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Industrial Structure and Employment Structure Evolution and Forecast in Viet Nam

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Abstract
The interaction mechanism between industrial structure and employment structure has great importance in the development of any economy. But it always needs a constant vigilance to adjust and evolve which promotes the economic development of a country. This study tries to find out the optimization correlation between industrial structure and employment structure in Vietnam for the period of 1995-2014. This study has found that labor is moving gradually from low efficiency production section to high efficiency production section. This paper uses the vector auto-regression model (VAR) to forecast industrial structure and employment structure change trend in Vietnam for 2015-2020. The forecasted results show that industrial structure trend is moving towards higher progression, eventually transforming to "321" pattern. However, the change in employment structure lags behind changes in the industrial structure as labor structure is showing a "132" pattern.
Keywords: Industrial structure, Employment structure, vector auto-regression, Vietnam

1. Introduction

Industries are the main source of employment in any country. When the factors of production flow from an inefficient sector to the high-efficiency sector, it can cause a substantial change among different departments. In such a dynamic environment, the industrial structure changes will inevitably lead to labor transfer flow between different industries, resulting in the change of employment structure. The interaction process of industrial structure and employment structure interact presents some kind of inner link. A healthy development of an economy depends on the adaption and coordination of industrial structure and employment structure. Industrial structure must have a reasonable employment structure correspondence otherwise the industrial structure growth will be impeded [1]. Therefore, it is important to quantify the relationship between the industrial structure and the employment structure and the evolution law. Then changes can be predicted between those two factors and it has significant theoretical significance and application value.

Economists are focusing their research work on industrial structure and employment structure relationship and through their empirical work they have defined some general rules. In the 17th century, an economists Petty found that the relative income differences between departments are the main reasons of labor flow between sectors. The British economist Clark investigated labor transfer problems between the industrial structures in many countries and then concluded that, the labor force transfer from the primary industrial structure to the secondary industrial structure with the increase in per capita national income and when the per capita national income level improves further, the labor force transfer to the tertiary industrial structure. This discovery by Petty and Clark is collectively known as Petty - Clark's law [2]. Later, researchers found the relationship between capital investment and economic growth and empirically showed that the adjustment of economic structure and transformation is bound to drive the changes in employment structure. Researchers like Chenery [3] and Syrquin [4] constructed a model on the basis of the development and empirically studied the problem of industrialization and found that industrialization, urbanization and labor transfer are the mass of the interactive process.

Prior research about the evolution of industrial structure and labor transfer provide important theoretical basis. Various researchers [5] have analyzed the development of structural change and the evolution of the industrial growth model and this analysis is based on the heterogeneity of different sectors of the economic enterprise behavior while some [6] have uses deviation-share method to evaluate the manufacturing and service industries in Europe, America and Japan with relative weight of the structure change process.

Researchers have used industrial structure and employment structure ratio to analyze and forecast the relationship between industrial structure and employment structure and have used proportional direction to overcome restrictions which is equal to 1[7]. Researchers have designed various mapping techniques for component data dimension reduction. But application of various techniques produces different results [8]. For this study, we have used Vector Auto-Regression (VAR) model to analyze Vietnam's industrial structure and employment evolution, forecasting three industrial output values and overall labor structure. On the basis of forecasted values, future development trend can be predicted [9, 10, 11].

2. Industrial Structure and Employment Structure Analysis

Since 1996, the Vietnamese Government proposes vigorously to promote country's industrialization and

modernization. In 2001, Vietnam determined to establish a socialist-oriented market based economy and identified three strategic priorities, which are the center of industrialization and modernization, the development of various economic sectors which play a dominant role in state-owned economy and supporting the establishment of the management system of the market based economy. After 15 years of innovation, Vietnam's economy has maintained rapid growth. From 1995 to 2010, annual GDP growth averaged 6.9%. There are certain factors like the coordinated industrial structures, continuous improvement to the openness of the economy and the pattern of continuous development of various economic sectors, altogether helped to expand the Vietnamese economy.

From 1995 to 2014, there is a rapid development in various industries of Vietnam economy. In 2000, Vietnam's GDP is 441646.0 billion VND (1 USD = 14,157 VND in 2000), while in 2014, Vietnam's GDP is 3937856.0 billion VN ((1 USD = 21.20 VND in 2014). The first industrial output value is 696969.0 billion VND. The second industrial output value is 1505802.0 billion VND. The tertiary industrial output value is 1735006.0 billion VND. The ratio value for primary industry is 17.95%, the secondary industry is 37.25% and the tertiary industry is 44.8% (see Table 1). It can be seen that the output values of three industrial changes in year 2004 for primary industry is 21.81%, the secondary is 40.21% and the tertiary is 37.98%. Overall, it shows that the output value of the primary industry has reduced over time, the output value of the secondary industry has increased but the tertiary industry has shown a change but at a lower rate. Since the economic reforms and opening up, the output value of the primary industry situation is declining as compared to overall economic development but the output value of secondary industry is rising proportionally. From year 1995 to year 2004, the proportion of the tertiary industry output shows decline but since 2006 the output value has become better but still a lower value than average. The output value structure is showing "321" pattern. (Table 1)

At the same time, the proportion of the labor force of three industries in Vietnam also has undergone a big change. There is a significant decline from 71.2% to 46.3% in the proportion of primary industry employment from 1995 to 2014. Secondary industry employment is showing an increase from 8.5% to 21.4% for the period of 1995 to 2014.Tertiary industry is also showing an increasing trend from 20.3% to 32.3% for the same time period. Overall, Labor structure is showing a "132" pattern (Table 1).

Table1. Vietnam industrial and employment structure

Year	Industrial structure (%)			Employment structure (%)		
	Primary Industry	Secondary industry	Tertiary Industry	Primary Industry	Secondary industry	Tertiary Industry
1995	27.18	28.76	44.06	71.2	8.5	20.3
1996	27.76	29.73	42.51	70.7	8.9	20.4
1997	25.77	32.08	42.15	70.1	9	20.9
1998	25.78	32.49	41.73	69.6	9.1	21.3
1999	25.43	34.5	40.07	68.9	9.2	21.9
2000	24.53	36.73	38.74	64.4	10.1	25.5
2001	23.24	38.13	38.63	63.6	10.9	25.5
2002	23.03	38.49	38.48	58.7	11.1	30.2
2003	22.54	39.47	37.99	56.9	12.6	30.5
2004	21.81	40.21	37.98	58.7	12.5	28.8
2005	19.3	38.13	42.57	57	15.9	27.1
2006	18.73	38.58	42.69	54.3	18.2	27.5
2007	18.66	38.51	42.83	52.9	19	28.1
2008	20.41	37.08	42.51	52.3	19.4	28.3
2009	19.17	37.39	43.44	51.6	20.1	28.3
2010	18.89	38.23	42.88	48.8	21.8	29.4
2011	20.08	37.90	42.02	48.4	21.6	30.4
2012	19.67	38.63	41.70	47.4	20.9	31.7
2013	18.38	38.31	43.31	46.8	21.3	31.9
2014	17.95	37.25	44.8	46.3	21.4	32.3

Source: Viet Nam Statistical Yearbook 2016 [12]

With the economic development and substantial GDP increase, still the employment figure of the primary industry is still high which is causing an enormous amount of labor surplus. Currently, the employment structure in Vietnam Industry is showing transfer trends among primary industry to secondary industry and to tertiary industry. Therefore, the secondary industry and tertiary industry are unceasing rising labor.

Based on the above analysis, it can be seen that changing trends of Vietnamese industrial structure and employment structure are basically in line with the general rules of industrial structure evolution. Even though, with this substantially changes there are still some changes in the magnitude and extent which are not same. The

change of employment structure lags behind changes in the industrial structure.

3. Forecasting of Industrial Structure and Employment Structure in Vietnam

3.1 Vector Auto-Regression (VAR) model

3.1.1. *VAR Model Summary*

Christopher Sims [13] advocated VAR models and has criticized the claims and performance of earlier modeling in macroeconomic econometrics. He recommended VAR models as a statistical specialty in control theory which had previously appeared in time series statistics and system identification. Sims advocated VAR models as providing a theory-free method to estimate economic relationships which can be an alternative to the "incredible identification restrictions" in structural models. VAR models are also increasingly used in health research for automatic analyses of diary data or sensor data. A VAR model describes the evolution of a set of k variables (called endogenous variables) over the same sample period (t = 1, ..., T) as a linear function of only their past values. The variables are collected in a k × 1 vector yt, which has as the ith element, Yi,t, the observation at time "t" of the ith variable. For example, if the ith variable is GDP, then Y i,t is the value of GDP at time t.A p-th order VAR, denoted VAR(p), is

$$y_t = c + A_1 y_{t-1} + A_2 y_{t-2} + \ldots + A_p y_{t-p} + e_t \qquad (1)$$

Where, the l-periods back observation yt−l is called the l-th lag of y, c is a k × 1 vector of constants (intercepts), Ai is at ime-invariant k × k matrix and et is a k × 1 vector of error terms satisfying.

Or matrix $\begin{pmatrix} y_{1t} \\ y_{2t} \\ \vdots \\ y_{kt} \end{pmatrix} = c + A_1 \begin{pmatrix} y_{1t-1} \\ y_{2t-1} \\ \vdots \\ y_{kt-1} \end{pmatrix} + \ldots + A_p \begin{pmatrix} y_{1t-p} \\ y_{2t-p} \\ \vdots \\ y_{kt-p} \end{pmatrix} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \vdots \\ \varepsilon_{kt} \end{pmatrix}$ and $\begin{pmatrix} x_{1t} \\ x_{2t} \\ \vdots \\ x_{kt} \end{pmatrix} = c + A_1' \begin{pmatrix} x_{1t-1} \\ x_{2t-1} \\ \vdots \\ x_{kt-1} \end{pmatrix} + \ldots + A_p' \begin{pmatrix} x_{1t-p} \\ x_{2t-p} \\ \vdots \\ x_{kt-p} \end{pmatrix} + \begin{pmatrix} \varepsilon_{1t}' \\ \varepsilon_{2t}' \\ \vdots \\ \varepsilon_{kt}' \end{pmatrix}$

3.1.2. The construction of VAR model

Selection (I) is Vietnam's output proportional value of three industries and (E) is employment proportion jointly decided by a double variable VAR model, which are:

$$I_t = \beta_1 + a_{11} I_{t-1} + a_{1p} E_{t-1} + b_{11} I_{t-p} + b_{1p} E_{t-p} + \varepsilon_{1,t} \qquad (2)$$

$$E_t = \beta_2 + a_{21} E_{t-1} + a_{2p} I_{t-1} + b_{21} E_{t-p} + b_{2p} I_{t-p} + \varepsilon_{2,t} \qquad (3)$$

From equations (2) and (3):

$$\begin{pmatrix} I_t \\ E_t \end{pmatrix} = \begin{pmatrix} \beta_1 \\ \beta_2 \end{pmatrix} + \begin{pmatrix} a_{11} & a_{1p} \\ a_{21} & a_{2p} \end{pmatrix} \begin{pmatrix} I_{t-1} \\ E_{t-1} \end{pmatrix} + \begin{pmatrix} b_{11} & b_{1p} \\ b_{21} & b_{2p} \end{pmatrix} \begin{pmatrix} I_{t-p} \\ E_{t-p} \end{pmatrix} + \begin{pmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \end{pmatrix} \qquad (4)$$

β1 and β2 are constant. a11, a12,a21,a22 and b11,b12,b21,b22 is parameters; ε1,t and ε2,tis a κ×1 vector of error terms satisfying. (Average random disturbance is 0), variance is constant.

3.2 Model test

3.2.1 ADF test

ADF test is used for all variables to ensure the reliability of regression model results [14, 15]. The output value proportion and employment proportion of three industry of the logarithm respectively are I1, I2, I3 and E1, E2, E3; and with ΔI1, ΔI2, ΔI3 and ΔE1, ΔE2, ΔE3 are first-order difference sequences of each sequence.

Table 2. ADF test

Variables	ADFtest value	The critical value（5%）	P value	Conclusion
I_1	-1.1482	-3.0299	0.6738	Unstable
I_2	-4.1178	-3.0655	0.0068	Smooth
I_3	-1.3082	-3.0299	0.6035	unstable
E_1	-0.7526	-3.0299	0.8096	unstable
E_2	-0.4553	-3.0299	0.8801	unstable
E_3	-1.1658	-3.0299	0.6664	unstable
ΔI_1	-4.6705	-3.0403	0.0019	smooth
ΔI_3	-3.3309	-3.0403	0.0286	smooth
ΔE_1	-4.5000	-3.0403	0.0027	smooth
ΔE_2	-3.3753	-3.0403	0.0262	smooth
ΔE_3	-3.8909	-3.0403	0.0093	smooth

Source: Run E-views9.0 software

E-views 9.0 software has been used for all the logarithmic ADF test results. Table 2 shows that the

ADF test value of five original sequences are greater than the critical value (5%) which shows sequence imbalance but only I2 sequence of the original sequence is in balance. So, on the basis of that null hypothesis cannot be rejected. After first order difference, ADF values of five variables are less than the critical value (5%), therefore rejects the null hypothesis. The main reason is first order difference sequence is a stationary series so it combines all the values as a whole single sequence.

3.2.2. Characteristic roots test

The stability of vector autoregressive (VAR) model can be checked by implying that all the characteristic values fall within the unit circle (real number line based on the horizontal axis and vertical axis for the imaginary axis in the coordinate system. The origin point is the center of the circle and the circle of radius 1 is called a unit circle) [9, 14]. So, the characteristic value of modulus is less than 1. If all the roots and the system modules are less than 1, it shows that system model is stable. If the root and the reciprocal fall outside the unit circle, the characteristic value of modulus is greater than 1 which shows that the model system is unstable.

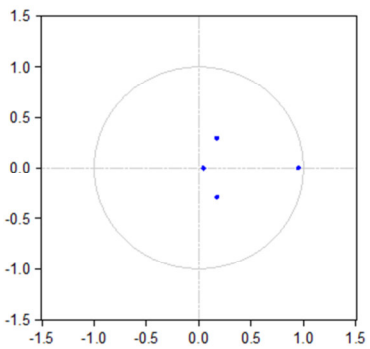

Figure 1. Primary industry

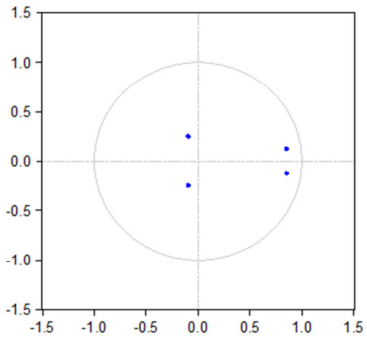

Figure 2. Secondary industry

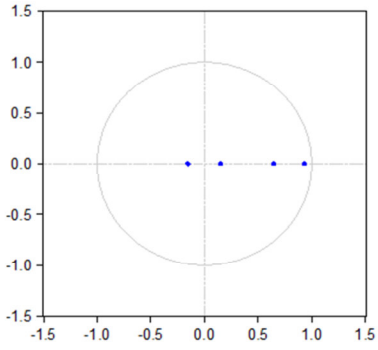

Figure 3. Tertiary industry

So, it can be seen from Figure 1, Figure 2, and Figure 3, that the three industry VAR model is stable

3.2.3 Lag results

In the ideal state, VAR of random perturbation terms should be subject to the vector of error terms satisfaction. If a certain lag period is selected to satisfy the vector of error term, it can resolve the disturbance vector of error terms. So, this study has implied the lag of disturbance vector of error terms. So, the issue of lag problem is well resolved. The lag selection results of the primary, secondary and tertiary industrial as shown in tables 4, 5, 6, respectively.

Table 4. The lag result of the primary industrial

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-94.72806	NA	90.58983	10.18190	10.28132	10.19873
1	-56.86951	63.76177*	2.579042*	6.617844*	6.916088*	6.668318*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion

Table 5. The lag result of the secondary industrial

Lag	Log L	LR	FPE	AIC	SC	HQ
0	-99.94877	NA	156.9442	10.73145	10.83086	10.74827
1	-46.69438	89.69161*	0.883690*	5.546776*	5.845020*	5.597251*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion

Table 6. The lag result of the tertiary industrial

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-92.28717	NA	70.06378	9.924965	10.02438	9.941790
1	-60.88206	52.89282*	3.934528*	7.040217*	7.338460*	7.090691*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion

In case of a limited sample, first-order VAR model has been used to apply different standards for optimal lag order number. Tables 4, 5, 6 show the results of various criterion such as SC, AIC, FPE, LR, SC, HQ for optimal lag order to 1.

3.3 The results

According to the structure analysis, the forecasted (2015-2020) output value proportion and employment proportion of three industry in Vietnam using VAR model are shown in table 7 and figure 4, 5, 6.

Table7 and figure 4 show that the output value proportion and employment proportion of the primary industrial are showing decreasing trend during the period of 2015-2020. The proportion of output value declines from 17.95% in 2014 to 16.45% in 2020. While the employment proportion declines from 46.3% in 2014 to 41.61% in 2020. It is obvious that the proportion of employment in the primary industry fell more than the decline in the proportion of its output value.

Table 7. Forecasting industrial structure and employment structure in Vietnam

Year	Primary Industry		Secondary Industry		Tertiary Industry	
	I_1（%）	E_1（%）	I_2（%）	E_2 (%)	I_3 (%)	E_3 (%)
2015	17.67	45.36	37.33	21.88	45.23	31.73
2016	17.4	44.54	37.2	22.01	45.52	31.93
2017	17.15	43.75	37.09	22.09	45.79	32.13
2018	16.9	43	36.98	22.14	46.05	32.31
2019	16.67	42.29	36.91	22.15	46.29	32.48
2020	16.45	41.61	36.83	22.14	46.52	32.64

*E_1,E_2,E_3 : Employment structure of primary industry, secondary industry and tertiary industry.
*I_1,I_2,I_3: Industrial structure of primary industry, secondary industry and tertiary industry

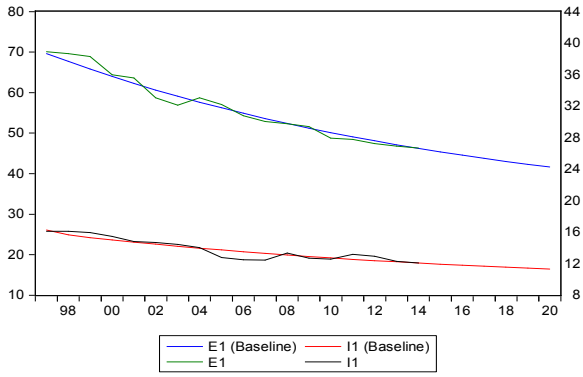

Figure 4. Forecasting of primary industry

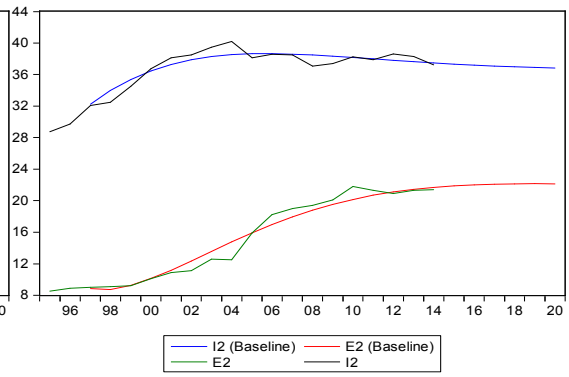

Figure 5. Forecasting of secondary industry

The proportion of output value and the proportion of employment in Vietnam's secondary industry (FIG. 5) are showing different trends as the proportion of secondary industry output value is decreasing slowly from 37.25% in 2014 to 36.83% in 2020, while its share of employment is rising slightly from 21.4% in 2014 to 22.14% in 2020.

Vietnam's tertiary industry, the proportion of output value and the proportion of employment are showing an upward trend as the output value is changing from 44.8% in 2014 to 46.52% in 2020 whilst, the

proportion of employment is changing from 32.3% in 2014 change to 32.64% in 2020.

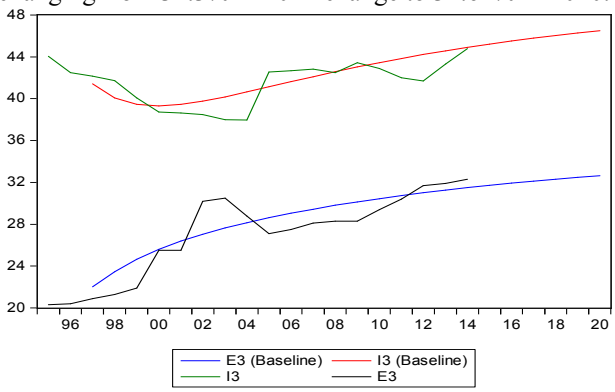

Figure 6. Forecasting of tertiary industry

Overall, on the basis of forecasted values for the three industrial structures and employment structure in Vietnam through VAR model it can be assumed that Vietnam's industrial structure will still show a "321" pattern and the employment structure will show a “132” pattern for next 5 years.

4. Conclusions

The interaction mechanism between industrial structure and employment structure has great importance for the development of any economy. But it always needs a constant vigilance to adjust and evolve which promotes the economic development of a country. This study tries to find out the optimization correlation between industrial structure and employment structure in Vietnam for the period of 1995-2014. This study has found that labor is moving gradually from low efficiency production section to high efficiency production section. This paper uses the vector auto-regression model (VAR) to forecast industrial structure and employment structure change trend in Vietnam for 2015-2020.The forecasted results can be described as, Firstly, industrial structure and employment structure has the convergence in the pattern of distribution. The orderly development of economy demands the industrial structure and employment structure to adapt each other as the adjustments in industrial structure upgradation will affect the change of employment structure while, the employment structure adjustment is an important part of the evolution of industrial structure change as a reasonable employment structure can effectively promote the optimization of industrial structure. The forecasted results show that industrial structure trend is moving towards higher progression, eventually transforming to "321" pattern. However, the change of employment structure lags behind changes in the industrial structure as labor structure is showing a "132" pattern and by the end of 2020, the article predicts that both will have convergence with time.

Secondly, the predicted value curve of employment structure is more intense than the real value and industry structure change curve. This is mainly due to the employees affected by industrial structure, the restricted labor flow among territories and also the restriction on household registration system and land system. Moreover, industry operation patterns which cause the economic system transition and bring uncertainty and instability of labor employment, also can affect the distribution of employment in the three-industrial structure. Therefore, from the overall trends, employment structure and industrial structure are significantly higher than the employment structure changes in industrial structure.

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