南　　華　　大　　學

管理經濟學系經濟學碩士班

碩士論文

金融發展與經濟成長：以台灣實證為例

The effect of financial development on economic growth: evidence from Taiwan

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碩 士 學 位 論 文

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Abstract

This paper use GJR-GARCH in mean model to examines the causal relationship between financial development and economic growth in Taiwan for the period 1978Q1 – 2007Q3. It focuses on the effects of two aspects of financial development on growth: stock market and banking sector. GJR-GARCH in mean model has advantages over traditional measures. By including the conditional variance. In the mean equation, and was shown to retrieve more efficient estimator than traditional OLS. Also, the GJR-GARCH in mean framework emphasizes the asymmetry of the volatility response to news, which allows positive and negative unanticipated returns to have different impacts on the conditional variance. The result demonstrates that the GJR-GARCH is more appropriate than the other GARCH models and confirms the presence of conditional variance in the mean equation. The cointegration test provides evidence of the non-existence of a long-run equilibrium relationship between financial development and economic growth. The empirical results suggest that leverage effect was present and shocks have asymmetric impact on the volatility.

Keywords: Nonlinearity; GJR-GARCH in mean; Leverage effect; Uncertainty.

JEL classification: E44; O16; O53

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1. Introduction

Since Goldsmith (1969) documented the relationship between financial development and economic growth, it has been a subject of great interest and debate among economists during the last four decades. The general idea that economic growth is related to financial development and structure can go back at least to Schumpeter (1911). Schumpeter emphasized the importance of the banking system in economic growth and highlighted circumstances when financial institutions can actively spur innovation and future growth by identifying and funding productive investments. Further more, McKinnon (1973) and Shaw (1973) showed that financial development would raise saving capital accumulation, and hence economic growth. Recent theoretical works like Greenwood and Jovanovic (1990), Levine (1991), Saint-Paul (1992), King and Levine (1993a), and Bencivenga, Smith, and Starr (1995) these researchers support the point of views that financial development may raise savings rate, stimulate investment, avoid premature liquidations of capital, reduce the cost of external finance, enhance the efficiency of capital allocation and insure more productive technological choices, all factors that in turn lead to high economic growth.

Previous studies largely confirm that both stock market and banking sector development have strong positive effect on growth (King and Levine, 1993a; 1993b; Levine and Zervos, 1998; Beck et al., 2000; Levine et al., 2000; Bekaert et al., 2001; Beck and Levine, 2004). However, other empirical evidence are does not support the positive effect proposition. For example, Boyreau-Debray (2003) and Akinlo (2004) found that financial development had a significantly negative effect on GDP growth. Ram (1999), Dawson (2003), and Rousseau and Vuthipadadorn (2005) reported an insignificant effect on economic growth. Thus far no clear consensus regarding has been reached the effect of financial development and economic growth.

The past literature explored the relationship between financial development and economic growth with multivariate regression (King and Levine, 1993a; 1993b; Ram, 1999; Allen and Ndikumana, 2000; Boyreau-Debray, 2003; Dawson, 2003). However, a linear framework implies that the analytical model is a symmetric system, whose effect of financial development on economic growth has the non-varying strength in different time periods. An increasing number of studies suggest that macroeconomic variable series, such as real output, investment and finance, may not behave in a linear fashion. The impacts of business cycle and abrupt shocks may produce a nonlinear relationship for macroeconomic activities (Beaudry and Koop, 1993; Thomas, 1997; Gatti et al., 1998; Öcal, 2001).

Additionally, several theoretical and empirical studies have pointed out that the nonlinear behavior is better at describing the linkage between the financial development and economic growth (Greenwood and Javanovic, 1990; Berthelemy and Varoudakis, 1994; Deidda and Fattouh, 2002). Researchers suggest that the phenomenon is due to the deficiency in the competition of financial institutions and an increase in the intermediation cost of credit market. In the aspect, the methods utilizing linear models do not seem rich enough to accommodate the true dynamics of an economy.

Demirgü-Kunt and Levine (1996b) used 44 cross-countries data from 1986 through 1993 had found that a positive relationship between stock market and financial institutions development. Levine and Zervos (1998) investigated whether measures of stock market liquidity, size, volatility and integration with world capital markets are correlated with economic growth. Leahy et al., (2001) used OECD countries data and showed that stock market and financial institutions development are correlated with economic growth.

Arestis, Demetriades, and Luintel (2001) used quarterly data and applied time series model to five developed economies and showed that while both banking sector and stock market development could explain subsequent growth, the effect of banking sector development had been substantially larger than that of stock market development. Hsu and Lin (2000) had investigated the relationship between long-run economic growth and financial development to see whether stock market and financial institutions promote economic growth using Taiwan's data from 1964 through 1996. The empirical method utilized is the vector autoregressive error-correction model proposed by Johansen and Juselius (1992). They found that both banking and stock market development are positively related with short-run and long-term economic growth. In particular, the financial dept measured by the ratio of the broad monetary aggregate (M2) and GDP had strong effect on the output growth. In addition, they also found that Granger causality exists between financial development measures and economic development in both directions.

In this paper, we use the set of proxies for banking development proposed by King and Levine (1993a; b) that has been recurrently used in most of the subsequent empirical work. Additionally, we consider market capitalization and value trade as a measure of stock market development (Levine and Zervos, 1998).

We use GJR-GARCH in mean methods to test all four hypotheses in a single model. Researchers provide (Black,1987; Caporale and Mckiernan, 1996; Alan ,1999) evidence of a statistically significant positive relationship between output variability and economic growth. Other researchers (Kormendi and Meguire, 1985; Grier and Tullock, 1989) have used the standard deviation of growth rates to proxy variability to provide evidence supporting a positive influence of output variability on mean growth rates. Most recent theoretical and empirical literature on investment under uncertainty shows that it is likely that uncertainty has a negative effect on investment and economic growth (Caballero, 1991; Abel an Eberly, 1994; Dixit and Pindyck, 1994). The testable hypothesis we consider from his work is that greater output growth uncertainty raises or reduces the average economic growth.

Allen (1989) and Chye (2007) examines the impact of demand for money uncertainty on the economic growth. Monetary factors, specifically money growth variability, are more predominant than output in dictating velocities of narrower monetary aggregates. The literature on financial development and economics stresses that financial intermediation encourages economic growth by mobilizing saving and increasing the productivity of capital due to a more efficient allocation of resources. Balazs et al., (2007) found that there existed a large amount of uncertainty in the determination of the equilibrium level of private credit. The assessment of expected volatility in financial markets is important for portfolio selection and risk management as well as for the pricing of assets. Empirical research over the past two decades has provided much evidence indicating that volatility is time-varying, and that changes in volatility are predictable, to some extent, in many asset markets (Friedmann et al., 2002; Huang et al., 2004; Balaban et al., 2005). A number of studies bring to light empirical evidence on “volatility clustering” with regard to the impact of the news on stock price volatility. Seminal studies finding evidence on “volatility clustering” are provided by Engle (1982), Pindyck (1986) and Bollerslev (1986). All of these studies support the view that news tend to be clustered together and this has an influence on stock price volatility. The testable hypothesis we consider from the work is that greater financial development uncertainty reduces the average economic growth.

The literature on financial development and economic growth, argues that financial intermediaries can better manage risk than individual wealth holders. This implies that firms in countries with a more developed financial sector are in a better position to diversify risks. Therefore, the effect of policy uncertainty on economic growth probably depends on the development of the financial sector. The testable hypothesis we consider from the work is that greater economic growth uncertainty reduces the average financial development. The conclusion is that the Friedman hypothesis cannot be rejected if money supply volatility is modeled explicitly, using models that capture important volatility effects that previous work has ignored (Serletis et al., 2006).

We simultaneously estimate the conditional means, variances and covariance of economic growth and financial development. We hypothesize that financial development uncertainty and economic growth uncertainty will be significant. Our key result is that in a variety of models and sample periods, financial development uncertainty and economic growth uncertainty are significant negative.

In the study, we choose Taiwan as a sample country for the following reasons. Firstly, lack of emerging economies in early studies of Taiwan makes it harder to draw direct inference about the contributions of financial intermediaries and development at early stages of economic development. Moreover, the growth of East Asian economies has gained a widespread attention from the world to this region. Among Asia countries, Taiwan economy grew impressively. High growth rates during the period of 1960's to 1990's made Taiwan a newly industrialized country. However, Taiwan has suffered from many economic unrests and large shocks in recent years, which makes it an ideal candidate for this investigation.

The remainder of the paper is organized as follows. Section 2 presents an empirical specification. Section 3 describes the data source and explanatory variables which measure the bank and stock sector development. Results are reported in Section 4. The last section presents the findings and conclusions of the investigation.

2. The Model

Based on the framework of Odedokun (1996), the aggregate production function incorporates financial development as one of the input factors given as:

$$Y_t = F(L_t, K_t, F_t, EX_t) \tag{1}$$

where Y_t denotes the real GDP; L_t denotes the labor force; K_t denotes the capital stock; F_t denotes the financial development level; EX_t denotes export. The study (Odedokun, 1991) have empirically detected positive and significant effects of export expansion on economic growth. All variable are logarithm, and division nominal GDP except labor force. We obtain the following empirical equation:

$$\log\frac{Y_t}{Y_t} = \log L_t + \log\frac{K_t}{Y_t} + \log\frac{F_t}{Y_t} + \log\frac{EX_t}{Y_t} \tag{2}$$

That appropriately manipulating or rearranging the resulting expression, we shall arrive at the growth equation set as:

$$\log\frac{Y_t}{Y_t} = \lambda_1 \Delta L_t + \lambda_2 \log\frac{I_t}{Y_t} + \lambda_3 \log\frac{F_t}{Y_t} + \lambda_4 \log\frac{EX_t}{Y_t} \tag{3}$$

The expression ($\log I_t / Y_t$) is the share of logarithm real gross gross fixed capital formation ($\log I_t$) in the nominal GDP (Y_t) while λ_1, λ_2, λ_3 and λ_4 are constant parameters . This study follow Sharma et al. (1991), which use real gross fixed capital formation instead private investments. After adding the intercept and error terms to eq. (3) becomes:

$$\log \frac{Y_t}{Y_t} = \lambda_0 + \lambda_1 \Delta L_t + \lambda_2 \log \frac{I_t}{Y_t} + \lambda_3 \log \frac{F_t}{Y_t} + \lambda_4 \log \frac{EX_t}{Y_t} + \varepsilon_t \tag{4}$$

where λ_0 is the intercept or constant term and ε_t is the error term that is expected to satisfy the usual assumptions.

This new approach is based on Engle's (1982) capturing time-varying volatility (uncertainty) using the autoregressive conditional heteroskedasticity (ARCH) model, and subsequent developments forming the ARCH family of models. Of these models the most popular has been the generalized ARCH (GARCH) model of Bollerslev (1986), especially for the analysis of financial data. GARCH techniques specifically estimate a model of the variance of unpredictable innovations in a variable, rather than simply calculating a variability measure from past outcomes or from conflicting individual forecasts.

In our empirical work, we estimate bivariate GARCH in mean systems for financial development and economic growth. The model allows us to simultaneously estimate equations for the means of financial development and economic growth that include the conditional variance of both series as regressors, along with the time-varying residual covariance matrix. Several parameterizations of the general multivariate model are possible, including the constant conditional correlation model of Bollerslev (1990). In the constant correlation model, the conditional covariance matrix is time-varying but the conditional correlation across equations is assumed to be constant. The assumption of a constant correlation matrix represents a major reduction in terms of computational complexity and is commonly used in multivariate GARCH models. That is, GARCH estimates a time-varying residual variance that corresponds well to the notion of uncertainty. Generally, ARCH and GARCH models assume that shocks are symmetric in their effect on volatility. This means that positive and negative shocks have same magnitude of impact on the conditional volatility.

This feature of GARCH models does not correspond to the results of a number of researchers, who have found evidence of asymmetry in financial development and economic growth behavior. In many studies the GARCH(1,1) process Particularly, negative surprises seem to increase volatility more than positive surprises. The conditional standard deviation term in the mean equation captures the time-varying relationship between total financial development uncertainty and economic growth uncertainty.

We use the GJR variant of the basic GARCH model in order to allow for a possible asymmetry behavior, that model is modified to allow positive and negative unanticipated returns to have different impacts on the conditional variance, which is included in mean equations (Nelson, 1991; Glosten et al., 1993). This phenomenon is called the “Leverage Effect”. Leverage effects are commonly present in economic growth uncertainty and financial development uncertainty volatility. The economic intuition of the Leverage Effect is that negative shocks increase in risk more than positive shocks.

Using GJR-GARCH in mean to measure uncertainty has advantage over traditional measures, like the survey of the standard deviation. GJR-GARCH in mean model will retrieve more efficient estimator than traditional OLS by using the conditional variance. This methodology addresses the possibility that uncertainty may change over time, which makes it possible to study our different hypotheses.

Since Engle (1982), numerous studies have been written on the family of GARCH models (e.g., Poon and Granger, 2003; Andersen et al., 2006; Bauwens et al., 2006). The attractiveness of GARCH models stems from the fact that they model the conditional variance asset returns by taking into account persistence in volatility and leverage effects. These two features are central to our hypotheses that our bivariate GJR-GARCH in mean model for financial development and economic growth is :

$$\Delta y_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i} \Delta y_{t-i} + \sum_{i=1}^{o} \alpha_{2i} \Delta l_{t-j} + \sum_{i=1}^{p} \alpha_{3i} \Delta k_{t-k} + \sum_{i=1}^{q} \alpha_{4i} \Delta ex_{t-l} + \sum_{i=1}^{r} \alpha_{5i} \Delta f_{t-1} + \theta_1 h_{yt} + \theta_2 h_{ft} + \varepsilon_{yt} \quad (5)$$

$$\Delta f_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i} \Delta f_{t-i} + \sum_{i=1}^{o} \alpha_{2i} \Delta y_{t-j} + \sum_{i=1}^{p} \alpha_{3i} \Delta l_{t-k} + \sum_{i=1}^{q} \alpha_{4i} \Delta k_{t-l} + \sum_{i=1}^{r} \alpha_{5i} \Delta ex_{t-1} + \theta_1 h_{yt} + \theta_2 h_{ft} + \varepsilon_{ft} \quad (6)$$

$$h_{yt} = a_0 + a_1 h_{yt-1} + a_2 \varepsilon_{yt-1}^2 + \gamma_y S_{yt-1}^{-} \varepsilon_{yt-1}^2 \quad (7)$$

$$h_{ft} = b_0 + b_1 h_{ft-1} + b_2 \varepsilon_{ft-1}^2 + \gamma_f S_{ft-1}^{-} \varepsilon_{ft-1}^2 \quad (8)$$

$$Cov_t = \rho (h_{yt}, h_{ft})^{0.5} \quad (9)$$

Eq. (5) shows the conditional mean of economic growth as a function of lagged economic growth, lags of labor force, lags of capital stock, lags of export, lags of financial development, and the conditional variances of economic growth and financial development. The conditional variances (h_{yt} and h_{ft}) are included to evaluate the response of economic growth to both economic growth uncertainty and financial development uncertainty. Eq. (6) describes the conditional mean of financial development as a function of lags of financial development, lagged economic growth, lags of labor force, lags of capital stock, lags of export and the conditional variances of economic growth and financial development. Equation (7) is a modified GJR-GARCH(1,1) model of the conditional variance of economic growth and leverage effect for economic growth. Equation (8) is a GJR-GARCH(1,1) model of the conditional variance of financial development and leverage effect. Eq. (9) is a simple, constant correlation, model of the covariance of the two error terms.

This study will apply GJR-GARCH in mean model to examine the leverage effect in financial development and economic growth. Where $\varepsilon_{yt-1} = 0$ and $\varepsilon_{ft-1} = 0$ are threshold such that shocks greater than the threshold have different effects than shocks below the threshold; S_{t-1}^{-} is a dummy variable which takes a value of 1 when $\varepsilon_{t-1} < 0$ (bad news, also called a negative return shock) and value of 0 when $\varepsilon_{t-1} \geq 0$. When $\gamma > 0$, negative shocks will have a larger impact on h_t than positive shocks.

3. Data Sources and Variable Definitions

The data source obtained from the Quarterly National Economic Trends (QNET), Financial Statistical Databank (FSM) and Manpower Statistical Databank (MAN) economic statistics data base. The period included in our empirical investigation starts in 1978Q1 and ends in 2007Q3. In our study, all variable series are in logarithm. The definitions of the variables used in the article study are as follows:

Definition of Variables:

Description	Variable	Units measured
GDP	Y	real GDP per capita
Labor	L	total employment / total population
Capital	K	ratio of fixed domestic capital formation / GDP
Export	EX	the ratio of export of goods and services / GDP
Liquid Liabilities	LL	currency plus demand and interest-bearing liabilities of bank and non-bank institutions / GDP
Private Credit	PC	domestic credit made by commercial banks and other deposit-taking banks to private sector / GDP
Market Capitalization	MC	the total value of stocks listed on the domestic market / GDP
Value Trade	VT	the total value of shares traded on the stock exchange / GDP

Note: The financial development indicators are based on the provided by World Bank's World Development Indicators (2006).

The data set incorporates two measures of banking system development (Liquid Liabilities and Private Credit) and two indicator of stock market development (Market Capitalization and Value Trade). The first one is liquid liabilities, it measures the overall size or financial depth (see Goldsmith, 1969; King and Levine, 1993a; 1993b). The second one is private credit as suggested by Demetriades and Hussein (1996). Following Levine and Zervos (1998), we use an assortment of stock market development measures, including the overall size of the market, stock market liquidity.

The first one is liquid liabilities (LL), it measures the currency plus demand and interest-bearing liabilities of bank and non-bank institutions divided by nominal GDP, which is to capture the overall size of the formal financial intermediary sector. The traditional practice (Goldsmith, 1969; King and Levine, 1993a; 1993b) has been to use the size of the formal financial intermediary sector relative to economic activity to measure financial sector development or “financial depth.” As the size of the financial intermediary sector is directly related to the quality and quantity of financial services being offered, LL is considered the most crucial variable for measuring banking sector development (Levine et al., 2000).

The second one is private credit (PC), which measures the ratio of domestic credit made by commercial banks and other deposit-taking banks to private sector divided by nominal GDP. The measure excludes loans issued to governments and public enterprises. It also excludes credits issued by the central bank. Use of PC was recommended since it is more inclusive than other measures of financial development, and it also captures an important activity of the financial sector; namely, channeling funds from savers to investors in the private sector (Levine and Zervos, 1998; Denizer et al., 2000). A large value of PC which reflects high availability of financial services suggests a well-functioning banking system (Levine et al., 2000).

The set of variables to measure the stock market development includes Market Capitalization and Value Trade. First, the common indicator for the size of stock market is Market Capitalization (MC), which equals the total value of stocks listed on the domestic market divided by nominal GDP. In this regard, a country with a well-developed stock market tends to have a larger stock market relative to the size of its economy. MC reflects the importance of financing through equity issues in the capital mobilization and resource allocation processes (Rousseau and Wachtel, 2000).

Second, the variable that measure the level of stock market liquidity is Value Trade (VT). VT is the total value of shares traded on the stock exchange divided by nominal GDP. Since VT measures the volume of stock being traded as a share of total output, it should accurately reflect the stock market liquidity relative to the size of the economy (Levine and Zervos, 1998). For this reason, VT may be considered a better indicator of stock market growth than MC alone. Though not a direct measure of trading costs or the uncertainty associated with trading on a particular market, it reflects liquidity positively on an economy wide basis (Levine, 1991; Bencivenga et al., 1995; Levine and Zervos,1998; Bekaert et al., 2001).

4. Empirical Results

4.1 Unit Root test

Common stochastic trends present among the variable is the determination of whether each series contain a unit root, that is nonstationary. In this study we use the conventional Augmented Dickey Fuller (ADF), Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) and Zivot and Andrew (ZA) unit root test. That ADF and ZA tests are non-stationarity as their null hypothesis shile the KPSS test uses the null hypothesis of stationarity. Zivot and Andrew (1992; hereafter ZA) alternative tests allows for a unit root against the alternative of trend stationary process with a structural break.

These tests are shown to have greater power for variables following a non-linear threshold process (Taylor, 2001). Akaike Information Criterion (AIC), Schwartz Information Criterion (SBC), and Ljung-Box are utilized to obtain the number of lags length in the Test. All variables are nonstationary at the level, but stationary in first differences at the 5% level of significance. Table 1 shows that all unit root tests unanimously confirm that all variable are I(1).

4.2 Cointegration test

The next step, therefore, is to proceed with cointegration test. In conducting cointegration analysis, we employ the Johansen (1998) methodology because of its superiority over other alternatives. Since Johansen cointegration test is sensitive to the lag length lag used, prior to performing the cointegration test, we use the Akaike Information Criterion (AIC), Schwartz Information Criterion (SBC), Hannan-Quinn information criterion (HQ), and Lagrange Multiplier (LM) to determine the appropriate number of lag. The 5% critical values are shown from the Statistics Table of Johansen and Juselius (1990) with T = 400, but the sample of this study is only 119 and therefore we adjust the statistics of the λ_{trace} and $\lambda_{\max}$ by applying the approach of Reinsel-Ahn (Reimers, 1992). The tests were performed with trend. The results,

Table 1. The Results of the Unit Root Test

Variable	ADF	Lag	KPSS	ZA	Quarter of Break
Y	-0.477	(5)	0.487**	-3.208	1994Q2
ΔY	-5.030**	(5)	0.040	-5.874**	2000Q4
L	-1.885	(5)	0.385**	-3.949	1985Q4
ΔL	-4.821**	(6)	0.076	-6.126**	1989Q1
K	-3.040	(4)	0.154*	-3.358	1988Q1
ΔK	-4.806**	(5)	0.056	-5.599**	1986Q2
EX	0.167	(6)	0.392**	-3.307	1983Q3
ΔEX	-7.083**	(6)	0.102	-9.209**	1987Q4
LL	-0.918	(5)	0.456**	-4.827	1991Q2
ΔLL	-3.670**	(4)	0.107	-5.952**	1983Q3
PC	-1.636	(5)	0.272**	-4.187	1987Q4
ΔPC	-4.251**	(4)	0.143	-5.476**	1990Q2
MC	-2.571	(4)	0.232**	-4.507	1987Q1
ΔMC	-4.114**	(3)	0.068	-6.239**	2003Q3
VT	-1.807	(6)	0.683**	-4.722	1987Q1
ΔVT	-5.844**	(5)	0.055	-7.205**	1990Q1

Note: Eleven variables are tested. ADF (1976) unit root test with H_0: variable are I(1); KPSS (1992) unit root test with H_0: variable are I(0). ZA (1992) unit root test with structural break. Number in parentheses are dates of structural break. The numbers in parentheses are the lag order, which are selected by the modified Akaike information criterion, Schwarz information criterion, and Ljung-Box test for residual serial correlation. Asterisk * and ** indicate statistical significance at the 5% and 1% levels, respectively.

Table 2. Cointegration Test Results

H_0	Without a trend		Critical Values (5%)	
λ Tests	λ_{trace}	Critical Value	$\lambda_{\max}$	Critical Value
		after adjustment		
1.Variables:(Y,L, K, EX, LL)				
$r = 0$	112.8881	112.4256	45.24043	48.52706
$r \le 1$	67.64766	80.86714	30.92663	40.66179
$r \le 2$	36.72103	54.33071	18.22556	32.69218
$r \le 3$	18.49547	32.75409	13.5022	24.54399
$r \le 4$	4.993271	15.84776	4.993271	15.84776
3.Variables: (Y, L, K, EX, PC)				
$r = 0$	123.8091	112.4256	46.71257	48.52706
$r \le 1$	77.09655	80.86714	36.67137	40.66179
$r \le 2$	40.42518	54.33071	23.84801	32.69218
$r \le 3$	16.57718	32.75409	9.495205	24.54399
$r \le 4$	7.081971	15.84776	7.081971	15.84776
4. Variables: (Y, L, K, EX, MC)				
$r = 0$	103.2738	112.4256	41.36845	48.52706
$r \le 1$	61.90539	80.86714	26.61078	40.66179
$r \le 2$	35.29462	54.33071	22.95771	32.69218
$r \le 3$	12.33691	32.75409	8.647126	24.54399
$r \le 4$	3.689784	15.84776	3.689784	15.84776
5. Variables: (Y, L, K, EX, VT)				
$r = 0$	115.9923	112.4256	41.83756	48.52706
$r \le 1$	74.15473	80.86714	35.64529	40.66179
$r \le 2$	38.50943	54.33071	25.58246	32.69218
$r \le 3$	12.92697	32.75409	9.694385	24.54399
$r \le 4$	3.232588	15.84776	3.232588	15.84776

Note: r indicates the number of cointegrating relationship. The tests was conducted with trend. The optimal number of lags, determined by minimum AIC, SBC HQ and LM. This result is assumed that there is a constant in the cointegrating vector. The 5% critical values are shown from the Statistics Table of Johansen and Juselius (1990) with T = 400, but the sample of this study is only 119 and therefore we adjust the statistics of the λ_{trace} and $\lambda_{\max}$ by applying the approach of Reinsel-Ahn (Reimers, 1992). The adjustment equation is given by $CR_T = CR_L{}^*(T/T\text{-}KP)$, where CR_T denotes the critical value after adjustment; CR_L indicates the initial critical value; T stands for the number of sample; K is the number of variable; P is the chosen lag length. The optimal number of lags, determined by min AIC,SBC and HQ statistics, is 4.

shown in Table 2, suggest a non-significant cointegration relationship in all case. It provide evidence of the non-significant a long-run equilibrium relationship between financial development and economic growth.

4.3 Serial Correlation and ARCH test

The results Table 3 presents the results of Ljung-Box (1979) and Lagrange Multiplier tests for serial correlation and autoregressive conditional heteroskedasticity (ARCH), respectively, in the economic growth and financial development. However, squared residuals of 4 and 8 lags are reject the null homoskedasticity, which shows existence of serial correlation, which is a signal of the presence of conditional heteroskedasticity in the data, but not serially dependent.

Table 3. Tests for serial correlation and ARCH

Variables	$Q(4)$	$Q(8)$	$Q^2(4)$	$Q^2(8)$	$LM(4)$
Δ LL	8.247	9.069	36.064	69.652	53.154
	(0.083)	(0.336)	(0.000)	(0.000)	
Δ PC	1.688	1.688	30.588	57.607	58.137
	(0.792)	(0.989)	(0.000)	(0.000)	
Δ MC	1.356	1.357	12.384	18.028	31.184
	(0.852)	(0.995)	(0.015)	(0.021)	
Δ VT	4.952	10.365	13.653	28.592	29.154
	(0.292)	(0.240)	(0.008)	(0.000)	

Note: $Q(4)$ and $Q(8)$ are the Ljung-Box statistics for the fourth and eighth-order serial correlation in the residuals. $Q^2(4)$ and $Q^2(8)$ are the Ljung-Box statistics but it corresponds to the serial correlation in the squared residuals. $LM(4)$ are Lagrange Multiplier test statistics with four lags in the respective squared residual.

4.4 GJR-GARCH in mean model

In our empirical work, we estimate the multivariate GJR GARCH in mean model. Equation (4)-(8) using the Broyden-Fletcher-Goldfarb-Shanno (BFGS) method calculates the general maximum likelihood estimates of the parameter. To determine the exact lag structures of equation, we perform a Hannan-Quinn information criterion (HQ) to performed to determine the lag structures of Eqs. (5)-(8) to select the most parsimonious model. The maximum lag length considered in the execution of these tests is 8. Due to the number of HQ test performed to generate final estimated model, results from these tests will be provided upon request. Based on the results from correlegrams for both series, the LR test and SIC criterions, the final best-gitted model for the mean equation. After allowing for the construction of lags, the time period evaluated is 1978Q1-2007Q3. As indicated earlier, the conditional variances (h_{yt} and h_{ft}) are included in the mean equations to measure the response of economic growth and financial development to both growth uncertainty and financial uncertainty.

Table 4 gives a detailed report on the estimates of the final models. In the conditional mean equation for economic growth, the coefficients on Δy_{t-2}, Δy_{t-4}, Δl_{t-2}, Δl_{t-4}, Δk_{t-2}, k_{t-3}, k_{t-4}, Δex_{t-1}, Δex_{t-3}, Δll_{t-2}, Δll_{t-4}, h_{yt} and h_{llt} are statistically significant at the 5% level while in the conditional mean equation for liquid liabilities (LL) the coefficients on Δll_{t-2}, Δll_{t-4}, Δy_{t-2}, Δy_{t-4}, Δl_{t-2}, l_{t-4}, Δk_{t-1}, Δk_{t-2}, Δk_{t-3}, Δk_{t-4}, Δex_{t-1}, Δex_{t-2}, Δex_{t-4}, h_{yt} and h_{llt} are significant at the 5% level.

Of primary interest are the answers as to whether or not uncertainty lowers or has no impact on economic growth and liquid liabilities. The sign and significance of the conditional variances (h_{yt} and h_{llt}) can provide such answers. The significantly negative coefficient (-0.434) on h_{yt} and (-0.309) on h_{llt} in the mean economic growth equation implies increases in economic growth uncertainty boosts up LL. In

Table 4. GJR-GARCH-M model: Liquid Liabilities and economic growth

Conditional Mean Equations

$$\Delta y_t = 0.123 - 0.139\Delta y_{t-2} + 0.092\Delta y_{t-4} - 0.266\Delta l_{t-2} + 0.170\Delta l_{t-4} + 0.003\Delta k_{t-1} - 0.005\Delta k_{t-2}$$
(6.539)(–4.483) (4.416) (–2.508) (2.071) (1.042) (–1.667)
$$- 0.006\Delta k_{t-3} + 0.006\Delta k_{t-4} + 0.015\Delta ex_{t-1} - 0.037\Delta ex_{t-3} + 0.164\Delta ll_{t-2} - 0.104\Delta ll_{t-4}$$
(–1.912) (1.701) (2.046) (–3.451) (5.168) (–3.343)
$$- 0.434 h_{yt} - 0.309 h_{llt}$$
(–2.671) (–2.272)

$$\Delta ll_t = 0.114 - 0.188\Delta ll_{t-2} + 0.098\Delta ll_{t-4} + 0.202\Delta y_{t-2} + 0.021\Delta y_{t-3} - 0.109\Delta y_{t-4} + 0.539\Delta l_{t-2}$$
(4.530)(–5.467) (3.807) (5.978) (0.631) (–3.519) (2.908)
$$- 0.486\Delta l_{t-4} - 0.013\Delta k_{t-1} + 0.012\Delta k_{t-2} - 0.011\Delta k_{t-3} + 0.010\Delta k_{t-4} - 0.032\Delta ex_{t-1}$$
(–3.213) (–3.978) (3.256) (–2.032) (2.009) (–3.761)
$$+ 0.034\Delta ex_{t-2} + 0.030\Delta ex_{t-4} - 0.102 h_{yt} - 0.018 h_{llt}$$
(2.553) (2.567) (–2.458) (–2.101)

Conditional Variance / Covariance Equations

$$h_{yt} = 0.134 + 0.179 h_{yt-1} + 0.018\varepsilon^2_{yt-1} + 0.019 S^-_{yt-1}\varepsilon^2_{yt-1}$$
(25.318)(4.208) (2.168) (2.292)
$$h_{llt} = 0.153 + 0.115 h_{llt-1} + 0.012\varepsilon^2_{llt-1} + 0.066 S^-_{llt-1}\varepsilon^2_{llt-1}$$
(22.561)(2.455) (1.826) (1.779)
$$Cov_t = 0.065\sigma_{yt}\sigma_{llt}$$
(0.403)

	Residual diagnostics					
	Mean	Variance	$Q(4)$	$Q^2(4)$	$Q(8)$	$Q^2(8)$
Z_{yt}	0.1613	0.9733	1.4865	0.6778	6.3299	7.6974
			[0.6854]	[0.9540]	[0.2754]	[0.4636]
Z_{llt}	0.0568	1.1772	1.6575	6.1187	6.7464	9.1991
			[0.6464]	[0.1905]	[0.2402]	[0.3258]

Note: T-statistics are displayed as (.). Marginal significance levels are displayed as [.].

the mean LL equation, the estimated coefficient on h_{yt} and h_{llt} are negative (-0.102 and -0.018) and significant at the 5% level, which provides evidence that economic growth uncertainty lowers LL uncertainty.

Note that the coefficient on Δll_{t-2} and Δll_{t-4} are significant in the mean equation for economic growth and lagged economic growth term Δy_{t-2} and Δy_{t-4} in the mean financial development equation suggest a bidirectional Granger causality running from financial development to economic growth.

In both equations for the conditional variance of economic growth and liquid liabilities, the asymmetry effects are found as indicated earlier. The coefficient on γ_y is positive and statistically significant at the 5% level, suggesting negative economic growth surprises in Taiwan are greater than positive ones in their influence on the conditional variance. Similarly, the positive and significant coefficient on γ_{ll} suggests that LL uncertainty rises more in response to negative liquid liabilities surprises than positive ones. However, the coefficient on the lagged residual variance for economic growth (0.179) is smaller than liquid liabilities (0.115), implying that the effects of LL are shorter-lived than the effects of economic growth uncertainty.

Overall, the model appears well specified. The Ljung-Box Q-statistics are calculated for the standardized residuals (Z_{yt} and Z_{llt}) ,and their corresponding squares. None of these values is significant at conventional levels; hence we conclude that standardized residuals and the squared residual are not serially correlated and arch effects.

Several results stand out in Table 5. As these results show, the constant term and the coefficients on Δy_{t-2}, Δy_{t-4}, Δl_{t-2}, Δl_{t-3}, Δk_{t-2}, Δk_{t-3}, Δk_{t-4}, Δex_{t-1}, Δex_{t-2} , Δex_{t-3}, Δpc_{t-1}, Δpc_{t-2}, h_{yt} and h_{pct} in the conditional mean equation

Table 5. GJR-GARCH-M model: Private Credit and economic growth

Conditional Mean Equations

$$\Delta y_t = 0.214 - 0.252\Delta y_{t-2} - 0.005\Delta y_{t-3} + 0.182\Delta y_{t-4} - 0.101\Delta l_{t-1} - 0.393\Delta l_{t-2} + 0.254\Delta l_{t-3}$$
(11.584)(–8.387) (–0.016) (7.923) (–0.863) (–3.761) (2.236)
$$- 0.010\Delta k_{t-2} - 0.008\Delta k_{t-3} + 0.005\Delta k_{t-4} + 0.037\Delta ex_{t-1} - 0.029\Delta ex_{t-2} - 0.041\Delta ex_{t-3}$$
(–3.709) (–2.420) (1.704) (4.908) (–3.041) (–4.249)
$$- 0.012\Delta ex_{t-4} + 0.067\Delta pc_{t-1} + 0.167\Delta pc_{t-2} - 0.008\Delta pc_{t-3} - 0.180 h_{yt} - 0.038 h_{pct}$$
(–1.169) (3.495) (6.604) (–0.330) (–2.015) (–3.549)

$$\Delta pc_t = 0.042 - 0.058\Delta pc_{t-2} + 0.007\Delta pc_{t-3} + 0.187\Delta pc_{t-4} + 0.017\Delta y_{t-1} + 0.393\Delta y_{t-2}$$
(1.039)(–0.840) (0.141) (5.356) (0.267) (6.408)
$$+ 0.128\Delta y_{t-3} + 0.162\Delta l_{t-4} - 0.016\Delta k_{t-1} + 0.020\Delta k_{t-3} - 0.065\Delta ex_{t-1} + 0.007\Delta ex_{t-2}$$
(2.894) (0.692) (–2.961) (3.290) (–4.113) (0.391)
$$+ 0.039\Delta ex_{t-4} - 0.051 h_{yt} - 0.046 h_{pct}$$
(2.568) (–2.145) (–2.341)

Conditional Variance / Covariance Equations

$$h_{yt} = 0.124 + 0.147 h_{yt-1} + 0.026\varepsilon^2_{yt-1} + 0.022 S^-_{yt-1}\varepsilon^2_{yt-1}$$
(24.338)(2.772) (3.026) (2.395)
$$h_{pct} = 0.304 + 0.018 h_{pct-1} + 0.043\varepsilon^2_{pct-1} + 0.078 S^-_{pct-1}\varepsilon^2_{pct-1}$$
(13.843)(2.191) (2.137) (2.239)
$$Cov_t = 0.058\sigma_{yt}\sigma_{pct}$$
(0.427)

	Residual diagnostics					
	Mean	Variance	$Q(4)$	$Q^2(4)$	$Q(8)$	$Q^2(8)$
Z_{yt}	0.0840	0.9263	2.6881	1.4044	6.0867	9.6589
			[0.2608]	[0.8434]	[0.1928]	[0.2898]
Z_{pct}	0.0974	0.9135	3.7239	2.5584	5.1310	14.7978
			[0.1554]	[0.6342]	[0.2741]	[0.0632]

Note: T-statistics are displayed as (.). Marginal significance levels are displayed as [.].

for economic growth are all individually significant at the 5% level, whereas in the conditional mean equation for private credit (PC) the coefficients on Δpc_{t-4}, Δy_{t-2}, Δy_{t-3}, Δk_{t-1}, Δk_{t-3}, Δex_{t-1}, Δex_{t-4}, h_{yt} and h_{pct} are individually significant at the 5% level. The statistical significance of Δpc_{t-1} and Δpc_{t-2} in the mean equation for economic growth together with the absence of lagged economic growth terms in the mean equation for PC indicate bidirectional Granger causality from private credit to economic growth in Taiwan.

In the mean equation of economic growth, the significantly negative coefficient (-0.180) on h_{yt} implies that increases in economic growth uncertainty boosts up than PC uncertainty. Likewise, in the mean PC equation, the estimated coefficient on h_{pct} is negative (-0.046) and significant at the 5% level, that economic growth uncertainty lower than economic growth.

Both variance equations shows that the conditional variances of economic growth and PC are time varying and asymmetrical. However, the coefficient on the lagged residual variance for PC is in a smaller magnitude to the one on economic growth, implying that the effect of PC uncertainty are shorter-lived than the effect of economic growth uncertainty. The coefficient on γ_y is positive and statistically significant at the 5% level, suggesting negative economic growth surprises are greater than positive ones in their influence on the conditional variance. Similarly, the positive and significant coefficient on γ_{pc} suggests that private credit uncertainty rises more in response to negative private credit surprises than positive ones.

We calculate Ljung-Box Q-statistics at 4 and 8 lags for the levels, squares of the standardized residuals for the estimated GJR-GARCH in mean system. The null hypothesis of no fourth-order and eighth-order serial linear dependence of the $Q(4)$,

$Q^2(4)$, $Q(8)$ and $Q^2(8)$ tests, are not significant at 5% level; hence, we conclude that standardized residuals and the squared residual are not serially correlated.

Table 6 reports parameter estimates from the estimation of the reduced model. Both the GJR-GARCH in mean equation for the economic growth the constant term and Δy_{t-2}, Δy_{t-4}, Δk_{t-1}, Δk_{t-2}, Δk_{t-3}, Δk_{t-4}, Δex_{t-1}, Δex_{t-3}, Δmc_{t-2}, Δmc_{t-4}, h_{yt} and h_{mct}, whereas in the conditional mean equation for market capitalization (MC) the coefficients on Δy_{t-4}, Δl_{t-2}, Δex_{t-1}, Δex_{t-3}, h_{yt} and h_{mct} are all individually significant at the 5% level.

However, the coefficient on the lagged residual variance for economic growth and MC are significant at 5% level. The coefficient on the lagged residual variance is smaller for economic growth (0.147) than for MC (0.016), suggesting that MC shocks have shorter-lived effects on financial development uncertainty than MC shocks have on economic growth uncertainty.

For GJR-GARCH in mean model, the presence of asymmetric effects is tested on the basis of the alternative hypothesis being that ($\gamma_y \neq 0$ and $\gamma_{mc} \neq 0$) and leverage effect is tested by the hypothesis that ($\gamma_y > 0$ and $\gamma_{mc} > 0$). As shown in Table 6, both hypotheses are rejected for indices, it indicates there are asymmetric and leverage effects.

The statistical significance of Δmc_{t-2} and Δmc_{t-4} in the mean equation for economic growth together with the existence of lagged economic growth terms Δy_{t-4} in the mean equation for market capitalization indicate bidirectional Granger causality from growth to economic growth in Taiwan.

Again, the diagnostic tests using Ljung-Box Q-statistics on the level and squared standardized residuals reveal that there are no serial dependence in the residuals and

Table 6. GJR-GARCH-M model: Market Capitalization and economic growth

Conditional Mean Equations

$$\Delta y_t = 0.189 - 0.335\Delta y_{t-2} + 0.263\Delta y_{t-4} - 0.036\Delta l_{t-2} + 0.158\Delta l_{t-4} + 0.008\Delta k_{t-1} - 0.012\Delta k_{t-2}$$

(9.808)(–7.410) (6.416) (–0.245) (1.600) (2.833) (–3.825)

$$- 0.008\Delta k_{t-3} + 0.013\Delta k_{t-4} + 0.039\Delta ex_{t-1} - 0.041\Delta ex_{t-3} + 0.021\Delta mc_{t-2} - 0.012\Delta mc_{t-4}$$

(–2.219) (3.677) (4.632) (–3.795) (2.870) (–2.589)

$$- 0.500 h_{yt} - 0.008 h_{mct}$$

(–2.908) (–3.030)

$$\Delta mc_t = -0.002 - 0.065\Delta mc_{t-2} + 0.093\Delta mc_{t-4} + 0.659\Delta y_{t-2} - 0.760\Delta y_{t-4} + 0.454\Delta l_{t-2}$$

(–0.008)(–0.826) (1.432) (1.520) (–2.486) (3.352)

$$+ 0.926\Delta l_{t-4} + 0.008\Delta k_{t-1} - 0.003\Delta k_{t-2} - 0.194\Delta ex_{t-1} + 0.008\Delta ex_{t-2} + 0.145\Delta ex_{t-3}$$

(0.947) (0.021) (–0.006) (–1.682) (0.060) (2.819)

$$- 0.863 h_{yt} - 0.032 h_{mct}$$

(–2.472) (–1.839)

Conditional Variance / Covariance Equations

$$h_{yt} = 0.132 + 0.016 h_{yt-1} + 0.029\varepsilon^2_{yt-1} + 0.028 S^-_{yt-1}\varepsilon^2_{yt-1}$$

(19.142)(4.192) (3.365) (3.187)

$$h_{mct} = 0.702 + 0.147 h_{mct-1} + 0.043\varepsilon^2_{mct-1} + 0.094 S^-_{mct-1}\varepsilon^2_{mct-1}$$

(10.054)(3.365) (2.721) (2.800)

$$Cov_t = 0.010\sigma_{yt}\sigma_{llt}$$

(0.889)

	Residual diagnostics					
	Mean	Variance	$Q(4)$	$Q^2(4)$	$Q(8)$	$Q^2(8)$
Z_{yt}	0.0963	0.9213	2.9051	0.0215	5.5230	10.0960
			[0.5738]	[0.8835]	[0.7005]	[0.1207]
Z_{mct}	0.0117	0.9663	7.4704	5.5940	10.8231	15.8953
			[0.1130]	[0.0180]	[0.2119]	[0.0143]

Note: T-statistics are displayed as (.). Marginal significance levels are displayed as [.].

remaining GARCH effects.

Table 7 reports, the constant term and the coefficients on Δy_{t-2}, Δy_{t-4}, Δl_{t-3}, Δk_{t-1}, Δk_{t-2}, Δk_{t-3}, Δk_{t-4}, Δex_{t-1}, Δex_{t-2}, Δex_{t-3}, Δvt_{t-2}, Δvt_{t-4}, h_{yt} and h_{vtt} in the conditional mean equation for economic growth are all individually significant at the 5% level. In the conditional mean equation for value trade (VT) the coefficients on Δvt_{t-1}, Δvt_{t-3}, Δy_{t-2}, Δk_{t-4}, Δex_{t-4}, h_{yt} and h_{vtt} are significant at the 5% level.

Consistent with the Lagrange Multiplier test results reported in Table 3, the results for the variance equations demonstrate that the variances of both economic growth and value trade are time varying, display asymmetry, and exhibit statistically significant GARCH terms. Of greatest note are the estimated asymmetry effects. The coefficients on h_{yt-1} and h_{vtt-1} in the conditional variance equations for economic growth and VT, respectively, are both negative and statistically significant at the 5% level. Overall, the model appears to be well specified. The standardized residuals, Z_{yt} and Z_{vtt}, both possess means and variances that are statistically non-significant , respectively, and both satisfy the nulls of no fourth and eighth order serial dependence, as indicated by Ljung-Box test.

In the conditional mean equation for economic growth, the estimated coefficients on h_{yt} and h_{vtt} indicate that both increased economic growth uncertainty and increases economic growth uncertainty uppers average economic growth. In the mean equation for value trade, the parameter estimate h_{yt} is positive and statistically significant, indicating that increased economic growth lowers average value trade in Taiwan. Interestingly, however, the estimated coefficient on the asymmetry term γ_y in the conditional variance equation for economic growth indicates that economic

Table 7. GJR-GARCH-M model: Value Trade and economic growth

Conditional Mean Equations

$$\Delta y_t = 0.232 - 0.291\Delta y_{t-2} + 0.224\Delta y_{t-4} + 0.378\Delta l_{t-3} + 0.010\Delta k_{t-1} - 0.009\Delta k_{t-2} - 0.013\Delta k_{t-3}$$
(14.536)(−4.452) (4.206) (3.652) (2.862) (−3.629) (−2.709)

$$+ 0.011\Delta k_{t-4} + 0.040\Delta ex_{t-1} - 0.030\Delta ex_{t-2} - 0.059\Delta ex_{t-3} - 0.005\Delta ex_{t-4} + 0.004\Delta vt_{t-1}$$
(3.576) (4.019) (−3.046) (−4.476) (−0.355) (1.508)

$$+ 0.007\Delta vt_{t-2} + 0.002\Delta vt_{t-3} - 0.005\Delta vt_{t-4} - 0.002h_{yt} - 0.436h_{vtt}$$
(3.680) (0.649) (−2.608) (−2.761) (−2.759)

$$\Delta vt_t = -0.037 - 0.157\Delta vt_{t-1} + 0.220\Delta vt_{t-3} + 2.138\Delta y_{t-2} - 1.546\Delta y_{t-3} + 0.711\Delta l_{t-1} - 0.230\Delta l_{t-3}$$
(−0.029)(−2.250) (1.966) (2.300) (−0.878) (1.069) (−0.275)

$$- 0.241\Delta l_{t-4} - 0.329\Delta k_{t-1} - 0.548\Delta k_{t-4} - 0.652\Delta ex_{t-1} - 0.746\Delta ex_{t-2} + 1.267\Delta ex_{t-4}$$
(−0.240) (−1.164) (−2.880) (−1.439) (−0.877) (4.708)

$$- 0.165h_{yt} - 0.081h_{vtt}$$
(−5.014) (−5.818)

Conditional Variance / Covariance Equations

$$h_{yt} = 0.123 + 0.416h_{yt-1} + 0.028\varepsilon^2_{yt-1} + 0.024S^-_{yt-1}\varepsilon^2_{yt-1}$$
(21.593)(4.228) (2.232) (3.385)

$$h_{vtt} = 0.942 + 0.182h_{vtt-1} + 0.092\varepsilon^2_{vtt-1} + 0.079S^-_{vtt-1}\varepsilon^2_{vtt-1}$$
(11.941)(3.754) (3.847) (1.803)

$$Cov_t = 0.084\sigma_{yt}\sigma_{vtt}$$
(0.656)

	Residual diagnostics					
	Mean	Variance	$Q(4)$	$Q^2(4)$	$Q(8)$	$Q^2(8)$
Z_{yt}	0.0890	0.8110	0.8002	2.1086	4.7044	4.0490
			[0.9384]	[0.7158]	[0.7887]	[0.7741]
Z_{vtt}	0.0623	1.3466	2.2230	2.8011	13.0330	8.5122
			[0.6948]	[0.5916]	[0.1107]	[0.2896]

Note: T-statistics are displayed as (.). Marginal significance levels are displayed as [.].

growth uncertainty rises more in response to negative economic growth surprises than to positive surprises. Finally, the estimated coefficient on the asymmetry term γ_{vt} in the conditional variance equation for value trade indicates that VT uncertainty rises more in response to negative growth shocks than to positive shocks.

5. Conclusions

In this study, we employ an alternative empirical specification, that have constructed a nonlinear GJR-GARCH in mean model in a multivariate context of Taiwanese economic growth uncertainty and financial development uncertainty over the period 1978:1 to 2007:3. We use real GDP, labor force, capital stock, export of goods and services and four financial development indicators as proxy variables to re-evaluate its impacts.

The results, suggest non-significant cointegrating relationships in all case. We began by considering the four hypotheses. Our results, based on GJR-GARCH in mean model of the conditional variance of the residuals, showed strong evidence of volatility persistence in the financial development and economic growth. This study find strong evidence for the predications that increased economic growth uncertainty and financial development uncertainty reduces average economic growth and financial development. In additional, while success to uncover a statistically significant relationship between economic growth uncertainty and financial development uncertainty. All financial development equation suggest bidirectional Granger causality running from to economic growth. Lastly, significant and positive coefficient on γ_y and γ_f in the condition variance equation for economic growth and financial development. It implies that rises more in response to negative financial development and economic growth surprises than to positive surprises.

This paper shows the financial development uncertainty have robust and negative individual effect on economic growth. The results of this paper point at three important conclusions. First, in Taiwan where the financial sector is often very rudimentary, a stable and credible financial development policy appears to be of utmost importance. Second, a well-developed financial sector is an important means by which growth-reducing effects of financial development uncertainties and economic growth uncertainties can be mitigated. Third, our key result is that in a variety of models and sample periods, financial development uncertainty are shorter-lived than the effects of economic growth uncertainty.

References

Abel, A. B., and Eberly J. C., (1994), "A unified model of investment under uncertainty," *American Economic Review,* 84, 1369-1384.

Akinlo, A. E., (2004), "Foreign direct investment and growth in Nigeria: an empirical investigation," *Journal of Policy Modeling*, 26, 627-639.

Alan, E. H., (1999), "UK output variability and growth: some further evidence," *Scottish Journal of Political Economy,* 46, 175-184.

Allen, S. D., (1989), "Financial market effects on aggregate money demand: a bayesian analysis," *Journal of Money, Credit, and Banking,* 21, 158-175

Allen, D. S., and Ndikumana, L., (2000), "Financial intermediation and economic growth in Southern Africa," *Journal of African Economics*, 9,132-60.

Andersen, T. G., Bollerslev, T., Christoffersen, P. F., and Diebold, F. X., (2006), "Volatility and correlation forecasting," In: Elliott, G., Granger, C.W. J., Timmermann, A. (Eds.), *Handbook of Economic Forecasting*, 778-878.

Arestis, P., Demetriades, P. O., and Luintel, K. B., (2001), "Financial development and economic growth: the role of stock markets," *Journal of Money, Credit, and Banking,* 33, 16-41.

Balazs, E., Peter, B., and Tina, Z. (2007), "*Credit* growth in central and eastern europe -new (over) shooting stars?" *Comparative Economic Studies,* 49, 201-31.

Balaban, E. and Bayar, A., (2005), "Stock returns and volatility empirical evidence from fourteen countries," *Applied Economics Letters*, 12, 603-611.

Bauwens, L., Laurent, S., Rombouts, J.V.K., (2006), "Multivariate GARCH model: a survey," *Journal of Applied Econometrics 21*,79-109.

Beaudry, P., and G. Koop, (1993), "Do recessions permanently affect output?" *Journal of Monetary Economics*, 31, 149-163.

Beck, T., Levine, R. and Loayza, N. (2000), ‘‘Finance and the sources of growth,’’ *Journal of Finance Economics*, 58, 261-300.

Beck, T. and Levine, R. (2004), ‘‘Stock markets, banks, and growth: panel evidence,’’ *Journal of Banking & Finance*, 28, 423-442.

Bekaert, G., Harvey, C. and Lundblad, C. (2001), “Emerging equity markets and economic development,” *Journal of Development Economics*, 66, 465-504.

Bencivenga V. R., Smith and Starr R. M., (1995), “Transactions costs, technological choice, and endogenous growth,” *Journal of Economic Theory*, 67, 153-177.

Berthelemy, J. C., and Varoudakis, A. (1994), “Financial intermediation and endogenous growth,” *Revue Economique*, 45, 737-750.

Black, F., (1987), “Business cycles and equilibrium.” New York: Basil Blackwell.

Bollerslev, T., (1986), “Generalised autoregressive conditional heteroscedasticity,” *Journal of Econometrics*, 31, 307-327.

Bollerslev, T., (1990), “Modelling the coherence in short-run nominal exchange rates: a multivariate generalized ARCH model,” *Review of Economics and Statistics*,

Boyreau-Debray, G., (2003), “Financial intermediation and growth: Chinese style,” *World Bank Working Papers*, No. 3027.

Caballero, R. J., (1991), “On the sign of the investment-uncertainty relationship,” *American Economic Review*, 81, 279-288.

Caporale, T. and Mckiernan, B. (1996), “The relationship between output variability and growth: evidence from post war UK data,” *Scottish Journal of Political Economy*, 43, 229-36.

Chye T. E., (2007), “Monetary Velocities in Malaysia: an empirical Note,” *Malaysian Journal of Economic Studies*, 44, 23-36.

Dawson, P. J., (2003), “Financial development and growth in economies in transition,” *Applied Economics Letters*, 10, 833-836.

Deidda, L., and Fattouh B., (2002), "Nonlinearity between finance and growth," *Economics Letters*, 74, 339-345.

Demirgü-Kunt A., and Levine, R. (1996c), "The financial system and public enterprisereform: concepts and cases. In Hermes, N., and Lensknk, R. (Eds.)," *Financial development and economic growth: Theory and experiences from developing countries*, 247-286. London: Routledge.

Demetriades, P., and Hussein, K., (1996), "Does financial development cause economic growth? Time series evidence from 16 countries," *Journal of Development Economics*, 51, 387-411.

Dixit, A. K., and Pindyck R. S., (1994), "Investment under uncertainty," Princeton university Press.

Engle, R. F., (1982), "Autoregressive conditional heteroskedasticity with estimates of the variance of UK inflation," *Econometrica*, 50,987-1008.

Engle, R. F., and Ng V. K., (1993), "Measuring and testing the impact of news on volatility," *Journal of Finance*, 48, 1749-1778.

Friedmann, R., and Sanddorf-KÖhle, W. G., (2002), "Volatility clustering and nontrading days in Chinese stock markets," *Journal of Economics and Business*, 54, 193-217.

Gatti, D., Gallegati M. and Mignacca D., (1998), "Nonlinear dynamics and european GNP data," *Studies in Nonlinear Dynamics and Econometrics*, 3, 43-59.

Glosten, L. R., Jagnnathan R. and Runkle D. E., (1993), "On the relation between the expected value and the volatility of the nominal excess return on stocks," *Journal of Finance*, 48, pp. 1779-1801.

Greenwood, J. and Jovanovic B. (1990), "Financial development, growth and the distribution of income," *Journal of Political Economy*, 98, 1076-1117.

Grier, K., and Tullock, G., (1989), “An empirical analysis of cross-national economic growth,” *Journal of Monetary Economics*, 24, 259-276.

Hsu, C. M., and Lin, S. M. (2000), “Financial development and endogenous growth model,” *Industry of Free China*, 9, 21-47.

Huang, W. C., and Zhu, Y., (2004), “Are shocks asymmetric to volatility of Chinese stock markets?” *Review of Pacific Basin Financial Markets and Policies*, 7, 379-395.

King, R. G., and Levine R. (1993a), “Finance and growth: Schumpeter might be right,” *Quarterly Journal of Economics*, 108, 717-738.

King, R. G., and Levine R. (1993b), “Finance, entrepreneurship and growth,” *Journal of Monetary Economics*, 32, 513-542.

Kormendi, R., and Meguire, P., (1985), “Macroeconomic determinants of growth: cross-country evidence,” *Journal of Monetary Economics*, 16, 141-163.

Leahy, M., Schich, S., Wehinger, G., and Pelgrin, F., (2001), “OECD economics department,” *OECD Economics Department Working Papers*, 280.

Levine, R. (1991), “Stock markets, growth, and tax policy,” *The Journal of Finance*, 46, 1445-1465.

Levine, R. (1992), “A sensitivity analysis of cross-country growth regressions,” *The American Economic Review*, 82, 942-963.

Levine, R. (1997), “Financial development and economic growth: views and agenda,” *Journal of Economic Literature*, XXXV, 688-726.

Levine R. and Zervos, S. (1998), “Stock markets, banks, and economic growth,” *The American Economic Review*, 88, 537-558.

Levine, R. Loayza N. and Beck, T. (2000), “Financial intermediation and growth: causality and causes,” *Journal of Monetary Economics*, 46, 31-77.

Levine, R. (2002), "Bank-based or market-based financial systems: which is better? " *Journal of Financial Intermediation,* 11, 398-428.

Levine, R. (2004), "Finance and growth: theory and evidence," working paper 10766.

Lee C., and Woung S. Y., (2005), "Inflationary threshold effects in the relationship between financial development and economic growth: evidence from Taiwan and Japan," *Journal of economic development,* 30, 49-69.

Mckinnon, R. I., (1973), "Money and capital in economic development," The brookings inInstitution, Washington, DC.

Nelson, D., (1991), "Conditional heteroskedasticity in asset returns: a new approach," *Econometric,* 59, 347-370.

Öcal, N., (2001), "Nonlinear models for U.K. macroeconomic time series," *Studies in Nonlinear Dynamics and Econometrics,* 3,123-35.

Odedokun, M. O., (1996), "Alternative econometric approaches for analyzing the role of the financial sector in economic growth: time-series evidence from LDCs," *Journal of Development Economics,* 50, 119-146.

Pindyck, R. S., (1986), "Risk, inflation and the stock market," *American Economic Review,* 74, 335-351.

Poon, S. H., Granger, C.W.J., (2003), "Forecasting volatility in financial markets: a review," *Journal of Economic Literature 41,* 478-539.

Ram, R., (1999), "Financial development and economic growth: additional evidence," *Journal of Development Economics,* 35, 164-174

Rousseau, P. L., and Wachtel P. (2000), "Inflation, financial development and growth," New York University, Leonard N. Stern School of Business, Department of Economices, Working Papers.

Rousseau, P. L., (2005), "Finance, investment, and growth: time series evidence from 10 Asian economies," *Journal of Macroeconomics,* 27, 87-106.

Saint-Paul, G. (1992), "Technological choice, financial markets and economic development," *European Economic Review*, 36, 763-781.

Schumpeter, J. A., (1911), "The theory of economic development," Harvard University Press, Cambridge, MA.

Serletis, A., and Shahmoradi A., (2006), "Velocity and the variability of money growth: evidence from a varma GARCH-M model," *Macroeconomic Dynamics*, 10, 652-666.

Shaw, E. S., (1973), "Financial deepening in economic development," Oxford University Press, New York.

Tang, D, (2006), "The effect of financial development on economic growth: evidence from APEC countries," 1981-2000. *Applied Economics*, 38, 1889-1904.

Thomas, L. B., (1997), "Money, banking, and financial markets," New York: McGraw-Hill.