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# The Impact of Financial Development in China 1993-2008: A Non-linear Model approach

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**ABSTRACT**

This paper investigates non-linearity in the development of financial sectors in China that would suggest a threshold point for inflation materially entering into decision of policy markers. We use a Smooth Transition Regression model (STR) which recently developed by Teräsvirta and Anderson (1992), Granger and Teräsvirta (1993), and Teräsvirta (1994). One of our main results is the existence of non-linearity among financial development, economic growth and inflation in China. No mater we apply which indicator to measure the development of finance, the transition mechanism specified tests strongly reject the linearity assumption. Consequently we found that when inflation was above 2% and less than 20%, the model was in a transition period. A positive impact of total market capitalisation occurred in China during 1993Q1 to 2008Q4, when inflation was above 7%. Meanwhile, we found the inflation-real economic output nexus from the STR model. A transition from a positive to a negative occurred when the rate of inflation was more than 2% and below 20%. Inflation had a negative impact on real per capita GDP, when inflation was above 11% in China during 1993Q1 to 2008Q4.

Keyword: Smooth Transition Regression model (STR); Financial development; Economic growth; Inflation; China

## INTRODUCTION

Even though a lot of studies have indicated a significant impact of finance on economic growth, the empirical results are mixed. Some studies suggest a non-linearity approach to show the influence of financial development on economic growth may differ with a certain level of financial development and economic conditions. Additionally, another type of study has used the aggregate of domestic credit to predict crises and economic downturns (e.g. Kaminsky and Reinhart 1999).

Existing literature stresses that inflation is not conducive to economic growth, maybe because higher inflation, and inflation-related uncertainty, distort the efficient allocation of resources, postpone investment projects, change optimal contract lengths and increase unemployment. Meanwhile, most studies suggest that it is non-linear, the impact of inflation on growth, if the level of strong inflation is within a specified range. Secondly, some literature suggests that inflation may have a detrimental effect on the operation of the financial system. For example, theoretical models have shown that high rates of inflation create distorted information flows and greater credit rationing, thereby intensifying credit market frictions. High inflation erodes the usefulness of monetary assets and decision-making, and causes policy distortions in the financial structure of financial intermediation. Additionally, the cointegration of the global financial system is delayed by a higher inflation uncertainly (Huang et al. 2010).

A small but growing literature has examined the different effects of the financial system on economic growth, with the possible adverse effect of inflation. Based on imperfect credit markets, theoretical models suggest that credit rationing and the distortion of information are caused by higher rates of inflation, thereby creating worsening credit market frictions. Financial intermediaries are repressed by high inflation eroding money assets, leading to policy decisions, which will distort the financial system. Furthermore, uncertainty about inflation is caused by high inflation, which delays the cointegration of the domestic financial system to the global market. Additionally, high inflation will intervene in the ability to allocate capital in the financial sector, and then reduce capital accumulation and economic growth. However, these theoretical models suggest that different threshold levels play a substantial role.

Deidda and Fattouh (2002) and Rioja and Valev (2004a) showed a weak or insignificant link between financial development and economic growth at a low level of per-capita income, and a strongly positive link at high levels of per-capita income. Rioja and Valev (2004b) mentioned when financial development has reached a certain size threshold, that it presents a strong positive impact on economic growth. Below this threshold, the effect is most uncertain. To see the effect of the threshold level, economists have used econometric models, to find the finance–growth nexus.

Haslag and Koo (1999) showed a link between inflation and financial repression. They showed a negative correlation of inflation on financial development, but that the increase of inflation rate above a threshold will cause a positive link. Boyd et al. (2001) indicated a discrete drop in the performance of the financial sector, which supports a non-linearity among financial development, inflation and economic growth. Khan et al. (2006) showed a threshold level of inflation of around 3-6%, and they indicated a strong adverse influence of inflation on financial development, if inflation rises above the threshold level. Huang et al. (2010) investigated whether the finance- growth relationship is dependent on different levels of inflation. More specifically, they explored a threshold effect on the finance-growth nexus. They found a threshold level of between 7.31 and 7.69%; so that the impact of finance on growth becomes negative or insignificant, if inflation exceeds this threshold level. They also indicated a threshold effect on the relationship between financial development and productivity growth. If the inflation rate is above a threshold of about 8%, there is an insignificant influence of financial development on productivity growth.

In this paper, we applied the Smooth Transition Regression model (STR) promoted by Teräsvirta and Anderson (1992), Granger and Teräsvirta (1993), and Teräsvirta (1994) to examine a non-linearity relationship in the finance-growth nexus. Using inflation rates as a transition variable, the model shows that the impact of financial development on real per capita GDP depends on different levels of inflation rates. The results from the non-linearity application tell us this. On the one hand, it makes an extension to show a non-linearity relationship among finance, economic growth and inflation. On the other hand, it shows how much benefit there is from the development of the financial sector, when we use inflation as a transition variable, which provides a channel to control the negative impact of financial liberalisation.

The structure of this paper is organised as follows. Section 2 discusses methodological approach and describes the data set used for the empirical analysis. Following that, the third section presents the results of the modelling process, and section 4 concludes with a discussion of the theses results.

## METHODOLOGY

Switching regimes are very common in economic variables, and a regime's switch may go through a suddenly abrupt change, or in a smooth way which take some time in transition from one regime to another. The second situation often uses Smooth Transition Regression (STR) models to apply economic studies.

Kavkler et al. (2006) concluded that transition is a continuous process in the Smooth Transition Regression (STR)[1] model, which depends on the transition variable, in contrast to discrete switching models (e.g. Hansen, 1999). The STR model provides more information to show the dynamics of variables during the transition period, when a transition switch to a new regime occurs over a short period, and it allows for incorporating regime switching behaviour. In addition, the STR model is a good candidate to apply numerous economic variables, capturing non-linearity and regime switching. Therefore, the STR model is a useful tool to study transition economies which have many structural breaks in the whole process of transition, and then we could model institutional structural breaks. But then, in established market economies, asymmetry exists in the dynamics of economic variables, which has been approved by several authors.

### Data description

In this paper, we use five indicators to measure financial development, which are not the same as for cross-country financial development. But indicators are most significant when exploring the different channels of funds to support economic growth in China. These are: LOAN, DEPOSIT, COMP, BUDGET and TMV.

The total of loans from the banking sector is a key source to investment that we used to measure the size of the banking sector (LOAN), which was calculated by the ratio of total loans to GDP. Additionally, we also used the level of savings (DEPOSIT) to measure the size of banking sector,

[1] Please see more details at van Dijk et al. (2002) a survey of recent development of smooth transition regression models.

which is the ratio of deposits to GDP. To find out the influence of competition in the banking sector, we generated the third indicator which calculates the loans issued by financial institutions other than the big four state banks, compared to those made by the big four. This shows competition in the banking sector (COMP). In addition, we applied the fourth indicator (BUDGET) to measure external financing of each provincial government as the substitution of loans, which is computed as the ratio of total loans to the state budgetary appropriation for fixed asset investment. Finally, we use the total marketing values (TMV) to measure the development of stock markets. Economic development is measured by per capita real GDP, in which GDP is expressed by the Chinese Yuan. The logarithm of the real GDP, denoted by LRGDP, indicates economic development.

We used a time series data set based on quarterly data from 1993-2008 in this paper. The GDP was calculated from the *Economy of China*[2], then using the Hodrick-Prescott Filter to apply seasonal adjustments. Population figures were collected from the *CHINA COMPENDIUM OF STATISTICS 1949-2008*. Total loans, total deposits and total loans of state-owned banks were from the *People's Bank of China*. The total market capitalisation in two stock markets was collected from the *China Securities Financial Database 1978-2008*[3]. Inflation rates were obtained from IFS (International Financial Statistics).

Table 1 shows descriptive statistics of quarterly data from 1993 to 2008 in China. Table 2 reports the correlations between real output and indicators of financial development. A positive relationship is confirmed by measuring the development of the banking sector and financial market with the proxies of LOAN, DEPOSIT, COMP, BUDGET, and TMV. Meanwhile, we also discover a strong negative relationship between inflation and real per capita GDP. Figure 1 exhibits the time series of each indicator at the STR model from 1993-2008.

**Smooth Transition Regression Model (STR)**

Teräsvirta and Anderson (1992), Granger and Teräsvirta (1993), and Teräsvirta (1994) developed a regime switching model in the macroeconomics area, which was named the Smooth Transition Regressive model. This is defined as follows:

$$y_t = x_t'\varphi + (x_t'\theta).G(s_t;\gamma,c) + u_t,\ t = 1,2,...,T. \qquad (1)$$

where $x_t$ is the vector of the endogenous variable and the exogenous variables with lags, [illegible], and $\varphi = (\varphi_0, \varphi_1, ..., \varphi_p)'$ and $\theta = (\theta_0, \theta_1, ..., \theta_p)'$ are the parameter vectors, whereas $u_t$ denotes a sequence of independent identically distributed errors. *G* presents a continuous transition function, which is limiting between 0 and 1. According to the feature of the transition function, the STR model will explain two extreme states when the transition function becomes 0 or 1, also the STR model shows a continuum of states when the transition function lies between those two extremes. $\gamma$ is the slope parameter. The parameter of threshold $c$ indicates the speed of transition between 0 and 1, and it points to where the transition comes about when $\gamma > 0$ . $s_t$ is the transition variable, which often chooses one of the explanatory variables or the time trend. Following Terasvirta (2004) we adopt a logistic transition function G as following:

$$G_1(s_t;\gamma,c) = \left[1 + \exp\left(-\gamma(s_t - c)\right)\right]^{-1}, \gamma > 0, \qquad (2)$$

$G_1$ is bounded between 0 and 1, which is a monotonously increasing function of the transition variable $s_t$ . The parameter of threshold $c$ presents the two extreme regimes with $\lim_{s_t \to -\infty} G_1 = 0$ and $\lim_{s_t \to \infty} G_1 = 1$ at the point of transition. An identifying restriction is $\gamma > 0$ .

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2 http://www.econchina.org.cn
3 Source from China security regulation commission

The equation (2) simplifies to a linear regressive model, if $\gamma \to \infty$ in the definition of $G_1$, then the equation (1) will become two extreme linear models $y_t = x_t' + u_t$ and $y_t = x_t'(\varphi + \theta) + u_t$. The transition function becomes constant and equal to 0.5, when $\gamma = 0$.

In this study, I followed the procedure which was provided by Kratzig (2005) to estimate the STR model. There are three stages: specification, estimation and evaluation.

1. Applying a linear VAR model for a starting point of the specification, and testing the non-linearity in the selected model, and then choosing a variable as the transition variable to decide which transition function should be used.
2. Finding the appropriate starting values of *c* and $\gamma$ before estimating coefficients.
3. After getting estimated results from step two, it must apply the specific evaluation to the STR model. There are also graphical and misspecification checks. The misspecification checks include the test of error autocorrelation, parameter non-constancy, remaining non-linearity, ARCH and non-normality.

**Model specification**

We generate a STR model that was used in this paper as following. Five models will be used in STR approach, each including one indicator of financial development and inflation rates.

$$\begin{aligned} &LRGDP_t = \alpha_0 + \beta_1 LRGDP_{t-1} + \beta_2 FD_t + \beta_3 FD_{t-1} + \beta_4 \inf lation_t + \beta_5 \inf lation_{t-1}, \\ &+(\alpha_1 + \lambda_1 LRGDP_{t-1} + \lambda_2 FD_t + \lambda_3 FD_{t-1} + \lambda_4 \inf lation_t + \lambda_5 \inf lation_{t-1}), \\ &\times[1+\exp(-\gamma(\inf lation_t - c))]^{-1} + u_t,\ t = 1, 2, ..., T, \end{aligned} \quad (3)$$

where *FD* is the explanatory variables of financial development (*LOAN, DEPOSIT, COMP, BUDGET,* and *TMV* ). *INFLATION* is the inflation rate as a transition variable. "$\gamma$" is the slope parameter in the transition function, and "*c*" is the threshold parameter points where the transition takes place. *LRGDP* is the logarithm real per capita GDP.

The second main step of the specification is to test non-linearity and to decide a specific transition variable, and select a particular model (LSTR1 or LSTR2). Teräsvirta (2004) suggests the use of an LM test statistic, which was from the auxiliary regression equation as follows:

$$\Delta y_t = \beta' \Delta z_t + \sum_{j=1}^{3} \beta_j' \tilde{z}_t s_t^j + u_t^* \quad (4)$$

where $z_t = (1, \tilde{z}_t')$, $\tilde{z}_t'$ is the corresponding( $m \times 1$ )vector of variables $u_t^*$ and is a function of $u_t$. The null hypothesis of linearity is $H_{01}: \beta_1 = \beta_2 = \beta_3 = 0$. If the hypothesis $H_{01}$ is rejected, the transition function is selected based on the following:

$$H_{04} : \beta_3 = 0$$
$$H_{03} : \beta_1 = 0 | \beta_3 = 0$$
$$H_{02} : \beta_1 = 0 | \beta_2 = \beta_3 = 0$$

where three hypothesis are tested with a sequence of $F$ –tests named $F_4$ , $F_3$ and $F_2$, respectively. Teräsvirta(1998) made a suggestion about how to choose the transition function to express the parameter vector $\beta_1$, $\beta_2$ and $\beta_3$ from Equation (4). The LSTR2 or the ESTR model will be chosen, if the hypothesis $H_{03}$ is rejected most strongly.

The test results of non-linearity is displayed in Table 3. The first test of the general hypothesis of linearity, $H_{01}$, which was strongly rejected at the 5% level, with inflation as the transition variable. This indicates non-linearity in all the models. The subsequent hypothesis was used to determine the suitable forms of the transition function. The *p*-value of $H_{02}$ was very low for all five models, which indicates that it is the strongest rejection in the non-linearity test. The transition function of LSTR1 was selected[4].

## EMPIRICAL RESULTS

The STR model was estimated by the conditional maximum likelihood, using a form of the Newton-Raphson algorithm (Teräsvirta 2004). First, it used a grid to search across $\gamma$ and $c$ to get initial values for the estimation algorithm that minimises the sum of squared residuals. The starting values of $c$ and $\gamma$ are shown in Table 4.

Table 5 shows the estimation results of the linear and non-linear parts from the STR model. The coefficient of $\gamma$ and $c$ were statistically significant at the 5% level. This indicates that we could use the non-linear part to interpret the relationship between financial development, economic growth and inflation, after model evaluation. The coefficients of the threshold were 0.10, 0.11 and 0.12 depending on the different indicators of financial development. This represents that the transition will occur when quarterly inflation rates reach 12%, 11% and 10%. In addition, the speed of transition will be determined by $\gamma$. As Table 5 shows, the coefficient of $\gamma$ was around 3.12 to 5.01, which is smaller than 10, and the speed of transition was very slow. Figure 2 depicts the speed of the transition function at different levels of inflation.

The coefficients of inflation were positive and statistically significant in the linear part, and negative and statistically significant in the non-linear parts. The coefficients of first lags of real per capita GDP were positive, with a statistical significance of 1% in the linear part ,and negative with a statistical significance of 1% in the non-linear part. In the linear part, the indicators of financial development of total deposits, state budget to fixed investment, and total market capitalisation were statistically significant in model II, model IV and model V. Nevertheless, in the non-linear part, only two indicators of financial development were statistically significant (LOAN and TMV). Hence, model V might be the best to examine the relationship between financial development, economic growth and inflation, because the coefficients were significant in both the linear and non-linear parts.

Before the estimation from the STR model is accepted to policy application, it is necessary to apply couple of procedural evaluation. To check the non-linearity still remaining in the model, we followed Equation (5) to assume an alternative function to test another particular type of non-linearity which remains in the STR model.

$$y_t = \phi' z_t + \theta' z_t G(\gamma_1, c_1; s_{1t}) + \varphi' z_t H(\gamma_2, c_2; s_{2t}) + u_t \qquad (5)$$

where $H$ is another transition function and $u_t \sim iid(0, \sigma^2)$. To test this alternative the auxiliary model

$$y_t = \beta' z_t + \theta' z_t G(\gamma_1, c_1; s_{1t}) + \sum_{j=1}^{3} \beta_j' \tilde{z}_t s_{2t}^j + u_t^* \qquad (6)$$

is used. We often use the null hypothesis $H_0: \beta_1 = \beta_2 = \beta_3 = 0$ to test no remaining non-linearity. The $F$ statistics were the same as the test on linearity. The resulting $F$ statistics were the same as the linearity test, which are shown in Table 6. The $H_{01}$ were not rejected at the 5 % level for all models. However, as Teräsvirta (2004, p. 234) notes:

But then, because a rejection as such does not say anything definite about the cause, the idea of extending the model further has to be weighed up against other considerations such as the risk of over fitting. Some protection against over fitting may be obtained by applying low significance levels. This is important because the number of tests typically carried out at this evaluation stage can be large.

In this study, the further non-linearity was not shown with model IV and model V, if we used a low significance level at 1% instead of 5%.

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[4] Following Teräsvirta(1998)

We used a null hypothesis to test the parameter constancy STR model against the smooth continuous changes in the parameter, to test hypothesis $H_{01}: \beta_1 = \beta_2 = ... = \beta_6 = 0$ in the auxiliary model as follows:

$$y_t = \beta_0' z_t + \sum_{j=1}^{3} \beta_j' z_t (t^*)^j + \sum_{j=1}^{3} \beta_{j+3}' z_t (t^*)^j G(\gamma, c; s_t) + u^*_t \quad (7)$$

The *F*-test results are given for three alternative transition functions

$$H(\gamma, c; t^*) = \left(1 + \exp\left\{-\gamma \prod_{k=1}^{K} (t^* - c_k)\right\}\right)^{-1} - \frac{1}{2}, \gamma > 0 \quad (8)$$

with $K = 1, 2, 3$ respectively and assuming the $\gamma_\theta = \gamma_\phi$. The results of the parameter constancy test, as shown in Table 7, were rejected at the 1% level for all models.

To test the no error autocorrelation in each model, we used a general test described in Godfrey (1988), which has been discussed in the application of STR models of Teräsvirta (1998). The test statistic is then:

$$F_{LM} = [(SSR_0 - SSR_1)/q]/[SSR_1/(T - n - q)] \quad (9)$$

where $SSR_0$ is the sum of squared residuals of the STR model, $SSR_1$ is the sum of squared residuals from the auxiliary regression. The results of no error autocorrelation are shown in Table 8. The no error autocorrelation was rejected at the first lag of model I, model III and model IV, which indicates that error autocorrelation was in these models. Nevertheless, the hypothesis was not rejected in model II and model V, which indicates that there is no error autocorrelation in these two models.

In addition, to obtain a satisfactory model, the diagnostic tests of normally distributed errors and no ARCH effects are necessary. With regards to the results in Table 9, the *p*-values of the Jarque-Bera test showed that the null hypothesis of the normally distributed errors, cannot be rejected. Table 9 shows that there was no ARCH effects present in all the models, because the null hypothesis of no ARCH effects is not rejected at the 5% significance level for all the models.

After all the diagnostic tests were carried out, model V was found to be a satisfactory model to interpret the relationship between financial development, economic growth and inflation rates in China, with total market capitalisation used as the indicator of financial development.

Figure 3 shows the impact of the non-linear part of model V from 1993 Q1 to 2008 Q4. When inflation rates increased, the transition function (*G*) was close to one and the non-linear part became more sensitive. The first peak appeared in the fourth quarter of 1994, when inflation was above 20%. The second peak was in the first quarter of 2008, when inflation was roughly 8%. The third peak was in the third quarter of 2004, when inflation rose above 5%.

To be more specific, we summarise the impact of total market capitalisation (TMV) and inflation on real per capita GDP, under different levels of inflation in Table 10. The results show that total market capitalisation (TMV) had a negative impact on economic growth, when inflation rates were below 2%; a positive impact appears when inflation rates were above 20%. When inflation was above 2% and less than 20%, the model was in a transition period, going from a negative impact to a positive impact dependent on the transition function (G). We calculated the impact of total market capitalisation becoming zero, when the transition function (G) is 0.18[5]. If the transition function (G) was more than 0.18, the impact of the non-linear part became more, which made a positive contribution of total market capitalisation. To apply this condition to Figure 2.5, we got that inflation was about 7%, when the transition function (G) was 0.18. Therefore, a positive impact of total market capitalisation occurred in China during 1993Q1 to 2008Q4, when the inflation rate was above 7%.

Meanwhile, a threshold of inflation rate for the inflation-growth nexus has been examined by the STR model, and is shown in Table 10. This indicates that there was a positive influence of inflation on the real economic output nexus, when inflation was at 2% or below, which adds up as two different lags of inflation. When the rate of inflation was at 20% or above, the impact of inflation on real per capita GDP was negative. A transition from a positive to a negative occurred when inflation was more

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[5] The zero impact of total market capitalisation when $G^*(0.11TMV_t)+(-0.02TMV_t)=0$, G=0.1818

than 2% and below 20%. We calculated the impact of inflation to real per capital GDP becoming zero, when the transition function (G) was 0.588[6]. To apply this condition to Figure 2.5, we got that inflation was about 11% when the transition function (G) was 0.588. This indicates that inflation had a negative impact on real per capita GDP, when the rate of inflation was above 11% in China, during 1993Q1 to 2008Q4.

## CONCLUSION

Recently, growth literature has found that growth and inflation are negatively related and non-linear in a long-run relationship. The non-linearity arises from the existence of threshold effects. Rousseau and Wachtel (2002) found that a significant and positive influence of financial development on economic growth when the threshold of inflation is at 6% to 8%. The effect of financial development on economic growth becomes adverse if the inflation rate is above the threshold level. Huang et al. (2010) showed the threshold level of inflation to the finance-growth nexus is at between 7.31% and 7.69%, which is determined by sets of conditioning information.

In this paper, we have used the Smooth Transition Regression model (STR) to look into the relationship among inflation, financial development and real per capita GDP in China from 1993-2008, based on a quarterly data set. Firstly, the empirical results indicated that the thresholds of quarterly inflation rates are 10%, 11% and 12%. Secondly, after a processed diagnostic test about misspecification in the Smooth Transition Regression model, the model that used total capitalisation of the stock market to measure the development of the financial market was found to be an optimal model to meet the theoretical basis of the STR model.

The STR model found that the total market capitalisation (TMV) had a negative impact on economic growth when inflation was below 2%, a positive impact when inflation was above 20%. When inflation was above 2% and less than 20%, the model was in a transition period. A positive impact of total market capitalisation occurred in China during 1993Q1 to 2008Q4, when inflation was above 7%. Meanwhile, we found the inflation-real economic output nexus from the STR model. It showed a positive influence of the inflation-real economic output nexus when inflation was at or below 2%. When inflation was at or above 20%, the impact of inflation on real per capita GDP was negative. A transition from a positive to a negative occurred when the rate of inflation was more than 2% and below 20%. Inflation had a negative impact on real per capita GDP, when inflation was above 11% in China during 1993Q1 to 2008Q4.

The threshold level at 11% inflation from the STR model is consistent with Khan and Senhadji (2001), who used a threshold model to test the threshold effect. They suggested slow economic growth when the threshold level of inflation is at 1-3% for developed countries, and 7-11% for developing countries, and a negative impact of inflation on growth, when inflation is above the threshold level.

The results from the STR model are closely related to Rousseau and Wachtel (2002), who showed the thresholds effect of the finance-growth nexus. They found a threshold level of 6% to 8% to inflation, based on the panel regression technique. They indicated an insignificant effect of finance on economic growth, when inflation rates exceed the threshold. However, the results in this paper differ from theirs. Firstly, I applied the STR technique to identify the existence of a non-linear relationship between the finance-growth nexus. Secondly, the STR model provided additional information about the dynamics of a variable, to represent the value during the transition period.

The results also related to Bose and Murshid (2008). They argued that the relationship between economic growth and inflation varies at different stages of financial development. They indicated that the negative effect of inflation on growth, was mitigated by development of the financial sector.

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[6] The zero impact of total market capitalisation when G × (-0.80INFLATION$_t$ +0.46INFLATION$_{t-1}$ ) -0.60INFLATION$_t$ +0.80INFLATION$_{t-1}$=0, G=0.588.

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Table 1: Descriptive statistics (1993 Q1-2008 Q4)

| **Variable** | **Obs** | **Mean** | **Std. Dev.** | **Min** | **Max** |
|---|---|---|---|---|---|
| LRGDP | 64 | 8.38 | 0.63 | 7.18 | 9.57 |
| LOAN | 64 | 1.75 | 0.27 | 1.22 | 2.19 |
| DEPOSIT | 64 | 1.47 | 0.29 | 0.99 | 1.89 |
| COMP | 64 | 0.31 | 0.11 | 0.09 | 0.51 |
| BUDGET | 64 | 0.01 | 0.002 | 0.00 | 0.01 |
| TMV | 64 | 0.54 | 0.37 | 0.10 | 2.00 |
| INFLATION | 64 | 0.05 | 0.07 | -0.02 | 0.27 |

Note: LOAN is the ratio of total loans of banking sector to GDP as an indicator of the size of the local banking sector. DEPOSIT is the ratio of total deposits of banking sector to GDP as an indicator of the size of the local banking sector. COMP is bank competition, measured by the share of credit issued by financial institution other than the four major state banks. BUDGET is computed as the ratio of total loans to the state budgetary appropriation for fixed assets investment. TMV is total market capitalization of two stock markets divided by GDP. LRGDP is the logarithm of the real per capita GDP. INFLATION is the inflation rates.

Table 2 : Correlations between fiancial development and real output(1993 Q1-2008 Q4)

| | LRGDP | LOAN | DEPOSIT | BUDGET | TMV | INFLATION |
|---|---|---|---|---|---|---|
| **LRGDP** | 1.00 | | | | | |
| **LOAN** | 0.46 | 1.00 | | | | |
| **DEPOSIT** | 0.34 | 0.95 | 1.00 | | | |
| **BUDGET** | 0.46 | 0.49 | 0.36 | 1.00 | | |
| **TMV** | 0.64 | 0.38 | 0.62 | 0.34 | 1.00 | |
| **INFLATION** | -0.57 | -0.84 | -0.44 | -0.48 | -0.43 | 1.00 |

Note: LOAN is the ratio of total loans of banking sector to GDP as an indicator of the size of the local banking sector. DEPOSIT is the ratio of total deposits of banking sector to GDP as an indicator of the size of the local banking sector. COMP is bank competition, measured by the share of credit issued by financial institution other than the four major state banks. BUDGET is computed as the ratio of total loans to the state budgetary appropriation for fixed assets investment. TMV is total market capitalization of two stock markets divided by GDP. LRGDP is the logarithm of the real per capita GDP. INFLATION is the inflation rates.

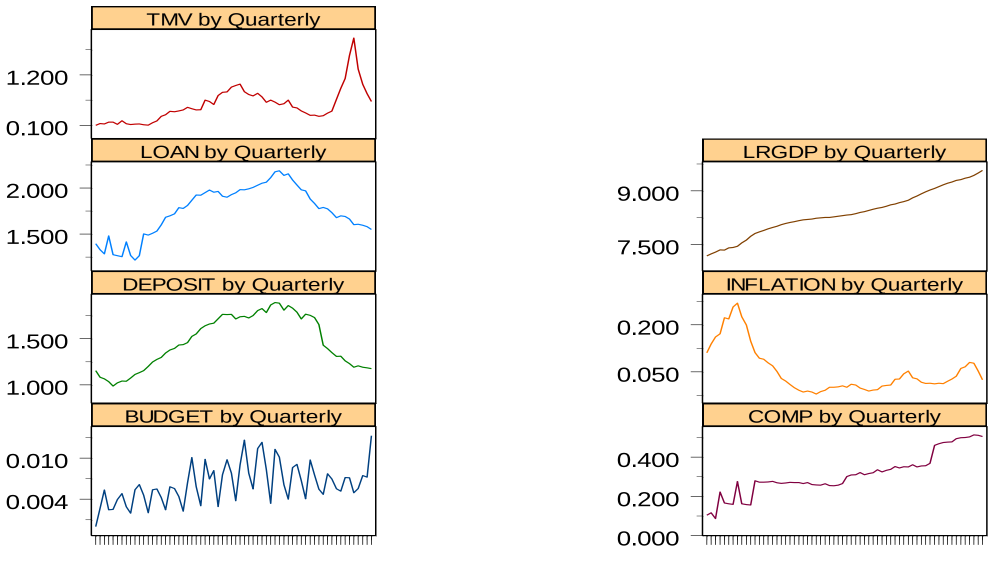


Figure 1: Time series of each indicator in STR model (1993-2008)

Table 3 : Testing linearity against STR

| **Model** | **Explanatory variables** | **Transition variables** | ***p*-values of F-tests** | | | |
|---|---|---|---|---|---|---|
| | | | $H_{01}$ | $H_{04}$ | $H_{03}$ | $H_{02}$ |
| I | $LOAN_t$ | $INFLATION_t$ | 0.000 | 0.002 | 0.006 | 0.000 |
| II | $DEPOSIT_t$ | $INFLATION_t$ | 0.000 | 0.005 | 0.000 | 0.000 |
| III | $COMP_t$ | $INFLATION_t$ | 0.000 | 0.007 | 0.003 | 0.000 |
| IV | $BUDGET_t$ | $INFLATION_t$ | 0.000 | 0.364 | 0.007 | 0.000 |
| V | $TMV_t$ | $INFLATION_t$ | 0.000 | 0.002 | 0.600 | 0.000 |

Note: LOAN is the ratio of total loans of banking sector to GDP as an indicator of the size of the local banking sector. DEPOSIT is the ratio of total deposits of banking sector to GDP as an indicator of the size of the local banking sector. COMP is bank competition, measured by the share of credit issued by financial institution other than the four major state banks. BUDGET is computed as the ratio of total loans to the state budgetary appropriation for fixed assets investment. TMV is total capitalization in two stock markets divided by GDP. LRGDP is the logarithm of the regional GDP. INFLAION is the inflation rates. The asterisk of '***', '**', and '*'indicates significance at the 1%, 5%, and 10% levels, respectively.

Table 3: Testing linearity against STR

| **Model** | **Explanatory variables** | **Transition variables** | ***p*-values of F-tests** | | | |
|---|---|---|---|---|---|---|
| | | | $H_{01}$ | $H_{04}$ | $H_{03}$ | $H_{02}$ |
| I | $LOAN_t$ | $INFLATION_t$ | 0.000 | 0.002 | 0.006 | 0.000 |
| II | $DEPOSIT_t$ | $INFLATION_t$ | 0.000 | 0.005 | 0.000 | 0.000 |
| III | $COMP_t$ | $INFLATION_t$ | 0.000 | 0.007 | 0.003 | 0.000 |
| IV | $BUDGET_t$ | $INFLATION_t$ | 0.000 | 0.364 | 0.007 | 0.000 |
| V | $TMV_t$ | $INFLATION_t$ | 0.000 | 0.002 | 0.600 | 0.000 |

Note: LOAN is the ratio of total loans of banking sector to GDP as an indicator of the size of the local banking sector. DEPOSIT is the ratio of total deposits of banking sector to GDP as an indicator of the size of the local banking sector. COMP is bank competition, measured by the share of credit issued by financial institution other than the four major state banks. BUDGET is computed as the ratio of total loans to the state budgetary appropriation for fixed assets investment. TMV is total capitalization in two stock markets divided by GDP. LRGDP is the logarithm of the regional GDP. INFLAION is the inflation rates. The asterisk of '***', '**', and '*'indicates significance at the 1%, 5%, and 10% levels, respectively.

Table 4 : The starting values of c and γ

| **Model** | **Explanatory variables** | **Transition variable** | **Transtion function** | **γ** | **c** | **SSR** |
|---|---|---|---|---|---|---|
| I | $LOAN_t$ | $INFLATION_t$ | LSTR1 | 3.55 | 0.10 | 0.00 |
| II | $DEPOSIT_t$ | $INFLATION_t$ | LSTR1 | 10.00 | 0.25 | -0.14 |
| III | $COMP_t$ | $INFLATION_t$ | LSTR1 | 2.89 | 0.11 | 0.001 |
| IV | $BUDGET_t$ | $INFLATION_t$ | LSTR1 | 3.55 | 0.10 | 0.001 |
| V | $TMV_t$ | $INFLATION_t$ | LSTR1 | 4.37 | 0.09 | 0.001 |

Note: LOAN is the ratio of total loans of banking sector to GDP as an indicator of the size of the local banking sector. DEPOSIT is the ratio of total deposits of banking sector to GDP as an indicator of the size of the local banking sector. COMP is bank competition, measured by the share of credit issued by financial institution other than the four major state banks. BUDGET is computed as the ratio of total loans to the state budgetary appropriation for fixed assets investment. TMV is total capitalization in two stock markets divided by GDP. LRGDP is the logarithm of the regional GDP. INFLAION is the inflation rates.

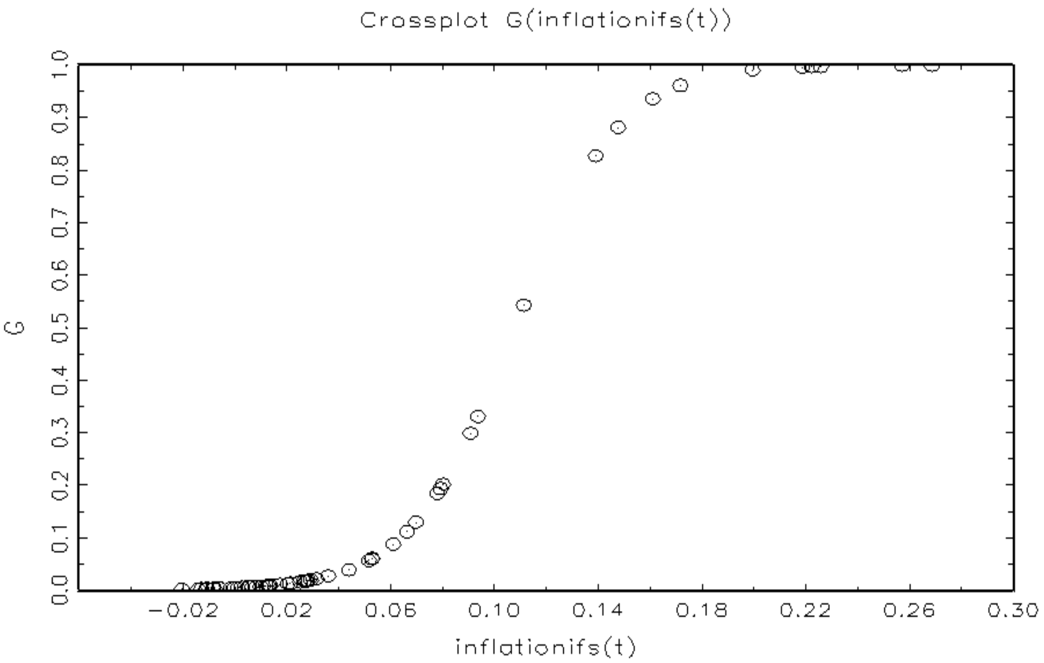

Figure 2.1: The speed of transition for Model I

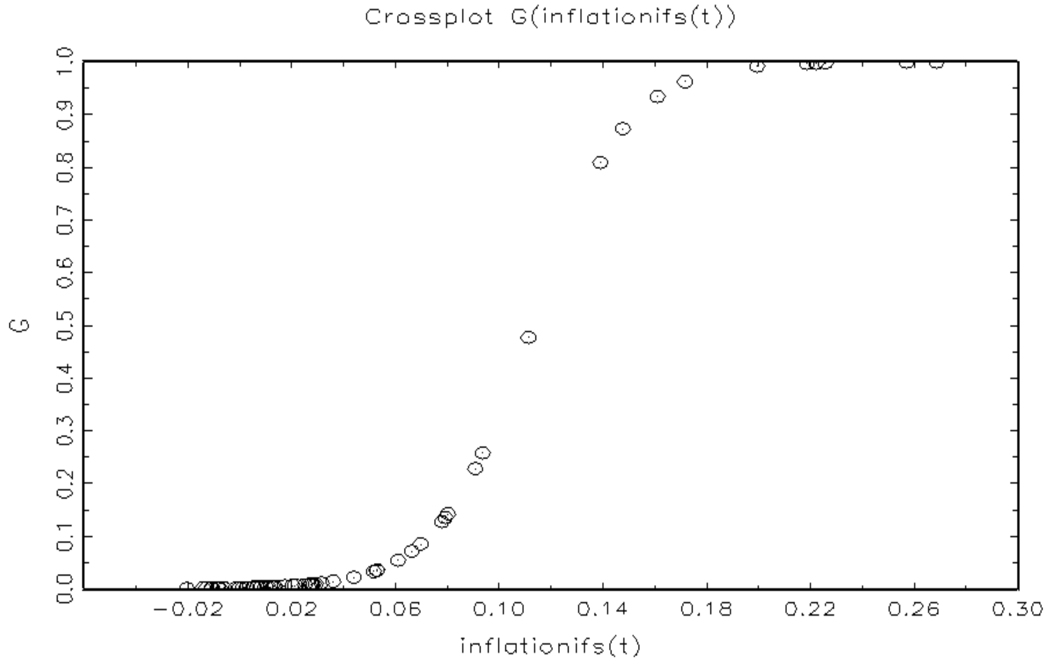


Figure 2.2: The speed of transition for Model II

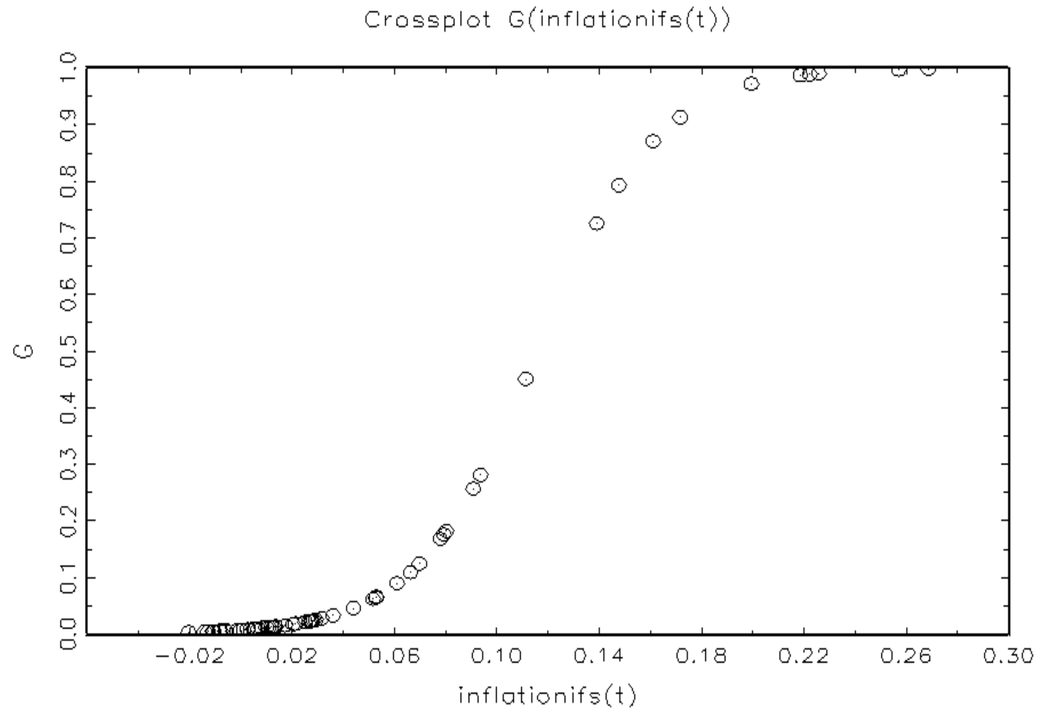


Figure 2.3: The speed of transition for Model III

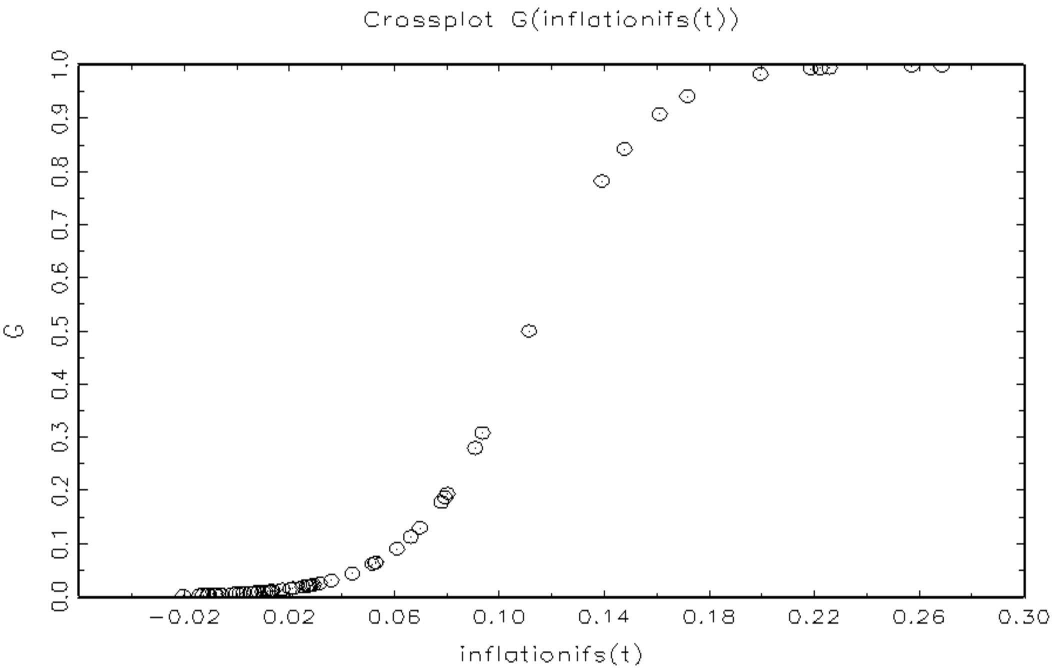


Figure 2.4: The speed of transition for Model IV

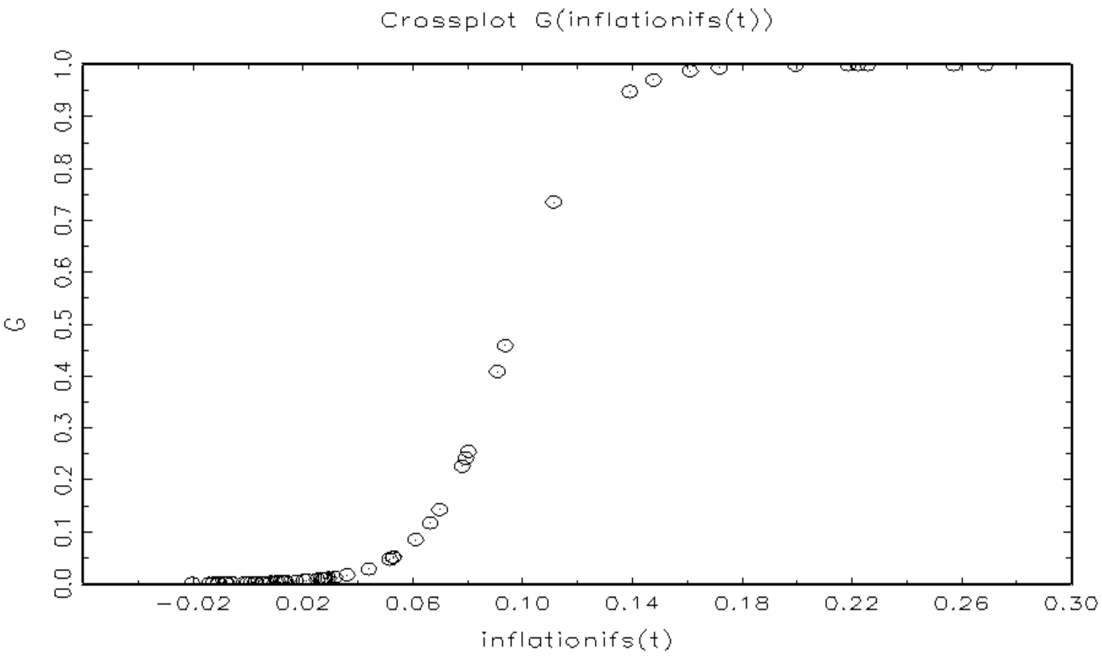


Figure 2.5: The speed of transition for Model V

Table 5: Estimated results from STR Model

| **Variable** | **Model I** | **Model II** | **Model III** | **Model IV** | **Model V** |
|---|---|---|---|---|---|
| linear part | | | | | |
| CONSTANT | -0.25*** (7.54) | -0.23*** (-8.96) | -0.27 *** (-4.52) | -0.21*** (-7.14) | -0.21 *** (-8.56) |
| $LRGDP_{t-1}$ | 1.03*** (302.33) | 1.03*** (349) | 1.04 *** (121.99) | 1.02*** (288) | 1.03 *** (356.3) |
| $INFLATION_t$ | -0.75*** (6.83) | -0.81*** (-8.91) | -0.60 *** (-4.88) | -0.61*** (-5.27) | -0.60 *** (-5.81) |
| $INFLATION_{t-1}$ | 1.03*** (11.41) | 1.06*** (13.07) | 0.90*** (10.38) | 0.90*** (10.27) | 0.80*** (9.41) |
| $LOAN_t$ | -0.01 (0.33) | | | | |
| $LOAN_{t-1}$ | 0.03 (1.17) | | | | |
| $DEPOSIT_t$ | | -0.02 (-1.02) | | | |
| $DEPOSIT_{t-1}$ | | 0.03* (1.85) | | | |
| $COMP_t$ | | | 0.03 (0.44) | | |
| $COMP_{t-1}$ | | | -0.08 (-1.40) | | |
| $BUDGET_t$ | | | | 0.74** (2.18) | |
| $BUDGET_{t-1}$ | | | | 0.20 (0.57) | |
| $TMV_t$ | | | | | -0.02** (2.52) |
| $TMV_{t-1}$ | | | | | 0.01 (0.77) |
| nonlinear part | | | | | |
| CONSTANT | 0.99*** (6.06) | 0.93*** (5.90) | 1.02*** (4.48) | 1.04*** (5.22) | 1.01*** (8.74 ) |
| $LRGDP_{t-1}$ | -0.11*** (5.60) | -0.13*** (-5.04) | -0.12*** (-4.03) | -0.13*** (-4.69) | -0.13 *** (-8.12) |
| $INFLATION_t$ | -0.56*** (3.75) | -0.39** (-2.52) | -0.72*** (-4.37) | -0.74*** (-4.62) | -0.80*** (-5.80 ) |
| $INFLATION_{t-1}$ | 0.07 (0.54) | 0.01 (0.05) | 0.29** (2.17) | 0.27** (2.20) | 0.46 *** (3.79) |
| $LOAN_t$ | 0.02 (0.50) | | | | |
| $LOAN_{t-1}$ | -0.06* (1.74) | | | | |
| $DEPOSIT_t$ | | 0.18 (1.50) | | | |
| $DEPOSIT_{t-1}$ | | -0.04 (-0.33) | | | |
| $COMP_t$ | | | -0.05 (-0.58) | | |
| $COMP_{t-1}$ | | | -0.01 (-0.12) | | |
| $BUDGET_t$ | | | | 0.75 (0.45) | |
| $BUDGET_{t-1}$ | | | | -0.46 (-0.31) | |
| $TMV_t$ | | | | | 0.11 ** (2.13) |

| | | | | | |
|---|---|---|---|---|---|
| $TMV_{t-1}$ | | | | | -0.01 |
| | | | | | (-0.28) |
| Gamma | 3.71*** | 4.08*** | 3.12*** | 3.40*** | 5.01 ** |
| | (3.43) | (3.54) | (2.95) | (3.33) | (2.15) |
| C | 0.10*** | 0.11*** | 0.12*** | 0.11*** | 0.10 *** |
| | (12.65) | (10.82) | (8.26 ) | (10.26) | (9.88) |
| R^2 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
| Adjusted R^2 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
| AIC | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 |

Note: LOAN is the ratio of total loans of banking sector to GDP as an indicator of the size of the local banking sector. DEPOSIT is the ratio of total deposits of banking sector to GDP as an indicator of the size of the local banking sector. COMP is bank competition, measured by the share of credit issued by financial institution other than the four major state banks. BUDGET is computed as the ratio of total loans to the state budgetary appropriation for fixed assets investment. TMV is total capitalization in two stock markets divided by GDP. LRGDP is the logarithm of the regional GDP. INFLAION is the inflation rates. The asterisk of '***', '**' and '*'indicates significance at the 1%, 5%, and 10% levels, respectively.

Table 6: Tests results of additional smooth transition type non-linearity

| **Transition variable** | | **p-values of F-tests** | | | |
|---|---|---|---|---|---|
| | | $H_{01}$ | $H_{04}$ | $H_{03}$ | $H_{02}$ |
| Model I | $INFLATION_t$ | 0.002 | 0.20 | 0.02 | 0.005 |
| Model II | $INFLATION_t$ | 0.004 | 0.04 | 0.20 | 0.007 |
| Model III | $INFLATION_t$ | 0.003 | 0.18 | 0.22 | 0.000 |
| Model IV | $INFLATION_t$ | 0.04 | 0.10 | 0.30 | 0.030 |
| Model V | $INFLATION_t$ | 0.02 | 0.02 | 0.07 | 0.660 |

Table 7 : Parameter constancy test results

| | ***F*-values** | **$df_1$** | **$df_2$** | ***p*-values** |
|---|---|---|---|---|
| Model I | | | | |
| $H_1$ | 11.15 | 10 | 37 | 0.000 |
| $H_2$ | 5.92 | 20 | 27 | 0.000 |
| $H_3$ | 9.02 | 30 | 17 | 0.000 |
| Model II | | | | |
| $H_1$ | 4.23 | 12 | 35 | 0.000 |
| $H_2$ | 7.50 | 24 | 23 | 0.000 |
| $H_3$ | 8.10 | 36 | 11 | 0.000 |
| Model III | | | | |
| $H_1$ | 4.07 | 12 | 35 | 0.000 |
| $H_2$ | 7.69 | 24 | 23 | 0.000 |
| $H_3$ | 5.40 | 36 | 11 | 0.002 |
| Model IV | | | | |
| $H_1$ | 7.73 | 12 | 35 | 0.000 |
| $H_2$ | 13.47 | 24 | 23 | 0.000 |
| $H_3$ | 11.69 | 36 | 11 | 0.000 |
| Model V | | | | |
| $H_1$ | 3.55 | 12 | 35 | 0.001 |
| $H_2$ | 5.50 | 24 | 23 | 0.000 |
| $H_3$ | 5.49 | 36 | 11 | 0.002 |

Table 8 : The results of no error Autocorrelation tests

| | lag | F-value | $df_1$ | $df_2$ | $p$-values |
|---|---|---|---|---|---|
| Model I | | | | | |
| | 1 | 7.19 | 1 | 47 | 0.010 |
| | 2 | 2.64 | 2 | 45 | 0.082 |
| | 3 | 1.89 | 3 | 43 | 0.144 |
| Model II | | | | | |
| | 1 | 4.68 | 1 | 47 | 0.035 |
| | 2 | 2.99 | 2 | 45 | 0.060 |
| | 3 | 1.65 | 3 | 43 | 0.190 |
| Model III | | | | | |
| | 1 | 11.06 | 1 | 47 | 0.001 |
| | 2 | 4.60 | 2 | 45 | 0.015 |
| | 3 | 3.09 | 3 | 43 | 0.036 |
| Model IV | | | 1 | 47 | |
| | 1 | 19.97 | 2 | 45 | 0.000 |
| | 2 | 14.76 | 3 | 43 | 0.000 |
| | 3 | 9.52 | 4 | 41 | 0.000 |
| Model V | | | | | |
| | 1 | 0.40 | 1 | 47 | 0.529 |
| | 2 | 1.10 | 2 | 45 | 0.341 |
| | 3 | 0.63 | 3 | 43 | 0.593 |

Table 9 : The results of normally distributed errors and no ARCH effects

| | | **JARQUE-BERA Test** | | **ARCH-LM Test** | |
|---|---|---|---|---|---|
| | Lags | Test Statistics | p-values | Test Statistics | $p$-values |
| Model I | 4 | 2.51 | 0.28 | 0.28 | 0.16 |
| Model II | 4 | 2.96 | 0.22 | 8.85 | 0.06 |
| Model III | 4 | 1.93 | 0.37 | 4.16 | 0.38 |
| Model IV | 4 | 2.65 | 0.26 | 5.05 | 0.28 |
| Model V | 4 | 1.55 | 0.45 | 4.55 | 0.33 |

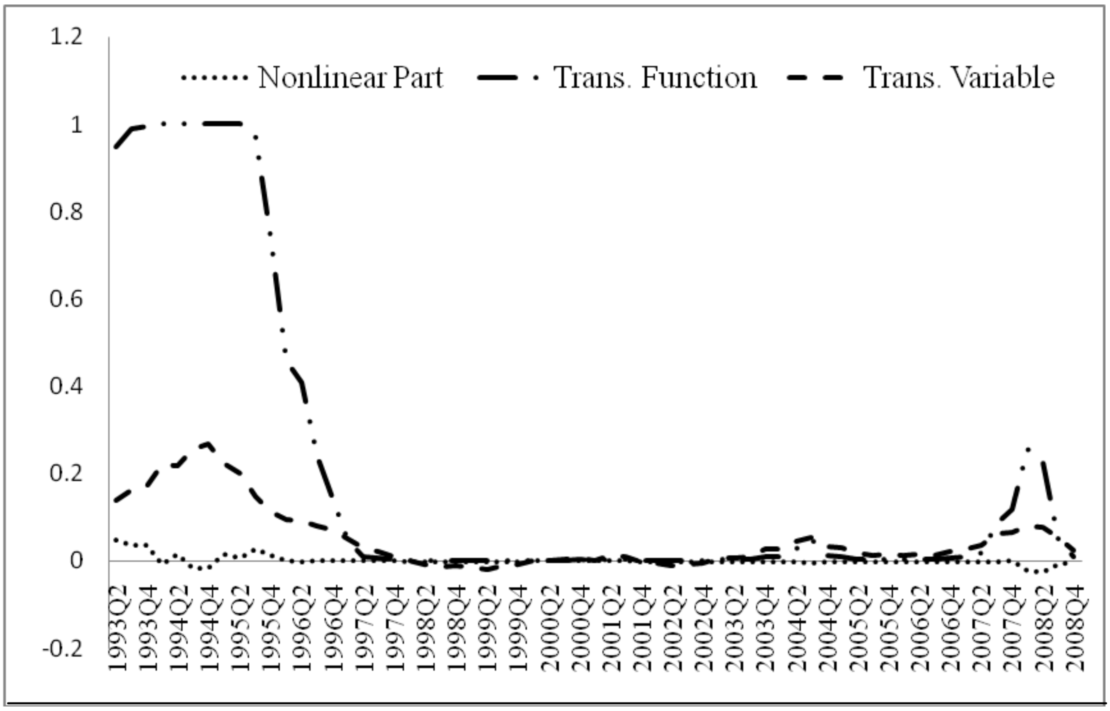


Figure 3: The impact of non-linear part of Model V

Table 10: Finance-growth nexus with inflation rate

| **Inflation rates** | **Model V** |
|---|---|
| <=2% | -0.21***CONSTANT+1.03***$LRGDP_{t-1}$-0.60***$INFLATION_t$ +0.80***$INFLATION_{t-1}$-0.02**$TMV_t$ |
| >2% and <20% | G × (1.01***CONSTANT-0.13***$LRGDP_{t-1}$-0.80***$INFLATION_t$ +0.46***$INFLATION_{t-1}$+0.11**$TMV_t$ ) -0.21***CONSTANT+1.03***$LRGDP_{t-1}$-0.60***$INFLATION_t$ +0.80***$INFLATION_{t-1}$-0.02**$TMV_t$ |
| >=20% | 1 × (1.01***CONSTANT-0.13***$LRGDP_{t-1}$-0.80***$INFLATION_t$ +0.46***$INFLATION_{t-1}$+0.11**$TMV_t$ ) -0.21***CONSTANT+1.03***$LRGDP_{t-1}$-0.60***$INFLATION_t$ +0.80***$INFLATION_{t-1}$-0.02**$TMV_t$ |

Note: TMV is total capitalization in two stock markets divided by GDP. LRGDP is the logarithm of the regional GDP. INFLAION is the inflation rates. The asterisk of "***", "**" and "*" represent the rejection of the null hypothesis at 1%, 5% and 10%.