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An Evaluation of Provincial Macroeconomic Performance in Vietnam

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Abstract

T*he study was targeted at developing a methodology for constructing a macroeconomic performance index at a provincial level for the first time in Vietnam based on 4 groups of measurements: (i) Economic indicators; (ii) oriented economic indicators; (iii) socio-economic indicators; and (iv) economic - social – institutional indicators. Applying the methodology to the 2011 - 2015 empirical data of all provinces in Vietnam, the research shows that the socio-economic development strategy implemented by those provinces did not provide balanced outcomes between growth and social objectives, sustainability and inclusiveness. Many provinces focused on economic growth at the cost of structural change, equality and institutional transformation. In contrast, many provinces were successful in improving equality but not growth. Those facts threaten the long-term development objectives of the provinces.*

Keywords: Macroeconomic performance; ISEPI model; Slack Based Model (SBM); input/ output Slack.

1. Introduction

For the purpose of evaluating the macroeconomic performance of an economy, researchers and policymakers have traditionally focused on certain aspects, including growth rate, price stability, employment rate and trade balance. Each criterion however, only reflects a single dimension of economic development and there might exist trade-offs between such dimensions in operating economic policies.

In addition, simply combining each of the dimensions using the same weight or imposing a subjective weighting scheme would not be appropriate for the different conditions of each economy in different periods, during which the priorities of economic development might also vary. Such an approach would make it very difficult to compare the performance among economies.

A solution to alleviate this problem is to construct a composite index, in which the weights of each measuring dimension are not assigned subjectively. This could be achieved by employing a linear programming technique, utilizing the concept of frontier. Lovell's (1995) is the first research to employ data envelopment analysis in order to compare the economic performance between countries. In Lovell's study, the weights of each component were not assigned subjectively, but were assigned objectively based on the characteristics of each data series. This approach allows the composite index to better represent the relative importance as well as the contribution of each separate measuring component. So far, there have been a number of different researches that followed this direction in an attempt to build a composite index at the national level.

At the same time, to evaluate and compare the macroeconomic performance at the provincial level, some of the indicators will no longer be meaningful, most notably the trade balance. Therefore, the most important issue in constructing the composite index is to select the appropriate dimensions that accurately reflect the objectives that the provincial governments were pursuing. Based on the theoretical framework of Lovell (1995), Sahoo and Acharya (2012) chose 3 dimensions to assess the macroeconomic performance of 22 Indian states, namely the gross state domestic product growth, price stability, and the fiscal balance.

Currently, in Vietnam, a set of indicators that could objectively assess the macroeconomic performance at the provincial level does not exist. Two sets of indicators that are widely employed by researchers include the Provincial Competitiveness Index (PCI) and the Public Administration Performance Index (PAPI). However, these two sets of indices only represent one aspect of the results of operating macroeconomic policies at the provincial level. While the PCI evaluates and ranks the business environment of each province, which shows their ability to establish a favorable environment for the development of private enterprises, the focus of PAPI is to investigate the effectiveness of the conduct and enforcement of policy and the provision of public services. Obviously, compared with PAPI, PCI is much more suitable for the purpose of cross-provincial study, however its focus on the aspect of the business environment will not provide useful information on the effectiveness of factor utilization. Also, one basic weakness of these two indices is that they are formulated from

certain component indicators using a set of fixed weights, which was subjectively assigned based on the opinion of the responsible agencies.

The effective utilization of resources, including capital and labour, would lead to better macroeconomic performance. To give the most comprehensive assessment of the effectiveness of macroeconomic activities, the PCI was also considered as one of the output dimensions, similar to other objectives. Additionally, as a developing country following the path of industrialization, the objectives that Vietnam's provinces are pursuing are not only limited to high growth, price stabilization and high employment rates, but also include positive structural changes and foreign direct investment attraction. Thus, constructing a composite index to better evaluate the effectiveness of macroeconomic performance and to take into account the various goals and objectives of Vietnam's provincial governments, is of extreme importance.

This study employed the theoretical framework of Lovell (1995) to methodologically construct a composite index that can be used to evaluate the macroeconomic performance at the provincial level in Vietnam. Instead of focusing on suggestions of specific policies, data from 2011 to 2015 was utilized mostly for the illustration of the method. Apart from the introduction, the paper includes 4 parts: (i) Literature reviews; (ii) Theoretical framework; (iii) Empirical Results; and (iv) Conclusions.

2. Literature review

Data envelopment analysis (DEA) was first proposed by Charnes, Cooper, and Rhodes (1978), and was based on the previous analysis of Farrell (1957) regarding the estimation of technical efficiency using the production frontier. DEA is a non-stochastic and parametric method that was based on the linear programming problem. Recently, DEA has become more widely used to measure the effectiveness of decision-making units (DMUs) and can be applied to multiple inputs and/or outputs. In other words, DEA allowed relative comparison of the level of effectiveness between different DMUs.

Recently, there has been a very important development in the use of DEA, which is the application of this method to evaluate the macroeconomic performance of an economy in relation to other economies. In those models, various output dimensions will be the indicators that represent economic performance. The first study that laid the foundation for this development is Lovell (1995), in which the author utilized the free disposal hull model (FDH) to evaluate macroeconomic performance of Taiwan's economy in the period from 1970-1988 in comparison with other economies. This study employed 4 outputs that were scaled into the 0 to 100 range. Those included basic macroeconomic objectives: economic growth; employment rate; trade balance and price stability.

Based on this model, Vu Kim Dung, Ho Dinh Bao and Nguyen Thanh Tung (2015) computed the effectiveness of macroeconomic activities in Vietnam in comparison with the ASEAN +3 countries and from that illustrated the risk that Vietnam's economy might be lagging behind other countries in the region.

Unlike comparisons at the national level, evaluating the performance between different regions within a country would make some of

the national indicators (trade openness as an example) become inappropriate. This comparison, however, is quite agreeable with the assumptions made in the model by Lovell (1995), even more so than the comparisons at the national level. In the model, Lovell assumed that all DMUs use the same input vector (the input represented macroeconomic policies). Different regions within the same country will apparently have the same policy inputs (or at least the differences are negligible), while at the national level, this condition might not be satisfied as countries pursued different development models.

There are several recently published empirical studies that have applied the concept of DEA to construct a composite index for the purpose of measuring macroeconomic performance at the regional level. The most notable is the paper by Sahoo and Acharya (2012). The authors incorporated 2 different approaches to evaluate 22 Indian states in the period from 1994-1995 to 2001-2002, which were: (i) the "grand MEP frontier approach" which was based on the study of Lovell (1995), and (ii) the Malmquist approach to assess the change in effectiveness of the states' macroeconomic activities between periods. To measure MEP, the authors employed both forms of DEA models, which were the traditional radial DEA model and the model based on non-radial output-oriented slack-based measure. In this paper, the output dimensions included two in the OECD's Magic Diamond which were the growth rate of GDP per capital and the state price stability index. Besides, in the model, the authors also incorporate several other dimensions which indicated other characteristics of the states' economic development.

A recent study by Le Quoc Hoi, Ho Dinh Bao and Nguyen Thanh Tung (2016) made calculations to measure the effectiveness of macroeconomic activities at the provincial level of Vietnam. However, due to the limit of data availability, the paper only conducted the evaluation for a single year, without considering the changes of effectiveness overtime. In the paper, the author employed 3 different methods to assess and compare the effectiveness of socio-economic activities of Vietnam's province in the year 2014.

3. Theoretical framework

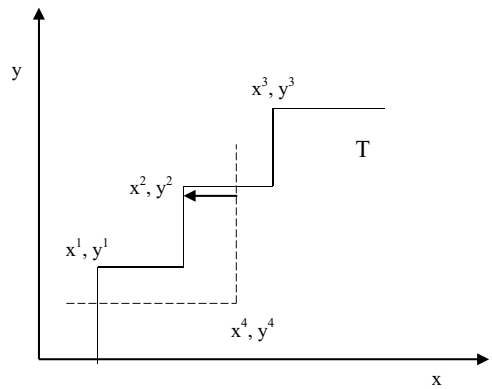
The FDH model

The free disposal hull model was first proposed by Deprins, Simar, and Tulkens (1984) without convexity assumption of production function. It means that this is a discrete function. In other words, DMUs that achieved the highest efficiency are not necessarily located on the frontier as in a conventional DEA model (Figure 1). The first use of the FDH model to evaluate macroeconomic performance is in the study of Lovell (1995), in which the author employed the model to compare the effectiveness of Taiwan's macroeconomic activities with other countries in East Asia and South East Asia.

A set of decision making units, indexed $i = 1,\ldots,I$, uses inputs $x^i = (x_1^i,\ldots, x_n^i) \in R_+^n$ to produce outputs $y^i = (y_1^i,\ldots, y_n^i) \in R_+^m$. The objective of DMUs is assumed to maximize outputs with given inputs,

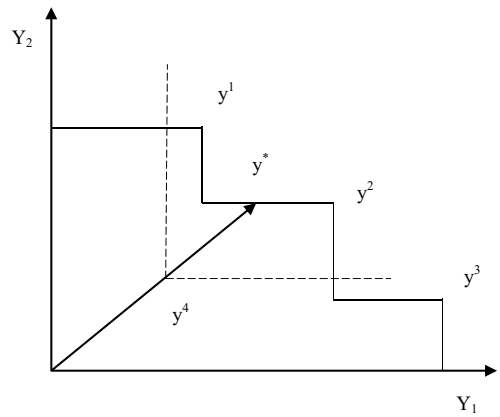
The production possibilities set $T = \{(x,y): x$ can produce $y\}$ with the given data $\{(y^i x^i), i = 1,..., I\}$. The only assumption for T set is 'free disposal' in the FDH model. A production pos-

Figure 1: Production function in FDH model



Source: Lovell (1995)

Figure 2: Production possibility function in FDH model



sibilities set satisfies that requirement if (x,y) ∈ T, => (x',y') ∈ T, ∀ x'≥x, y'≤y. In figure 1, T contains the observed data ($x^i y^i$), i = 1,…,4, and all other unobserved with no more output and no less output. The model in figure 2 assumed that all DMUs use the same input vector, hence, T consists of observed output vectors y^i, i = 1,…,4, and all output vectors without any larger component.

With the goal assumed to maximize outputs at a fixed input, the operation of the DMUs is measured based on the ability to reach this goal. Measuring the performance consists of two components: *dominance* and *efficiency*.

A DMU is dominated by the all the DMUs using no more of each input to produce no less of each output. And the DMU dominates all the DMU which using no less of each to produce no more of each output. In figure 1, DMU^1, DMU^2 and DMU^3 all are undominated. Whereas, DMU^4 is dominated by DMU^1, DMU^2 and all located in the quadrant northeast of it. The DMU^4 also dominates all DMUs located in the quadrant southeast of it.

In Figure 2, DMUs use the same input vector, and DMU^1, DMU^2 and DMU^3 with the output vectors y^1, y^2 and y^3, respectively, all are undominated. Similar to the case in Figure 1, the DMU^4 with output vector y^4 is dominated by DMU^1, DMU^2 and all DMUs located in the quadrant northeast of it. It also dominates all DMUs located in the quadrant southeast of it.

The efficiency of a DMU is measured by comparing its input-output vector with that of the most dominant of the DMUs that dominate it. In both Figure 1 and Figure 2, DMU^i, i=1,…,3 are each undominated and radially efficient. The DMU^4 is dominated and radially inefficient, with the radial efficiency score $y^4/y^2<1$. Hence, the most dominant of the DMU^4 (x^4, y^4) is the DMU^2 (x^2, y^2) in the first case. And the second case, the DMU^4 which produce y^4 output, is dominated and radially inefficient, with the radial efficiency score $y_2^4 / y_2^2 = y_1^4 / y_1^* <$ 1, the most dominant of it is the DMU^2.

The SBM model

Although being widely used in measuring macroeconomic performance, in both the FDH

model and the other traditional DEA models, the efficiency score and the level of slack are calculated separately. Therefore, to overcome this issue, in this paper, the authors will employ the efficiency-measuring scheme proposed by Tone (2001).

This model is based on the argument that a DMU is only considered to be optimal if this DMU satisfies both of those 2 conditions: (i) the traditional radial efficiency score is 1 (it lies on the optimal frontier), and (ii) there is no slack at any of the inputs/outputs. The SBM model combined both of those facts regarding the traditional radial efficiency score and the level of slack in each of the outputs to create a scalar measure to evaluate the overall level of macroeconomic performance. In this case, the output-oriented problem becomes:

$$\theta^{0} = max\ \left(1+\frac{1}{m}\sum_{j=1}^{m} s_j^{+} \Big/ y_j^{0}\right)$$

$$Subject\ to:\ \sum_{i=1}^{I}\lambda_i^0 y_j^i - s_j^{0+} = y_j^0 \quad j = 1,\ldots, m$$

$$\lambda_i^0 \geq 0,\ \sum_{i=1}^{I}\lambda_i^0 = 1 \quad (***)$$

$$\lambda_i^0 \in \{0,1\}$$

$$s_j^{0+} \geq 0$$

In which, s_j^{0+} measures the level of input slack regarding the input j of DMU^{0+}. In the cases in which the input vectors are different between DMUs, the input slacks measure the level of ineffectiveness in the use of inputs of DMUs. The SBM model is solved by transforming it into a linear programming problem, which follows those steps similar to the DEA CCR problem (Tone, 2001). A DMU^0 is considered efficient if $\theta^{0}=1$, this is equivalent to $s_j^{0+} = 0(\forall j)$, which means there is no slack in any of the DMU's outputs.

Tone (2001) suggests that if a DMU is considered efficient in traditional FDH models (which means it satisfied the 2 conditions mentioned above) then the DMU is also considered efficient in the SBM model. Therefore, it could be said that the efficiency score in the SBM model incorporates more information compared to those in the traditional models. For example, a DMU with an efficiency score of 1 in the traditional models might still have slack in one of the outputs, meanwhile, in the SBM model, this DMU will receive an efficiency score smaller than 1.

4. Empirical results

4.1. Selection of component indicators

In this study, 4 groups of indicators were selected to use as outputs, in order to evaluate different socio-economic aspects of the provinces/cities. The variables that were chosen as outputs including: economic growth rate; the level of price stability; the employment rate; the rate of structural change; the poverty rate; and the Provincial Competitiveness Index (PCI).

The economic growth rate (g) is collected from the General Statistics Office (GSO), the Statistical Yearbook and the Annual Socio-Economic Report of each province.

Price stability (p) measures the level of price stability and is calculated as 1 minus the rate of inflation (computed by the local CPI). Local CPI data is collected from the GSO.

The rate of employment improvement (e) measures the growth rate of the proportion of population aged 15 and older that is currently

working. The data is collected from the annual Report on Labour Force Survey by the GSO; this indicator shows whether the employment rate of a province is improved over time.

The rate of structural change (φ) measure the degree of economic structural change within a given period and is calculated using the formula:

$$Cos\varphi = \frac{\sum_{i=1}^{3} S_i^t * S_i^{t-1}}{\sqrt{\sum_{i=1}^{3}\left(S_i^t\right)^2} * \sum_{i=1}^{3}\left(S_i^{t-1}\right)^2}$$

S_i^t is the share of sector *i* in year *t*

According to this formula, $Cos\varphi \in [0,1]$, when $Cos\varphi = 1$ there would be no structural change; the smaller the value of $Cos\varphi$, the faster the rate of structural change. In this study, the rate of structural change is considered to represent the transformation of the economy to a more positive direction. As each of the provinces will tend to focus on the development of the sector in which they have more advantages, it is not necessary for all the provinces to follow the sole objective of reducing the proportion of the agricultural sector and increasing the share of the industrial sector. For that reason, in this paper, the rate of structural change is measured by the value of φ in degrees.

The improvement of living standards (l) measures the change in the quality of life of the people in each of the provinces. In this paper, living standards are assumed to be improved if the income per capita of a household is increased. Therefore, the improvement of living standards could be measured by the change in the proportion of population that live above the poverty line, or 1 minus the poverty rate. The poverty rate of each province is collected in the annual Statistical Yearbook by the GSO. The poverty rate is calculated using the average monthly income of the household, which adjustment for specific region and for inflation over the years.

Provincial Competitiveness Index (PCI) ranked the quality of conducting economic operations of the provincial governments, specifically in creating a favorable policy environment for the development of private enterprises.

In this study, the inputs vector is considered to be identical among all the provinces, with the assumption that the provinces adopted the same sets of policies established by the national government. In the studies of (Lovell, 1995), (Lovell, Pastor, and Turner, 1995), making this assumption of identical inputs vector between countries might be considered too strong. However, at the provincial level within the same country, this assumption is much more reasonable and could be accepted.

The outputs are categorized into 4 groups with the objective of evaluating different aspects of provincial macroeconomic activities, including:

- Group 1 – group of economic indicators: g, p, e
- Group 2 – group of economic indicators with structural consideration: g, p, e + φ
- Group 3 – group of socio-economic indicators: g, p, e, φ + l
- Group 4 – group of socio-economic and institutional indicators: g, p, e, φ, l + PCI

4.2. Empirical results

Economic aspect (g, p, e) – Model I

The first model evaluated the performance of 63 cities/provinces based purely on three eco-

Table 1: Provincial ranking by economic aspect – Model I

City/province	2011	2012	2013	2014	2015	City/province	2011	2012	2013	2014	2015
Hanoi	50	25	33	53	38	Quang Nam	42	18	23	8	13
Hai Duong	37	59	25	45	19	Quang Ngai	57	39	10	34	46
Hai Phong	49	40	55	24	14	Binh Dinh	16	49	43	36	43
Hung Yen	35	48	42	50	45	Phu Yen	8	37	24	60	6
Thai Binh	21	14	48	22	5	Khanh Hoa	20	41	44	35	63
Ha Nam	48	22	32	15	9	Kon Tum	24	6	22	42	39
Nam Dinh	59	38	4	12	17	Gia Lai	30	16	7	48	31
Ninh Binh	3	7	6	11	10	Dak Lak	36	46	63	54	30
Ha Giang	43	54	37	56	60	Lam Dong	14	21	9	43	48
Cao Bang	62	60	36	41	62	Dak Nong	46	27	47	47	53
Bac Kan	22	5	26	10	57	Ninh Thuan	58	32	40	5	40
Tuyen Quang	12	10	59	20	4	Binh Thuan	41	36	15	28	33
Lao Cai	33	45	30	29	36	Binh Phuoc	28	4	14	3	58
Yen Bai	56	28	34	37	24	Tay Ninh	10	13	12	38	21
Thai Nguyen	55	44	50	2	1	Binh Duong	40	2	20	14	18
Lang Son	53	62	46	9	42	Dong Nai	29	19	8	21	16
Quang Ninh	6	33	51	58	34	BR-VT	25	52	56	40	50
Bac Giang	38	26	21	7	20	HCM city	15	9	16	33	2
Phu Tho	44	57	58	26	26	Long An	39	1	18	39	22
Vinh Phuc	60	63	41	6	55	Tien Giang	52	3	27	62	27
Bac Ninh	5	30	29	61	49	Ben Tre	63	58	61	44	51
Dien Bien	61	50	60	16	7	Vinh Long	23	31	35	4	47
Lai Chau	45	11	1	63	28	Tra Vinh	31	17	39	46	8
Son La	47	35	31	57	11	Dong Thap	11	20	38	32	59
Hoa Binh	4	47	54	31	23	An Giang	19	53	5	51	52
Thanh Hoa	17	15	17	17	35	Kien Giang	13	12	11	25	37
Nghe An	32	55	3	55	32	Can Tho	7	8	13	27	15
Ha Tinh	2	24	2	1	29	Soc Trang	51	56	19	49	41
Quang Binh	27	43	45	18	54	Hau Giang	34	42	62	52	56
Quang Tri	54	51	57	23	3	Bac Lieu	9	61	49	59	61
Thua Thien Hue	18	29	53	19	25	Ca Mau	26	23	28	30	44
Da Nang	1	34	52	13	12						

Source: Authors' computation by Slack Based Model

nomic indicators: growth, price stability and employment. The results which are reported in Table 1 show that the macroeconomic performance of provinces experienced notable changes in the period from 2011-2015. This phenomenon reflected the unstable nature of the development over time in most of the provinces. There are 50/63 provinces that have their ranks changed by more than 10 positions in the ranking in 2015 compared with those in 2011. Simultaneously, the average level of change during this period is 21,4 positions.

In 2011, the provinces with the highest rankings, when only considering the economic aspects, were Da Nang, Ha Tinh, Ninh Binh, Hoa Binh, Bac Ninh, Quang Ninh, and Can Tho. This was the leading group with maximum efficiency scores from the calculation of the SBM model. However, by 2015, there were notable changes in the ranking. Apart from Ninh Binh, which was the only province that

maintained efficiency throughout the period, the rest of the group mostly fell in the ranking. In which, Da Nang fell from rank 1 in 2011 to rank 52 in 2013 before rising again to rank 12 in 2015. This decline in rank was mostly because the city's growth rate and level of price stability decreased relatively compared to the rest of the country. The figures showed that the growth rate of Da Nang fell from 12% in 2011 (21/63) to 9.1% (34/63), while the inflation rate fell from rank 23/63 in 2011 to 55/63 in 2013. Ha Tinh, although managing to maintain high ranking in 2011, 2013 and 2014, fell to rank 29 in 2015. In all of the 63 cities/provinces, Bac Ninh (49), Dong Thap (59) and Bac Lieu (61) were the provinces that experienced the sharpest drop in ranking from 2011 to 2015, with the declines in ranking to 44, 48 and 52 positions, respectively.

On the other hand, some provinces made significant breakthroughs in their performance ranking in 2015. The most notable were Thai Nguyen (1), Dien Bien (7), and Quang Tri (3). These three provinces increased their rankings respectively by 54, 54 and 51 positions compared to 2011 and entered the leading group. While Thai Nguyen achieved an impressive growth rate of 25,7% in 2015, Quang Tri had the highest rated level of price stability.

Among the major cities, Hanoi showed that its level of macroeconomic performance was on average with the rest of the country, it maintained a fairly low position in the ranking (ranked 50 in 2011 and 38 in 2015). On the other hand, HCM City possessed fairly high ranking through the years, which peaked in 2015 with its position reaching number 2 out of 63 provinces in the country.

Economic with structural changes aspect (g, p, e +) – model II

The addition of structural change indicators showed significant changes in macroeconomic performance in some of the provinces, which are presented in Table 2. This suggested that restructuring the economy was at higher priority (compared to other objectives) in some of the provinces. Meanwhile, the addition of other criteria such as poverty rate or CPI makes only small changes in ranking. The change in rating between the two models utilizing the SBM method stretched in the range from down 34 positions to up 42 positions. The average level of change according to this method is 10,6 positions. At the same time, the average efficiency score, as well as the number of provinces that achieved an above-average score, also displayed a rapid decline trend in the period from 2011-2015.

In particular, the rank of Thai Nguyen from 2011-2013 is considerably lower than those in the first model, which put this province at the bottom of the ranking before it broke into the leading group in 2014 and 2015. This incidence implied that in addition to the goal of pure economic development, Thai Nguyen is one of the provinces that focuses on structural change. In the earlier years, the rate of structural change in Thai Nguyen was far slower than the other provinces. However, a high rate of structural change combined with a high growth rate helped catapult Thai Nguyen into the leading positions in 2014 and 2015. On the contrary, some provinces were not be able to maintain their leading position after the addition of the structural change variable. These included Can Tho (fell from rank 1 in 2011 to rank 35 in

Table 2: Provincial ranking by economic with structural changes aspect– Model II

City/province	2011	2012	2013	2014	2015	City/province	2011	2012	2013	2014	2015
Hanoi	56	53	51	55	48	Quang Nam	44	34	28	41	20
Hai Duong	57	54	32	21	29	Quang Ngai	45	50	25	39	49
Hai Phong	49	56	52	57	10	Binh Dinh	22	24	15	56	44
Hung Yen	40	28	21	24	47	Phu Yen	14	37	22	50	26
Thai Binh	16	14	23	12	30	Khanh Hoa	27	38	35	36	63
Ha Nam	41	30	24	38	5	Kon Tum	23	10	17	9	33
Nam Dinh	53	35	7	28	37	Gia Lai	35	49	26	34	23
Ninh Binh	7	8	2	10	25	Dak Lak	10	19	59	25	27
Ha Giang	48	36	38	60	60	Lam Dong	20	22	6	15	6
Cao Bang	11	39	42	23	62	Dak Nong	38	26	54	61	51
Bac Kan	54	7	47	35	58	Ninh Thuan	52	20	56	16	21
Tuyen Quang	39	12	63	52	38	Binh Thuan	55	44	40	2	28
Lao Cai	13	43	19	22	3	Binh Phuoc	25	1	13	4	41
Yen Bai	50	47	36	46	14	Tay Ninh	3	4	18	13	11
Thai Nguyen	62	57	57	3	1	Binh Duong	26	9	48	48	19
Lang Son	59	62	37	17	32	Dong Nai	24	48	45	54	39
Quang Ninh	5	21	53	18	42	BR-VT	36	52	62	20	61
Bac Giang	46	40	12	33	13	HCM city	19	41	50	40	4
Phu Tho	58	59	60	26	40	Long An	42	2	30	19	34
Vinh Phuc	18	63	39	5	57	Tien Giang	33	3	34	42	7
Bac Ninh	9	55	41	63	43	Ben Tre	60	33	29	49	45
Dien Bien	63	6	44	27	2	Vinh Long	31	13	10	6	52
Lai Chau	32	32	4	7	54	Tra Vinh	17	16	3	11	12
Son La	51	11	33	30	22	Dong Thap	21	23	61	44	17
Hoa Binh	8	46	31	14	24	An Giang	28	60	11	8	50
Thanh Hoa	37	25	8	47	36	Kien Giang	12	15	16	45	16
Nghe An	43	58	9	53	15	Can Tho	1	27	20	43	35
Ha Tinh	2	5	1	1	18	Soc Trang	34	18	5	32	59
Quang Binh	29	45	49	37	53	Hau Giang	61	17	46	58	56
Quang Tri	30	29	55	59	8	Bac Lieu	4	61	58	62	55
Thua Thien Hue	15	51	14	29	46	Ca Mau	47	42	43	51	31
Da Nang	6	31	27	31	9						

Source: Authors' computation by Slack Based Model

2015); Ha Tinh (fell from rank 1 from 2011 to 2014 to rank 18 in 2015); Bac Lieu (fell from rank 4 in 2011 to the bottom group in the ranking from 2012 to 2015).

Compared with the pure economic ranking, some provinces showed significant improvement in their macroeconomic efficiency score, which included Lao Cai (3), Lam Dong (6), and Tien Giang (7). Lam Dong increased its ranking by 42 positions while Lao Cai and Tien Giang rose up respectively 33 and 30 positions in 2015. This incidence can be explained by the sizeable change in the structure of those provinces, with the respective growth rate of structural change reaching 9,3^{o}; 10,3^{o} and 8,3^{o}, the highest among all the provinces.

Meanwhile, the group of provinces with weak economic performance showed little change after the inclusion of the structural change indicator. Accordingly, Ha Giang, Cao

Table 3: Provincial ranking by socio-economic aspect– Model III

Cities/Provinces	2011	2012	2013	2014	2015	Cities/province	2011	2012	2013	2014	2015
Hanoi	60	53	50	49	10	Quang Nam	37	25	28	32	20
Hai Duong	59	55	33	30	31	Quang Ngai	39	12	26	33	50
Hai Phong	55	57	52	50	13	Binh Dinh	33	29	16	55	46
Hung Yen	45	34	22	43	49	Phu Yen	19	38	23	46	28
Thai Binh	24	19	24	25	34	Khanh Hoa	42	43	35	34	63
Ha Nam	44	33	25	35	5	Kon Tum	10	10	18	17	35
Nam Dinh	58	37	10	37	40	Gia Lai	36	46	27	31	26
Ninh Binh	13	8	1	16	32	Dak Lak	18	22	57	58	29
Ha Giang	5	11	4	51	60	Lam Dong	28	26	7	21	4
Cao Bang	15	41	44	20	62	Dak Nong	31	30	53	54	55
Bac Kan	11	5	46	8	59	Ninh Thuan	54	21	58	18	27
Tuyen Quang	49	14	63	6	6	Binh Thuan	61	47	41	5	30
Lao Cai	3	44	20	7	2	Binh Phuoc	40	1	14	11	42
Yen Bai	53	48	38	48	17	Tay Ninh	4	7	19	19	15
Thai Nguyen	56	56	56	4	3	Binh Duong	41	13	49	45	23
Lang Son	57	63	37	15	36	Dong Nai	38	50	45	47	43
Quang Ninh	7	23	54	22	45	BR-VT	46	51	62	23	61
Bac Giang	34	39	13	27	16	HCM city	26	45	51	38	7
Phu Tho	52	59	60	13	41	Long An	50	3	31	24	38
Vinh Phuc	22	61	39	9	58	Tien Giang	48	4	36	40	8
Bac Ninh	17	54	43	63	44	Ben Tre	62	35	30	57	47
Dien Bien	16	2	40	2	1	Vinh Long	47	17	11	10	54
Lai Chau	9	9	3	3	52	Tra Vinh	23	16	5	26	14
Son La	35	15	34	28	24	Dong Thap	29	27	61	53	21
Hoa Binh	8	49	32	12	25	An Giang	43	60	12	14	51
Thanh Hoa	14	28	8	36	39	Kien Giang	20	18	17	42	22
Nghe An	25	58	9	59	18	Can Tho	2	31	21	39	37
Ha Tinh	1	6	2	1	19	Soc Trang	32	24	6	56	11
Quang Binh	30	40	48	52	53	Hau Giang	63	20	47	61	57
Quang Tri	27	32	55	62	9	Bac Lieu	6	62	59	60	56
Thua Thien Hue	21	52	15	41	48	Ca Mau	51	42	42	44	33
Da Nang	12	36	29	29	12						

Source: Authors' computation by Slack Based Model

Bang and Khanh Hoa showed no discernable improvement and ranked respectively 60, 62 and 63 in 2015.

With a relatively stable economic structure, the major cities, which included Hanoi, Da Nang and HCM City displayed almost no sign of notable movement during the period from 2011 to 2015. This fact was the reason why these cities' ranks all dropped significantly compared to the results from model I.

Socio-economic aspect (g, p, e, φ + l) – Model III

Model III added indicators that measured the improvement of living standards, in order to evaluate the economic and social aspect of provincial macroeconomic performance presented in Table 3. The empirical results showed that there was not much change in the ranking, compared with model II. The average level of ranking movement was only 3,9 positions.

Table 4: Provincial ranking by Socio-economic and institutional aspects – Model IV

Cities/Provinces	2011	2012	2013	2014	2015	Cities/Provinces	2011	2012	2013	2014	2015
Hanoi	56	56	57	54	9	Quang Nam	11	35	12	4	4
Hai Duong	54	55	33	24	43	Quang Ngai	38	10	32	49	18
Hai Phong	53	58	45	57	13	Binh Dinh	36	17	9	47	46
Hung Yen	43	37	28	43	54	Phu Yen	44	31	23	48	42
Thai Binh	28	25	25	20	25	Khanh Hoa	20	44	34	44	31
Ha Nam	58	39	31	38	6	Kon Tum	41	42	38	35	62
Nam Dinh	60	46	16	36	35	Gia Lai	16	16	26	21	33
Ninh Binh	1	15	1	7	21	Dak Lak	46	48	30	37	24
Ha Giang	17	28	6	52	57	Lam Dong	24	30	60	58	36
Cao Bang	9	53	51	29	63	Dak Nong	47	38	13	28	5
Bac Kan	12	12	56	16	61	Ninh Thuan	30	40	58	61	60
Tuyen Quang	48	29	63	11	8	Binh Thuan	57	33	62	22	26
Lao Cai	18	24	5	2	1	Binh Phuoc	59	50	49	5	44
Yen Bai	51	51	47	46	19	Tay Ninh	27	9	22	12	51
Thai Nguyen	61	57	37	3	3	Binh Duong	3	13	24	26	14
Lang Son	50	63	41	14	39	Dong Nai	21	18	52	45	22
Quang Ninh	10	34	17	27	34	BR-VT	39	45	50	55	40
Bac Giang	42	52	21	30	16	HCM city	35	43	44	23	58
Phu Tho	62	62	61	17	45	Long An	31	1	54	34	7
Vinh Phuc	22	61	40	6	53	Tien Giang	33	4	35	25	29
Bac Ninh	5	11	42	63	37	Ben Tre	29	27	36	42	10
Dien Bien	2	14	48	10	2	Vinh Long	55	8	11	59	41
Lai Chau	14	5	4	13	48	Tra Vinh	45	2	18	9	52
Son La	49	23	39	32	27	Đong Thap	26	6	3	19	15
Hoa Binh	4	59	43	15	38	An Giang	7	22	19	8	17
Thanh Hoa	13	36	10	39	28	Kien Giang	32	3	20	18	47
Nghe An	37	60	15	53	30	Can Tho	19	7	14	40	23
Ha Tinh	6	19	2	1	20	Soc Trang	8	20	27	41	32
Quang Binh	40	47	55	56	59	Hau Giang	25	32	8	31	11
Quang Tri	34	41	59	62	12	Bac Lieu	63	26	29	51	55
Thua Thien Hue	23	49	7	33	49	Ca Mau	15	21	46	60	56
Da Nang	56	56	57	54	9						

Source: Authors' computation by Slack Based Model

In 2015, only 3 provinces, which were Tuyen Quang (moved up 32 positions), Ha Noi (moved up 38 positions) and Soc Trang (moved up 48 positions) displayed strong improvement in comparison with their ranks in model II. This implied that these provinces highly rated the objective of poverty reduction and prioritized it more than the other objectives.

The fact that the models used no fixed weighting scheme helped those provinces like Ho Chi Minh City (7) or Binh Duong (23) maintained a high position in 2015, despite little change in their poverty rates. Apparently, with an already low level of poverty, Ho Chi Minh City or Binh Duong would not prioritize the objective of improving living standards over the other goals of economic growth or price stabilization.

Overall, in the aspect of socio-economic development, Dien Bien, Lao Cai and Thai Nguyen were still the provinces with the highest efficiency scores. Already having high rankings in model II, combined with well-performed poverty reduction activities, these provinces succeeded in maintaining their leading positions. On the other hand, the group at the bottom of the ranking also experienced little change and

still included provinces such as Ha Giang, Ba Ria – Vung Tau, Khanh Hoa and Cao Bang.

Socio-economic and institutional aspects (g, p, e, φ, l + PCI) – model IV

The last model comprehensively included indicators that represent the aspect of economic, social and institutional development in the provinces and was expected to give information on the prospect of long-term, sustainable and inclusive economic development in the provinces which is reported in Table 4. Similar to model III, the addition of the PCI ranking as another output variable created significant changes in the ranking of the provinces, especially in the year 2011, 2012, and 2013. The average level of ranking change compared to model III in this period were 6,7; 10,2 and 7,5 positions.

While some provinces including Binh Duong, Dong Thap and Tien Giang improved their ranks after the inclusion of the PCI variables in 2011, Lao Cai and Lam Dong's ranks changed in the opposite direction. This suggested that each of the provinces had a different consideration for the goal of improving PCI, compared to the other socio-economic objectives.

However, the performance ranking in 2015 in the final model displayed not many changes in comparison with model II and model III. Lao Cai, Dien Bien and Thai Nguyen were still the provinces leading in the ranking, due to rapid economic growth rate combined with positive structural changes and high positions in the PCI ranking. In contrast, at the bottom of the ranking, Bac Kan, Khanh Hoa and Cao Bang showed almost no sign of improvement even after the inclusion of the PCI variable.

5. Conclusion

By incorporating different existing methods, this study developed a new method to construct a composite index for the purpose of evaluating the macroeconomic performance of the provinces in the country. The study also illustrated this method by calculating the index of macroeconomic performance of the provinces in Vietnam for the period 2011-2015 and produced the corresponding rankings with 4 different groups of indicators - Economic aspect; Economic with structural changes aspect; Socio-economic aspect; Socio-economic and institutional aspects.

With flexible weighting of each component, the estimated results of those four models show that as the whole economy, almost every province strongly focuses on economic growth rather than the other aspects of structural change, poverty reduction and institutional improvement. Such an economic development model may threaten the long term and sustainable development objectives and exclude vulnerable groups in the society. Generally, richer provinces tend to focus more on the economic aspect, while poorer provinces show better performance in structural change and poverty reduction. This actually differs from what we know about economic development. Rather than converging, it may enlarge the gap in the development process among provinces and groups of population. Within the 3 major economic centers of Vietnam, structural change and institutional improvement seem to be the biggest problems for Hanoi and Ho Chi Minh City, while Da Nang experiences a poor performance in poverty reduction.

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