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PVAR Model Analysis of Financial Assets Structure Adjustment and Industrial Structure Upgrading

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Abstract: In background that China has put forwards the transformation of the economic growth pattern and acceleration of industrial structure upgrading it is necessary to make an in-depth study of the industrial structure upgrading particularly. Starting from the adjustment of financial asset structure, this study constructs a Panel Vector Auto regression (PVAR) model, uses panel impulse response function and variance decomposition technology to make a multidimensional research with a provincial panel data of western China during 1993-2011, The conclusion proves that there is an interactive relationship between the structure adjustment of financial assets and industrial structure upgrading. But there are significant differences among different types of financial assets and industrial structure upgrading on interaction, direction and path.

Key words: Financial assets structure adjustment, industrial structure upgrading, PVAR model

INTRODUCTION

Industrial structure upgrading is the key to the transformation of the economic growth pattern. As a core element of the industry's development, the financial assets structure is one of the key factors that determine the industrial structure and has a very important impact on the industrial structure upgrading of a country or a region. But up to now, there are still many controversies about the path, direction and size of the interaction between financial assets restructuring and industrial structure upgrading in academia.

As early as in 1969, Goldsmith made use of the data from 1860-1963 in 35 countries for an empirical test and proved that a correlation existed between financial assets restructuring and industrial structure upgrading (Goldsmith, 1969). Beck and Levine (2002), Chang and Caudill (2005) and Luintel *et al.* (2008) further verified this conclusion. Christopoulos and Tsionas (2004) from the perspective of the developing countries, Su (2008) and Han and Fan (2010) from the perspective of province and Fan and Zhang (2003) from the perspective of regional comparison also proved that financial assets restructuring was an important motivator for upgrading the industrial structure. Through an empirical test on the data samples of 20 industries in 29 countries, Antzoulatos *et al.* (2011) found that two-way Granger causality did exist between financial assets restructuring and industrial structure upgrading. Different from the viewpoints mentioned above (Antzoulatos *et al*., 2011; Atindehou *et al*., 2005), Adjasi and Biekpe (2006) found that the impact of financial assets restructuring on industrial structure upgrading could be basically ignored and Gries *et al.* (2009) proved that no causality existed between financial assets restructuring and industrial structure upgrading (Atindehou *et al*., 2005; Gries *et al*., 2009).

In currently, there are still many problems in western China's industrial structure. For example, low industrialization and inefficiency production of the primary industry; low level of development and weak competitiveness of the secondary industry; low level of development and small output of tertiary industry; convergence of industrial layout, redundant construction between regions and other issues. In the background that China has put forwards the transformation of the economic growth pattern and acceleration of industrial structure upgrading it is particularly necessary to make an in-depth study of the industrial structure upgrading in this region. From the perspective of the financial assets restructuring, this study makes an in-depth study of the interaction between financial assets restructuring and industrial structure upgrading by using the Panel Vector Auto Regression (PVAR) model, panel co-integration test, panel impulse response and variance decomposition technology based on the data's of western China from 1993-2011.

PVAR MODEL ESTIMATION

Index setting and data selection: In order to reveal the interrelation between the diversification of financial assets and industrial structure upgrading in western China, the internal structure indexes of financial assets are adopted to reflect the financial asset structure, including HB, ST,

Table 1: Eigenvalues of financial assets structure and industrial structure in western china during 1993-2011

Varible	Mean	Median	Maximum	Minimum	SD
HB	0.838	0.857	0.998	0.377	0.105
ST	0.236	0.155	2.141	0.000	0.289
IN	0.012	0.012	0.023	0.002	0.004
FN	0.804	0.813	0.916	0.511	0.723

Notation: HB: M_2/total financial assets, it represents monetary asset structure; ST: Total market value of shares/total bank credit balances, it represents securities asset structure; IN: Ross premium income/total financial assets, it represents the structure of insurance assets, FN: Output value of the secondary industry and the output value of the tertiary industry/GDP, it represents the index of industrial structure upgrading

IN, wherein, HB: M_2/total financial assets it represents monetary asset structure; ST: Total market value of shares/total bank credit balances it represents securities asset structure; IN: Gross premium income/total financial assets it represents the structure of insurance assets. Due to the amount of bond during the period in this region is small and the availability of the data, the index of the bond asset structure is ignored here under the premise of without affecting the conclusion. The index of the industrial structure upgrading is estimated by the output value of the secondary industry and the output value of the tertiary industry/GDP which is represented by the proportion of the non-agricultural industries FN. As for the data selection, the sample used in this study is provincial panel data of financial assets restructuring and industrial structure upgrading from 1993-2011 in western China it includes 12 provinces. In order to ensure the comparability, taking 1993 as the base period, the data is revised according to the CPI index of each province from 1993-2011. The eigenvalues of the adjusted data sequences are shown in Table 1.

Table 1 shows the mean of monetary asset structure is maximum and the mean of insurance asset structure is minimum in western China during 1993-2011. The mean of monetary asset structure is the insurance asset structure's 69.833 times and the securities asset structure's 3.551 times. The monetary asset structure occupies a pivotal position in western China's financial asset structure; the insurance asset is underdevelopment clearly. From the view of residuals, the residual of securities asset structure is the largest, the residual of insurance asset structure is the smallest, this is consistent with the reality in western China.

Panel unit root test: Because the potency is often low in traditional unit root test, so this study has adopted three methods of LLC, ADF and Fisher-PP test to ensure the results are reliability. The result is shown in Table 2.

Table 2 shows the null hypothesis of " a unit root exists" can be rejected completely either the horizontal value of financial asset structure nor the horizontal value

Table 2: Stationary test of financial asset structure and industrial structure in western china during 1993-2011

Sequence	LLC	ADF	PP
FN	-1.437 (0.075)	11.205 (0.988)	28.896 (0.224)
ΔFN	-10.653 (0.000)***	131.331 (0.000)***	162.995 (0.000)***
HB	-2.098 (0.018)**	22.252 (0.564)	28.884 (0.225)
ΔHB	-16.439 (0.000)***	166.020 (0.000)***	179.788 (0.000)***
IN	0.972 (0.835)	9.279 (0.997)	12.120 (0.979)
ΔIN	-13.058 (0.000)***	170.993 (0.000)***	261.906 (0.000)***
ST	-3.113 (0.001)***	34.195 (0.081)	34.511 (0.076)
ΔST	-19.094 (0.000)***	193.206 (0.000)***	463.141 (0.000)***

***represents the significant level is 1%; **represents the significant level is 5%; *represents the significant level is 10%; HB: M_2/total financial assets, it represents monetary asset structure; ST: Total market value of shares/total bank credit balances, it represents securities asset structure; IN: Gross premium income/total financial assets, it represents the structure of insurance assets, FN: The output value of the secondary industry and the output value of the tertiary industry/ GDP, it represents the index of industrial structure upgrading. Δ represents first-order difference

of industrial structure in western China during 1993-2011 but it can be rejected significantly by the First-order difference of each sequence. Therefore, the sequences of financial asset structure and industrial structure in this region satisfy the nature of order one.

PVAR model estimation: Chamberlain (1983) has built the PVAR model based on panel data (Chamberlain, 1983). Holtz-Eakin *et al.* (1988) created the PVAR model with non stationarities across time coefficient and the Generalized method of moments (Holtz-Eakin *et al.*, 1988):

$$y_{it} = a_{0,t} + \sum_{l=1}^{m} a_{l,t} y_{i,t-l} + \sum_{l=1}^{m} \delta_{l,t} x_{i,t-l} + \psi_t f_t + \mu_{i,t} \quad (1)$$

i and t is the individual and time, respectively. i = 1,..., N; t = 1,..., T, f_i is the individual's difference unobserved; $a_{0,t}$, $a_{l,t}$, $\delta_{l,t}$, ψ_t are parameters need to be estimated. When i<s, $\mu_{i,t}$ meet the condition of orthogonal with $y_{i,s}$, $x_{i,s}$, f_i, that is:

$$E[y_{i,s}\mu_{i,t}] = E[x_{i,s}\mu_{i,t}] = E[f_i\mu_{i,t}] = 0, (i<s) \quad (2)$$

T≥m+3, m is the periods of lag, y_{it} can be observed. Hereafter, Pesaran and Smith (1995) 's study has revealed the model built by Chamberlain and Holtz-Eakin is difficult to estimate the parameters accurately When the N of the panel data is much larger than Binder *et al.* (2003) found the methods of extend GMM and QML can solve this problem effectively. The model (Pesaran and Smith, 1995; Binder *et al.*, 2003) is following:

$$W_{i,t} = (I_m - \Phi)\mu_i + \Phi w_{i,t-1} + \varepsilon_{i,t} \quad (3)$$

$w_{i,t}$ is a variable with m×1 dimensions; Φ is a cross-section coefficient matrix with m×m dimensions; μ_i is a disturbance which is a fixed effect vector with N dimensions. Then the PVAR model can be expressed as:

$$Y_{i,t} = \gamma_0 + \sum_{k=1}^{m} \Phi_{t,k} Y_{i,t-k} + \sum_{j=1}^{m} \psi_{i,j} X_{i,t-j} + \gamma_i + \mu_{i,t} \quad (4)$$
$$i = 1, 2, ..., N; t = 1, 2, ..., T$$

$Y_{i,t}$ is a vector with M×1 dimensions constituted of M observable variables that belongs to the cross-section individual i at time t, $X_{i,t}$ is a vector with M×1 dimensions that belongs to a exogenous variable which can be observed and determined, $\Phi_{t,k}$, $\psi_{i,j}$ is a matrix with M×M dimensions that need to be estimated, γ_i is a fixed effects matrix with M unobserved individuals which belongs to i, $\mu_{i,t}$ is error term. In practice, the parameters of endogenous and exogenous variables with lag term are often time-invariant:

$$Y_{i,t} = \gamma_0 + \sum_{k=1}^{m} \Phi_{k} Y_{i,t-k} + \sum_{j=1}^{m} \psi_{j} X_{i,t-j} + \gamma_i + \mu_{i,t} \quad (5)$$
$$i = 1, 2, ..., N; t = 1, 2, ..., T$$

Then, the PVAR model can derivate from model 5 simply:

$$V_{i,t} = B_0 + \sum_{j=1}^{k} B_j V_{i,t-j} + \eta_i + \varphi_t + \varepsilon_{i,t}$$

$V_{i,t}$ is a column vector including the variables of {FN, HB, ST, IN}^{T} which represent the index of industrial structure upgrading, monetary asset structure, securities asset structure and insurance asset structure, respectively. η_i is the "heterogeneity in different region" which represents the provinces' unique personality that be ignored in estimation. φ_t is the time effect, which represent the trends of independent variables. $\varepsilon_{i,t}$ is the disturbance term which distributes normally. Use the method of GMM to estimate the parameters of PVAR, the result is shown in Table 3. The result shows the variables's lag period is different, the size of effection among them are different significantly. AIC information criterion is used here to decide the best lag is one.

The results in Table 3 shows that FN has a positive effect on itself at 1% level significantly, the degree of effect is 0.923; has a positive effect on HB at 5% level significantly, the degree of effection is 1.448; has a positive effect on ST at 10% level significantly, the degree of effection is 0.581; has a weak positive effect on IN, the degree of effection is only 0.025, the effect is not significant. HB has a significant reverse influence on FN at 5% level, the degree of effection is -0.823; ST has a significant positive effect on FN at 10% level, the degree of effection is 1.051; IN has a weak reverse impact on FN, the degree of effection is -0.051, it is not significant.

Panel impulse response and variance decomposition: Based on the coefficients which is estimated by GMM and the variance-covariance matrix, this study uses method of Monte Carlo simulation to generate a large number of coeffcients, calculating the impulse response among variables repeatedly. These calculation is implemented 500 times, evaluating the impulse response by using the two standard error confidence intervals which is acquired from the simulation. Figure 1 shows the Orthogonalized impulse response, based on PVAR, between financial assets structure restructuring and industrial structure upgrading in western China, the horizontal axis represents retroactive period, it is 6; the vertical axis represents the size of response from dependent variable, when independent variable produces an impulse; the solid line, in the middle, is the curve of response function, and the two curves in the outer is the confidence interval, which is the standard deviation 2 times.

Figure 1 to 3 are the FN's response when a standard deviation shock is produced by HB, ST and IN, respectively. Figure 1 shows that FN has no response in

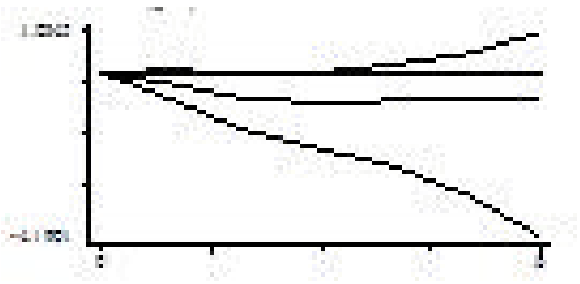

Fig. 1: FN's response when a standard deviation shock is produced by HB

Table 3: Result of panel vector autoregressive model estimated by GMM between financial asset structure adjustment and industrial stmcture upgrading in western china during 1993-2011

Lagged variable	FN	HB	ST	IN
FN (t-1)	0.923 (6.071)***	1.448 (1.966)**	0.581 (1.707)*	0.025 (1.167)
HB (t-1)	-0.823 (-2.015)**	0.134 (1.439)	-0.104 (-2.193)**	-0.015 (-0.314)
ST (t-1)	1.051 (1.713)*	1.159 (1.978)**	0.740 (1.663)*	0.002 (0.535)
IN (t-1)	-0.051 (-1.399)	-0.073 (-0.246)	0.164 (0.186)	0.145 (1.125)

Notation: HB: M_2/total financial assets, it represents monetary asset structure; ST: Total market value of shares/total bank credit balances, it represents securities asset structure; IN: Gross premium income/total financial assets, it represents the structure of insurance assets, FN: The output value of the secondary industry and the output value of the tertiary industry/ GDP, it represents the index of industrial stmcture upgrading

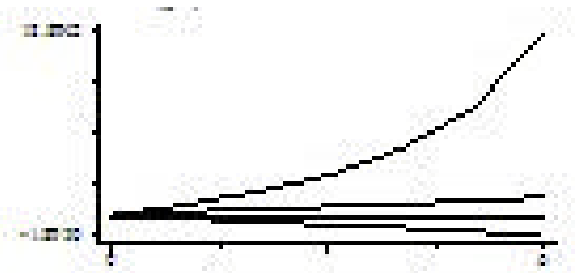

Fig. 2: FN's response when a standard deviation shock is produced by ST

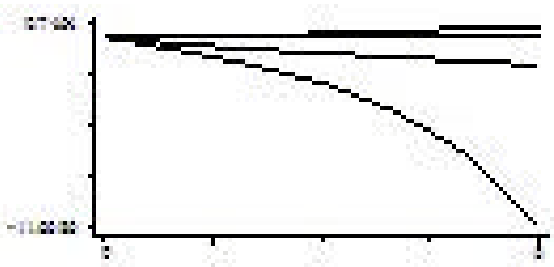

Fig. 3: FN's response when a standard deviation shock is produced by IN

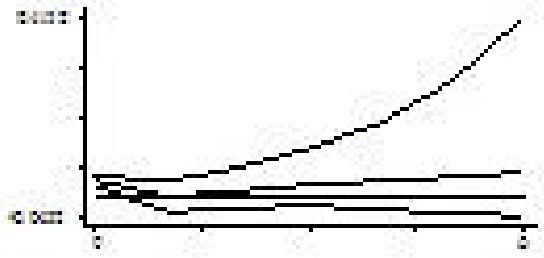

Fig. 4: HB's response when a standard deviation shock is produced by FN

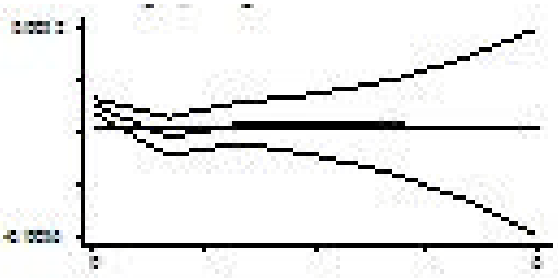

Fig. 5: ST's response when a standard deviation shock is produced by FN

spot when HB produces a standard deviation, then the response is all reverse either in short or long term. It shows the growth of HB does not promote the FN's upgrading. What is the reason? when the monetary assets structure is adjusted, the industrial structure can not respond immediately because it needs a period of time to reconstruct, so the response in current is 0. what is the reason that FN's response is negative when HB produces impulse? It is because when the monetary asset is increased, the investment will reduce correspondingly when the number of financial resources is fixed. Figure 2 shows that when ST produces a standard deviation shock, the FN's response is 0 in spot, the following is positive, it shows the adjustment of security asset structure is conducive to promote the industrial structure upgrading. It is consistent with the function of stock market's function of resource optimal allocation. Figure 3 shows that when IN produces a standard deviation shock, the FN's response is 0 in spot, the following is negative. What is the reason? It is perhaps when the benefits is poor, the insurance asset structure's elevating means the enterprises will insure for more employees or spend more money to insure for the employees, which will make the enterprises' burden more heavier, it is not conducive to the enterprises' development in short-term, so the response is inverse weakly when IN produces a standard deviation shock.

Figure 4-6 are the response of HB' ST and IN when a standard deviation shock is produced by FN, respectively. Figure 4 shows the response of HB is positive when a standard deviation shock is produced by FN, which means the industrial structure upgrading is conducive to monetary assets structure's enhancing. What is the reason? Because when the industrial structure is escalated, its efficiency of output will be higher, the enterprise and individual will have more savings and wealth, the result is the monetary funds in the whole community will increase. Figure 5 shows that when a standard deviation shock is produced by FN, the response of the securities asset structure is reverse weakly, following it will convert to positive. It shows that industrial structure upgrading is conducive to the development of securities assets. Figure 6 shows that when a standard deviation shock is produced by FN, the response of insurance asset structure is positive in spot, and then it converges to 0 gradually. Overall, the effect of industrial structure upgrading influence on the insurance asset structure is short and small.

Fig. 6: IN's response when a standard deviation shock is produced by FNNotation: HB: M_2/total financial assets, it represents monetary asset structure; ST: Total market value of shares/total bank credit balances, it represents securities asset structure; IN: Gross premium income/total financial assets, it represents the structure of insurance assets, FN: Output value of the secondary industry and the output value of the tertiary industry/GDP, it represents the index of industrial structure upgrading

Table 4: Result of variance decomposition based on panel vector autoregressive model for variable of $\{FN, HB, IN, ST\}^T$

Index	S	FN	HB	ST	IN
FN	10	37.288	17.336	41.343	4.033
HB	10	32.369	15.567	42.687	9.376
ST	10	29.191	23.962	42.907	3.940
IN	10	34.945	16.221	44.465	4.370
FN	20	34.513	17.192	44.947	3.349
HB	20	34.488	17.171	44.982	3.359
ST	20	34.450	17.195	45.022	3.333
IN	20	34.498	17.176	44.982	3.344
FN	30	34.493	17.178	44.991	3.339
HB	30	34.492	17.178	44.991	3.339
ST	30	34.492	17.178	44.991	3.339
IN	30	34.492	17.178	44.991	3.339

Notation: HB: M_2/total financial assets, it represents monetary asset structure; ST: Total market value of shares/total bank credit balances, it represents securities asset structure; IN: Gross premium income/total financial assets, it represents the structure of insurance assets, FN: The output value of the secondary industry and the output value of the tertiary industry/GDP, it represents the index of industrial structure upgrading

To inspect the volatility of HB, ST, IN and FN, Panel variance decomposition is used to decompose the prediction mean square error of HB, ST, IN and FN from 10,20 and 30 forecast period, respectively, calculate the importance of each variable, study the shock among the varibles. The results are shown in Table 4.

As seen in Table 4, in the 10,20 and 30 forecast periods, the variation of FN accounts for a percent of 37.288, 34.513 and 34.493 comes from itself, respectively, account for a percent of 4.033' 3.349 and 3.339 comes from IN, respectively. The order of size that effect on FN is securities asset restructuring, monetary asset restructuring and insurance asset restructuring. Correspondingly, the variation of HB accounts for a percent of 32.369, 34.488, and 34.492 comes from FN, the variation of ST accounts for a percent of 29.191' 4.450 and 34.492 comes from FN, the variation of IN accounts for a percent of 34.945' 34.498 and 34.492 comes from FN. It shows the sizes that industrial structure upgrading effect on the securities asset restructuring, currency asset restructuring and insurance asset restructuring are similar.

CONCLUSION AND POLICY RECOMMENDATION

This study is written from the point of adjustment of financial assets structure, with provincial panel data on the structure adjustment of western financial assets and industrial structure upgrading during 1993-2011 as samples. By constructing a PVAR model, using panel cointegration test, panel impulse response function and variance decomposition technology, as well as making multidimensional research the interactive relationship between the structure adjustment of western financial assets and industrial structure upgrading, the following basic conclusions is obtained:

- There is a interaction relationship between the adjustment of financial asset structure and industrial structure upgrading in western China. The direction that financial asset structure restructuring effects on industrial structure upgrading is: the monetary asset structure restructuring has a reverse inhibitory effect on the industrial structure upgrading; the securities asset structure restructuring has a positive effect on the industrial structure upgrading; the insurance asset structure restructuring has a weakly reverse effect on the industrial structure upgrading. The direction that industrial structure upgrading effects on the adjustment of financial asset structure is: Industrial structure upgrading is conducive to the growth of monetary asset, has a reverse effect on the growth of securities asset in short term, and in favor of securities asset's growth in long term; has a weak positive effect on the growth of insurance asset
- Judging from the volatility, the order of the size that impact on the industrial structure upgrading is securities asset restructuring, monetary asset restructuring and insurance assets restructuring. The size that industrial structure upgrading effect on securities asset restructuring, currency asset restructuring and insurance assets restructuring is similar

In the future, it should start from the two aspects of financial assets structure and industrial structure in western China, keep upgrading the structures of financial asset and industrial, and promote the positive interaction situation to become a reality under the premise of expanding the total financial assets and satisfying the need of industry structure's upgrading. The measures include: the first is to enhance the bank's capability of innovation, improve the efficiency that monetary asset effects on the industrial structure upgrading; the second is to create a favorable external environment for the coordinated development of industrial structure and financial asset structure by utilizing new technologies to transform traditional industries actively; third, we should enhance the speed and level of tertiary industry's development, increase the total amount of the tertiary industry greatly.

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