Dynamics and Causality among Financial Development, Industrial Structure Optimization and Economic Growth

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Abstract--**This paper analyzes long-term and short-term dynamic and the causal relationship among financial development, industrial structure optimization and economic growth. Cointegration and Vector Error Correction Model Analysis are applied to China's annual data set covering the period from 1978 to 2013. Several conclusions are drawn: in the long term, there are unidirectional causality between financial development and economic growth, financial development and industrial structure optimization; there is a negative bidirectional causal relationship between industrial structure upgrading and economic growth; there is a positive bidirectional causal relationship between industrial structure rationalization and economic growth. In the short term, there was bidirectional causal relationship between financial development and economic growth, however, the direction of interaction between them is opposite; there was unidirectional causal relationship between industrial structure optimization and economic growth.**

I. INTRODUCTION

Through a lot of statistical analysis, economists have confirmed that modern economic growth is not only an overall growth process, but also a structure change process, there is an inherent link between them. Existing literatures on financial development and economic growth are mostly focused on aggregate growth, with very little work about the growth structure. Based on industry heterogeneity, demand for financial resources between industries is different. The different industrial structure has a different impact on economic growth. Since the start of its reforms in 1978, the Chinese economy has maintained an annual growth rate of 9.8% in real terms. But in the last 5 years, the slowdown in economic growth has become a significant economic problem. Industrial structure adjustment lagged behind has become the main reason for the decline in economic growth. Structural change research has been paid more and more attention.

Although many researchers investigated the influence mechanism of financial development on economic growth from different perspectives, such as financial repression[14], financial deepening[19], entrepreneurship[13], financial function[1] and so on. But empirical analysis on the relationship between financial development and economic growth has not reached consistent conclusions. Most literatures on this issue focus on the financial development and economic growth, ignoring the effect of industrial structure optimization. On the other hand, the existing literatures mainly utilize cross-sectional or panel data in the developed countries, and view the financial development as an exogenous variable, to study the effect of financial development on economic growth or economic structure. However, there are few researches about dynamic and causal relationship among financial development, industrial structure optimization and economic growth, based on time-series data from developing countries. So it holds much significance to study the dynamics and causality among financial development, industrial structure optimization and economic growth by cointegration and vector error correction model.

This study primarily aims to analyze the dynamic and causal relationship among financial development, industrial structure optimization and economic growth in the long term and the short-term in China. Cointegration and Vector Error Correction Model analysis are applied to China's annual data set covering the period from 1978 to 2013. Under the new economic normal, to research these issues is particularly important for China's financial and industrial policy formulation.

The paper is organized as follows. Section 2 briefly reviews the related works. Next section introduces the methodology and data used in the study. Section 4 analyses and expounds the long-term and short-term dynamic and the causal relationship among financial development, industrial structure optimization and economic growth. Finally, last section concludes and proposes some policy suggestions.

II. LITERATURE REVIEW

A. Financial development and economic growth

The existing literatures studying mechanism of action of financial development on economic growth, mainly in the framework of neoclassical economic theory, from the supply point of view that financial development is exogenous, emphasize financial resource allocation function, and argue that financial development may lead to economic growth[13][12].

In contrast, the existing literatures in the study of the impact mechanism of economic growth on financial development, mainly in Schumpeterian-Keynesian framework, from the demand point of view, emphasize the financial production efficiency function on economic growth[16]. Herr[8] thinks that what is necessary for economic development is new credit created first and foremost by the banking system. It starts when the banking system gives new credit to firms for investment. Herr[8] elaborates a credit-investment-income-saving mechanism including the well-known goods market multiplier process.

B. Industrial structure optimization and economic growth

Industrial structure is a way of production capacity

constituted between different industries[20]. Optimization of industrial structure is that the structure of the product supply and demand will tend to equilibrium state. It contains two aspects: industrial structure upgrading and industrial structure rationalization[20].

Nishi[15] finds that structural change in output has a positive influence on economic growth. However, Baumol[2] thinks that structural change has a negative effect on aggregate growth, according to Baumol's hypothesis. On the contrary, the mechanism of economic growth impacting on structural change is due to different income elasticity of demand between industries, which gradually shift industry shares in overall consumption during the process of economic development[17]. Dietrich[4]draws some general conclusions by using the annual data of seven OECD countries over 1960-2004 period that economic growth hinders in the short term but prompts structural change with some lag in time.

C. Financial development and industrial structure optimization

Chen[3]finds that there are positive effects from financialization to industrial structure upgrading and rationalization. However, Lin, et al[11] argue that as the economy develops, capital accumulates, and thus its endowment structure upgrades, its leading industries will tend to be more capital-intensive and more technology-intensive, this will change gradually financial structure and increase financial development.

III. METHOD AND DATA

A. Method

According to Johansen[9] and Enders[5], this paper follows Vector Error Correction Model. Under some conditions of that all variable are satisfied with I(1), and there are cointegration relations between them, Vector Error Correction Model is listed below:

$$\Delta y_t = c + \alpha ecm_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + \varepsilon_t$$

Where y_t is 4-dimensional column vector, c is constant term, $ecm_{t-1}=\beta' y_{t-1}$ is error correction term, it shows long-run causal relation among the variables, ε_t are error terms with assumption of normal distribution.

B. Data

1) Definition and measurement of variables

a. Indexes of financial development

Given the availability of data, this paper still uses traditional indicators as a proxy of financial development. (i) Financial deepening ratio (FIR), which equals to the ratio of total loans to GDP[19]. (ii) Economic monetization degree (M2GDP)[18], which equals to the ratio of broad money stock to GDP. (iii)Financial development efficiency (DEPLOR), which equals to the ratio of the loan to deposit.

However, in the existing literature about relationship between financial development and economic growth, the growth effect of financial development is sensitive to the choice of proxy. Using different indicators, there are different conclusions. So, this paper will apply principal component analysis to construct a new aggregate index of financial development(FD). Hence, we aggregate the following three different measures of financial development into a single index.

The result obtained from principal component analysis (PCA) is shown in table 1. The first component explains 91.48% of the variance in the data and its eigenvalue is larger than one. The second and the third principal component each explain only 5.6% and 2.9% of the variation. Therefore, we use only the first principal component as a measure of financial development.

TABLE 1 RESULTS OF PCA ABOUT THE INDEX OF FINANCIAL DEVELOPMENT

	Variable	PC1	PC2	PC3
Eigenvectors	FIR	0.5717	0.7401	-0.3541
	M2GDP	0.5859	-0.0662	0.8077
	DEPLOR	-0.5744	0.6692	0.4714
Eigenvalues		2.7443	0.1679	0.0879
Proportion		0.9148	0.0560	0.0293
Cumulative Proportion		0.9148	0.9707	1.0000

b. Indexes of industrial structure optimization

From a dynamic perspective, industrial structure optimization of an economy contains two components: upgrading and rationalization[6]. About the index of industrial structure upgrading, most scholars have followed the nonagricultural sectors share of GDP. However, when an economy enters the latter stage of industrialization, the service sector share of GDP increases, this index is unable to capture this tendency. So this paper uses the ratio of added value of third industry to that of secondary industry (TS) to measure the industrial structure upgrading. The industrial structure rationalization reflects the degree of coordinated development between different industries, and it mainly includes value added structure and employment structure. This paper uses the Theil index to measure the rationalization of industrial structure. The model takes the form[6]:

$$TL = \sum_{i=1}^{n} \frac{Yi}{Y} LN\left(\frac{\frac{Yi}{Li}}{\frac{Y}{L}} \right)$$

Where Y is GDP; L is employment; i is industry; n is total number of industry; Y/L is productivity. According to classical economic hypothesis, the productivity of different industries tend to be same at the economic equilibrium level, namely $Y/L = Y_i/L_i$, TL=0. This indicates that the industrial structure is most rational. When TL≠0, which implies that the industrial structure deviates from the state of economic equilibrium. The bigger the value is, the more serious the industrial structure imbalance will be. On the contrary, the smaller the value is, the more rational the industrial structure will be.

c. Index of economic growth (LNPGDP)

We use real gross domestic product per capita deflated by price indexes in 1978 to measure the level of economic growth. To eliminate heteroscedasticity in time series, we take the natural logarithm of the variable.

2) Data sources

The relevant data of above all variables come from the China Statistical Yearbook（1981—2014）and the China Financial Yearbook（1986—2014). All data are coped with by Eviews8.0 software.

IV. EMPIRICAL ANALYSIS

To use cointegration and Vecm analysis, all variables should satisfied with the first order of integration. For that purpose, the Augmented Dickey-Fuller (ADF) unit root tests have been employed to test the integrating order of these variables. The results are summarized in tables 2. Tables 2 shows that economic growth, financial development, industrial structure upgrading and industrial structure rationalization are found non-stationary with intercept and trend at level. After first difference, stationarity is found for all the variables. This shows that all the series are integrated at I(1).

For VAR model, an important issue is to determine the optimal lag order. Fig. 1 shows the optimal lag order. Most of the guidelines in the table (LR, FPE, AIC and HQ) have shown that optimal lag order is the second order. And the method through the VAR model lag structure inspection, we find that for the estimated VAR model, the inverse of the entire roots module is less than 1, located inside the unit circle, and it passes the stability test. By Granger causality test, we find that when the economic growth(LNPGDP) is viewed as the dependent variable, three explanatory variables(Industrial Structure upgrading, industrial structure rationalization and financial development) are jointly significant.

Table 3 shows cointegration rank test results of four variables: economic growth, industrial structure upgrading, industrial structure rationalization and financial development. Both trace and maximum eigenvalue tests including the constant term and trend term find that there is one cointegration rank, which confirm the presence of cointegration relationship among these variables.

TABLE 2 ADF UNIT ROOT TESTS FOR STATIONARITY IN LEVEL FORM AND FIRST DIFFERENCE

Variable	ADF Value	Test style（c, t, p）	5% Critical Value	Test conclusion
LNPGDP	-1.433	（c, t, 4）	-3.563	NO
TS	-2.888	（c, t, 1）	-3.548	NO
TL	-1.965	（c, t, 1）	-3.544	NO
FD	-3.271	（c, t, 0）	-3.544	NO
D_LNPGDP	-3.877	（c, t, 3）	-3.563	YES
D_TS	-3.990	（c, t, 1）	-3.548	YES
D_TL	-5.116	（c, t, 1）	-3.548	YES
D_FD	-5.548	(c, t, 1)	-3.553	YES

Note：in Test style（c, t, p), c denotes constant term, t denotes trend term, p denotes lag order

Lag	LogL	LR	FPE	AIC	SC	HQ
0	35.45486	NA	1.65e-06	-1.965929	-1.782712	-1.905197
1	202.9588	282.6629	1.28e-10	-11.43493	-10.51884*	-11.13127
2	225.4410	32.31819*	9.02e-11*	-11.84006*	-10.19111	-11.29348*
3	234.0630	10.23858	1.64e-10	-11.37894	-8.997116	-10.58943
4	251.8732	16.69707	1.95e-10	-11.49207	-8.377386	-10.45964

Fig. 1 The results of the optimal Lag order Selection

Note: LR: sequential modified LR test statistic (each test at 5% level);
FPE: final prediction error;
AIC:Akaike Information Criterion;
SC: Schwarz information criterion;
HQ: Hannan-Quinn information criterion.
* indicates lag order selected by the criterion.

TABLE 3 THE RESULTS OF COINTEGRATION RANKS TEST

Hypothesized No.of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None*	0.6346	73.3303	63.8761	0.0065	34.2348	32.1183	0.0271
At most 1	0.4719	39.0955	42.9152	0.1145	21.7071	25.8232	0.1595
At most 2	0.2724	17.3884	25.8721	0.3865	10.8142	19.3870	0.5326
At most 3	0.1758	6.5742	12.5179	0.3910	6.5742	12.5180	0.3910

In the long run, the results about cointegration relationship among financial development, industrial structure upgrading, industrial structure rationalization and economic growth are listed table 4.

Financial development has a significant positive effect on economic growth, but economic growth has no impact on financial development. The conclusion conforms to financial development's supply leading hypothesis in most of literatures about the finance-growth nexus. But for the conclusion that economic growth has no effect on financial development, possible explanations are that the created money and credit is not flowing into the real economy to promote economic growth, but into the real estate and stock markets, resulting in the formation of asset market bubbles[7].

There is a significant negative effect on each other between the industrial structure upgrading and economic growth. The negative effect of industrial structure upgrading on economic growth is mostly due to Baumol effect. The negative effect of economic growth on industrial structure upgrading lies in the income structure and expenditure structure. Government revenues grew faster than people's income growth. Government revenues are mostly used for investment in low-productivity state-owned enterprises, which lack the power of industrial upgrading. And monopoly prices made by upstream SOEs also increases production costs of the downstream private enterprises and service[10]. So these non-SOE profits are squeezed, funds for innovative research is insufficient, and industrial structure upgrading is impeded.

There is a significant positive effect between the industrial structure rationalization and economic growth. This conclusion is consistent with the theory. As Gan[6] mentioned that over the past 30 years, the contribution of Chinese industrial structure to economic development is mainly through the industrial structure rationalization. The essence of the industrial structure rationalization process is how to transfer more rural surplus labor force. With rural labor force transferring into non-agriculture with higher productivity from agriculture with low productivity, labor resources get optimal allocation, which promotes economic growth.

Financial development promptes significantly industrial structure upgrading. But industrial structure upgrading has no effect on financial development.

Financial development significantly inhibits industrial structure rationalization. But industrial structure rationalization has no effect on financial development. The reason of the former conclusion is mainly that Chinese financial system has been dominated by the four largest state-owned banks. Their ownership nature and scale preference bring serious misallocation of financial resources, with a large portion of bank loans not allocated to the most efficient enterprises in the real economy. This phenomenon hampers technical innovation, accordingly hinders industrial structure rationalization.

TABLE 4 COINTEGRATION RELATIONSHIP TEST

Coint Eq	(1)	(2)	(3)	(4)
LNPGDP (-1)	1.000	0.535***	0.515***	-8.206***
		(0.083)	(0.089)	(1.414)
TS (-1)	1.871***	1.000	0.964***	-15.352***
	(0.416)		(0.238)	(3.780)
TL (-1)	1.942**	1.038***	1.000	-15.933***
	(0.726)	(0.385)		(4.983)
FD (-1)	-0.122*	-0.065**	-0.063**	1.000
	(0.067)	(0.036)	(0.029)	
@TREND (78)	-0.146***	-0.078***	-0.075***	1.199***
	(0.013)	(0.013)	(0.016)	(0.230)
C	-7.491	-4.004	-3.858	61.468

Note: * significant at 10%; ** significant at 5%; *** significant at 1%;
Figure in parentheses represents standard deviation

In table 5, there are VECM estimation results about the short run causality under one cointegration constraints among economic growth, industrial structure upgrading, industrial structure rationalization and financial development. The ECT coefficients of column (1) and column (2) are significant and negative, which implies that when economic growth and industrial structure upgrading deviate from the long-run equilibrium value in one period, and their system will make them get corrected to equilibrium state in the next period by the speed of the adjustment of 13.1 percent and 8.7 percent, respectively. Against that, the ECT coefficient of column (3) is significant but positive. The ECT coefficient of column (4) is insignificant and the speed of the adjustment is smallest. This shows that both industrial structure optimization and economic growth will not add to financial development in the long term.

In the short run, the economic growth equation result shows that previous financial development is positively significantly related to current economic growth; financial development will promote economic growth. This conclusion is in line with theorized expectations. The financial development equation result shows that previous economic growth is negatively significantly related to current financial development. That is to say, previous economic growth significantly retrains current financial development. The possible reason is that the bulk of the formal bank credits are

granted to inefficient SOEs, although increasing economic growth in current period, but also bringing the non-performing loan problem in the next period and inhibiting financial development.

Both previous industrial structure upgrading and previous industrial structure rationalization are negatively significantly related to current economic growth. There are unidirectional causal relationship between industrial structure optimization and economic growth. Industrial structure optimization inhabits current economic growth, but economic growth has no effect on industrial structure optimization. Because incomes are long-term cumulative process of change, in general, it holds constant in the short term. So, in the short term, economic growth has no effect on the industrial structure.

TABLE 5 THE RESULTS OF VECM TEST

Error Correction	D(LNPGDP)	D(TS)	D(TL)	D(FD)
	Column(1)	Column(2)	Column(3)	Column(4)
CointEq1	-0.131**	-0.087**	0.051**	0.500
	(0.057)	(0.043)	(0.024)	(0.499)
D(LNPGDP(-1))	0.723***	-0.044	-0.016	-2.531**
	(0.137)	(0.104)	(0.059)	(1.193)
D(TS(-1))	-0.528**	0.225	0.244**	-2.375
	(0.240)	(0.183)	(0.103)	(2.099)
D(TL(-1))	1.069**	0.013	-0.048	0.089
	(0.428)	(0.326)	(0.183)	(3.739)
D(FD(-1))	0.054***	0.009	0.013	-0.388**
	(0.020)	(0.015)	(0.009)	(0.177)
C	0.044**	0.019	-0.009	0.591***
	(0.022)	(0.017)	(0.009)	(0.191)
R-squared	0.595	0.302	0.321	0.267
Adj.R-squared	0.522	0.177	0.199	0.136
Log likelihood	63.187	72.493	91.985	-10.509

Note: Significance at 1%, 5% and 10% levels is shown by *, ** and ***, respectively.

V. CONCLUSION

This paper analyzes the long-term and short-term dynamic and causal relationship among financial development, industrial structure optimization and economic growth. Cointegration and vector error correction model analysis are applied to China's annual data over the 1978-2013 period. Several conclusions are drawn: Financial development always can prompt economic growth. Economic growth has no effect on financial development in the long run, but retrains financial development in the short run. Industrial structure upgrading always inhibits economic growth. Economic growth retrains industrial structure upgrading in the long run, but has no effect on industrial structure upgrading in the short run. Industrial structure rationalization increase economic growth in the long run, but inhibits economic growth in the short run. Economic growth prompts industrial structure rationalization in the long run, but has no effect on industrial structure rationalization in the short run. Financial development prompts industrial structure upgrading and inhibits industrial structure rationalization in the long run. Financial development has no effect on industrial structure upgrading and industrial structure rationalization in the short run. Both industrial structure upgrading and industrial structure rationalization have no effect on financial development at any time.

Some policy suggestions are concerned in China, inappropriate interventions from government should be restrained in the financial sector. Meanwhile, a well-functioning legal environment should be built to guarantee financial institutions efficient operation. Optimizing government expenditure structure, makes more capital flow into public and basic industries, to cultivate innovative talents, to prompt industrial structure optimization.

ACKNOWLEDGEMENTS

The authors thank the editorial insightful comments and suggestions. Yunfang Wang acknowledges the financial support from the National Natural Science Foundation in China(7132016), National Social Science Foundation in China (14BJY031), the Special Research Fund of Shaanxi Education Department(15JK1824) and Yan'an University High Level Projects: Study on Economic and Social Development in the adjoining areas of ShaanGanNingMengJin and Yan'an University Social Science Foundation(YDS2010-34). However, the views in this paper are the responsibility of the authors.

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