
				$H_0: \delta_{21} = \delta_{22} = \delta_{23} = \delta_{24} = 0$	
			Chi-square		4.06
			p-value		(0.40)

Note: Table 5 just show the estimation results of three groups partly.
"*" and "***" denote the 10%, and 1% significant levels.

Table 5. Dynamic panel data AB-GMM estimation with NCDR switched factor.

From **Table 5** (upper part), one can see that the coefficients are significantly positive only in the recovery subperiod. This tells that for group A (five Asian emerging countries), the stock return can explain the economic growth only in the recovery period. **Table 5** (middle part) shows that the coefficients are significantly positive only in the depression subperiod, which indicates that for group B (the G7 countries), the stock markets will go down before the economies start to grow.

The economic rationale behind this is as follows. Since the stock return and economic growth are positively correlated in the G7 countries, when they enter the depression subperiod, the stock market would go down to reveal the upcoming depressions. When the G7 countries enter the recovery subperiod, their production and consumption will increase. At this time, the G7 countries will place many orders on the Asian emerging markets, and this will help the Asian emerging markets grow and their firms perform well. These outcomes will be reflected by the stock markets in these emerging markets; with more foreign investments from the developed countries, these stock markets will stay in the bull status for a long time. This is why the stock market can significantly explain the economic growth in the recovery subperiod. Although both the Asian emerging markets and the G7 countries are all in the recovery subperiod, the economies will not grow as fast. Moreover, because developed countries tend to invest in high return foreign stock markets, there is no significant relationship between the stock return and economic growth in the G7 countries in the recovery subperiod.

Table 5 (lower part) reports the estimation result for group C (12 OECD members), the coefficients are significantly positive only in the depression subperiod, same as the result in **Table 5** (middle part). In addition, in the expansionary period, the stock return can significantly explain the economic growth, which is different from the results of other subperiod estimations. The results in **Table 5** (middle and lower parts) can be used to derive the results of **Table 4** that the stock return can explain the economic growth in both the depression and recovery subperiods.

The results of **Tables 5** are not quite the same as the result of **Table 4** (the whole sample estimation), which indicates that one cannot apply the conclusion of **Table 4** to every case. Some of the effects may be "cancelled out" by pooling all the countries into one sample.

The empirical findings of this chapter could benefit the corporations, financial companies, as well as regular investors. The contribution of this chapter can be summarized as follows. First, the empirical findings could avoid corporations from misunderstanding the recession period. In the recession period, the government tends to reduce the interest rate and enhance the government spending to stimulate the economy. When making future operation and finance decisions, if the decision maker can seize the chance to adjust the factory size or to raise corporate debts in the recession period or to finance in the expansionary period, it would be beneficial to the corporation. Second, the findings help financial companies or financial supervisors better understand the business cycle. Macroeconomic analyses and business cycles are crucial factors to investment decisions to maximize capital gains and to minimize risks from market fluctuations. Third, the findings help regular investors better understand the business cycle. The business cycle information can help regular investors with medium or long term investment decisions and avoid capital loss from short term fluctuations in the market.

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Fourth, the empirical findings prove that there does exist useful information in the recession period.

5. Conclusions

In this study, the existence of the subperiods of the recession period is observed by examine the business cycle plot of **Figure 1**, this chapter make up this gap by constructing a nonlinear DPDM to investigate the relationship between the stock return and economic growth in the subperiods. The finding of the present chapter can be summarized as follows.

First, the GMM estimation is adopted for the DPDM estimation to avoid possible bias from the OLS estimation. The NCDR proposed by Bradley and Jansen [12] is employed as the switched factor in the model. The empirical result shows that the stock market performance can be a leading indicator for the economic growth, especially in the recession period. This finding is consistent with the findings in previous studies.

Second, the empirical results show that in the whole sample estimation, the stock return can significantly explain the economic growth in the two subperiods of the recession period. In the estimation with different country development levels, it is found that in the Asian emerging markets, the stock return can significantly explain the economic growth only in the recovery period. The reason for this outcome is as follows. Generally speaking, the emerging markets have higher economic growth rates than the most of the developed countries do. When entering the recovery period, the emerging markets can attract more foreign funding into their stock markets. As to the developed countries, the stock return can significantly explain the economic growth only in the depression period. The reason for this result is the following. The developed countries lead the development of the world economy. When the developed countries enter the depression period, the investors will withdraw from the stock markets to avoid the risk of loss, which in turn, causes the stock markets to go down and results in a positive relationship between the depression and the down-turn stock market. This result indicates that various development levels will have different impact on the relationship between the stock return and economic growth. If one would like to use the stock market information to predict the economic growth, one must first ascertain the country's development status.

Appendix A. Data summary (1982Q1–2009Q4)

Country name	Stock market index		GDP	GDP Deflator
Australia	SHARE PRICES:(IMF)	○	○	CPI
Austria	SHARE PRICES (IMF)	○	○	CPI

Country name	Stock market index		GDP	GDP Deflator
Belgium	SHARE PRICES (IMF)	○	○	CPI
Canada	CL.TORONTO STOCK PRICES	○	○	CPI
Denmark	SHARE PRICES(IMF)	89q4~09q4	○	CPI
Finland	SHARE PRICES(IMF)	○	○	CPI
France	SHARE PRICES(IMF)	○	○	CPI
Germany	DAX 30 PERFORMANCE	○	○	GDP deflator
Hong Kong	HANG SENG	○	○	CPI
Israel	SHARE PRICE INDEX (IMF)	○	○	CPI
Italy	SHARE PRICES(IMF)	○	○	CPI
Japan	NIKKEI 225	○	○	CPI
Korea	KOREA SE COMPOSITE	○	○	CPI
Mexico	SHARE PRICES(IMF)	83q1~09q4	○	CPI
Netherlands	SHARE PRICES(IMF)	○	○	CPI
Norway	SHARE PRICES(IMF)	○	○	CPI
New Zealand	SHARE PRICES:(IMF)	○	87q2~09q4	CPI
Philippines	SHARE PRICES:(IMF)	82q1~09q2	○	CPI
Singapore	SINGAPORE STRAITS TIMES	○	○	CPI
South Africa	SHARE PRICES:(IMF)	○	○	CPI
Spain	MADRID SE GENERAL	○	○	CPI
Sweden	SHARE PRICES: (IMF)	○	○	CPI
Switzerland	SWISS MARKET -	88q3~09q4	○	CPI
Taiwan	TAIWAN SE WEIGHTED	○	○	CPI
United Kingdom	SHARE PRICES: (IMF)	○	○	CPI
United States of American	DJAI-30	○	○	CPI

Note: "○" denotes that the corresponding country has the full sample (1982Q1~2009Q4);
THE"CPI" denotes that the consumer price index, the IMF data code is 64.
The IMF data code of SHARE PRICES is 62.
The IMF data code of GDP is 99b.c.
The IMF data code of GDP deflator is 99blr.

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