Study on distribution and economic growth based on feder-model: evidence from Fujian province in China

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Abstract

The effect of distribution expansion on economic growth is examined as one of the sources of growth. The research available mostly focused on the direct effect of distribution and ignored the externality effect of distribution. The paper tested the direct effect of distribution on economic growth in Fujian province, China with the indicators such as direct contribution and direct contribution rate, and an analytical framework is developed, incorporating the possibility that marginal factor productivities are not equal in the distribution and non-distribution sectors of the economy. Econometric analysis utilizing this framework in the period 1978-2011 indicates that the existence of externality effect generated by distribution sector, which is much larger than the direct effect, significantly affected the economic growth in Fujian province, China. However, the results indicate the marginal productivity of distribution sector is lower than non-distribution sector in Fujian province, which constrains the externality effect of distribution sector. We should take action to improve the level of modernization and informationization of distribution sector and turn distribution sector from labour-intensive to technology-intensive as soon as possible.

Keywords: distribution sector, direct effect, externality effect, feder-model

1 Introduction

The research on the relationship between distribution sector and economic growth is important to clarify the role of distribution sector in regional economy. Researchers have made a thorough inquiry upon this issue from different angles, and have drawn some conclusions such as "distribution industry is a leading industry" [1], "distribution industry is a basic industry" [2], and "distribution industry is a strategic industry" [3], etc. The research above helped to explore the role of distribution sector contributing to the regional economic growth.

Many scholars also did empirical research on distribution and economic growth via mathematical statistics, econometrics and other methods. Qiao Jun estimated the contribution rate with regression analysis and proportion of distribution sector in Chinese national economy from 1986 to 1998, and concluded that the contribution rate of distribution sector in national economy in China was 10.08% from 1986 to 1998. It means that the growth of distribution sector by 1% will bring about the growth of Gross Domestic Products (shorted as GDP) by 0.1088% in China [4]. Zhou Chang-ling, Wen Qi-xiang extended the Solow Model of economy growth and obtained a new function of economy growth. The function illustrates that the growth rate of economy depends on the growth rate of distribution sector when the growth rate of key element, especially the growth rate of technology is constant [5].Yang Yi-miao investigated the contribution and its measurement methods of distribution sector to the economic growth from the views of GDP or GNP's growth, employment opportunities increase, national welfare and urban development respectively [6]. Zhao Ping analysed econometrically the direct and indirect contributions of distribution sector to the economic growth using multiple regression analysis and drew three conclusions: firstly, the externality effect of distribution sector to the economic growth was underestimated by using traditional analysis methods. Secondly, distribution sector played a significant role in the macro economy due to its contribution to macro economy, its radiation to regional economy, its control to upstream industry as well as its service capability to the consumption. Thirdly, the important role of distribution sector in the economic growth and the development of society have not been fully revealed since the constraints of distribution system and the block of transmission mechanism distribution [7].

2 The direct effect of distribution sector in Fujian Province, China

Generally, one can measure the contribution of distribution sector made to the growth of regional economy with direct contribution and direct contribution rate. In the paper, the direct contribution of distribution sector is measured by the proportion of distribution sector

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accounting for GDP. Taking Fujian Province as an example, it can be seen from Table 1 that the proportion of distribution sector in the aggregate output of Fujian province kept increasing in the last 35 years on the whole. Especially, it rose from about 9% in 1978 to 15% in recent years. Distribution sector has been one of the major components of the economy in Fujian Province.

In addition, distribution sector plays a key role in the economic growth in Fujian Province which can be measured by the direct contribution rate. The direct contribution rate can be expressed as

$$\lambda_t = \frac{CI_t - CI_{t-1}}{GDP_t - GDP_{t-1}} \times 100\% \ , \qquad (1)$$

where λ_t – the direct contribution rate, CI_t – the added value of distribution sector in year *t*, GDP_t – the GDP of Fujian province in year *t*.

Results adopting Equation (1) are reported in Table 2.

As can be seen from Table 2, the direct contribution rate of distribution sector in Fujian province fluctuated from 14% to 21% on the whole. Although the direct contribution rate became negative in 2005, it resumed high growth in 2006 soon. Since 1978, with the rapid economic development in Fujian Province, the materials exchange between Fujian and the outside world has been increasingly frequently. The distribution sector has become one of the pillar industries in the economic development of Fujian Province gradually.

TABLE 1 Direct effect of distribution sector in Fujian province 1978-2012

Year	the added value of distribution sector (hundred million Yuan)	GDP (hundred million Yuan)	Direct contribution (%)	Direct contribution rate (%)
1978	6.48	66.37	9.76%	–
1979	6.37	74.11	8.60%	-1%
1980	9.11	87.06	10.46%	21.16%
1981	12.5	105.62	11.83%	18.27%
1982	14.46	117.81	12.27%	16.08%
1983	16.57	127.76	12.97%	21.21%
1984	21.3	157.06	13.56%	16.14%
1985	28.17	200.48	14.05%	15.82%
1986	31.51	222.54	14.16%	15.14%
1987	41.85	279.24	14.99%	18.24%
1988	57.98	383.21	15.13%	15.51%
1989	70.37	458.40	15.35%	16.48%
1990	83.93	522.28	16.07%	21.23%
1991	100.98	619.87	16.29%	17.47%
1992	127.98	784.68	16.31%	16.38%
1993	169.75	1114.20	15.24%	12.68%
1994	237.66	1644.39	14.45%	12.81%
1995	296.85	2094.90	14.17%	13.14%
1996	362.61	2484.25	14.60%	16.89%
1997	415.29	2870.90	14.47%	13.62%
1998	667.82	3159.91	21.13%	87.38%
1999	731.24	3414.19	21.42%	24.94%
2000	809.77	3764.54	21.51%	22.41%
2001	858.43	4072.85	21.08%	15.78%
2002	910.97	4467.55	20.39%	13.31%
2003	999.40	4983.67	20.05%	17.13%
2004	1132.76	5763.35	19.65%	17.10%
2005	1039.81	6568.93	15.83%	-11.54%
2006	1204.90	7584.36	15.89%	16.26%
2007	1459.40	9249.13	15.78%	15.29%
2008	1686.09	10823.11	15.58%	14.40%
2009	2030.82	12236.53	16.60%	24.39%
2010	2448.57	14737.12	16.61%	16.71%
2011	2775.49	17560.18	15.81%	11.58%
2012	3097.81	19701.78	15.72%	15.05%

* Note: The distribution sector includes wholesale and retail trade, transportation industry, storage and logistic services, accommodation and catering industry in the paper. Source: Fujian Statistics Yearbook 1979-2012

3 The externality effect of distribution sector in Fujian Province, China

The distribution sector's effect to the economic growth reflects not only in driving the economic growth directly, but also in expanding domestic demand, increasing employment, accelerating the circulation of goods, reducing the operation costs of regional economy, optimizing the structure of the regional economy and improving the efficiency of other industries, etc. [8-9], i.e. distribution sector has externality effect (or makes indirect contribution) to the economic growth. However, most of studies evaluated the effect of distribution sector to the economic growth from the views of direct contribution and direct contribution rate, while the indirect contribution of distribution sector to the growth of regional economy was ignored. The paper is to analyse the all effect of distribution sector to the regional economic growth (including direct and indirect contributions) comprehensively with the Feder-model proposed by Gershon Feder in 1983 [10].

3.1 FRAMEWORK OF ANALYSIS

The Feder-model was proposed by Feder in 1983, which was used to estimate the effect of exports to the economic growth. Feder divided the national economy into two departments, i.e., export department and non-export department, and deduced a new econometric model to estimate the external effect of the export department to the non-export department based on the production equation of these two departments. Simultaneously, Feder model can be used to estimate the productivity difference between export-oriented sectors and non-export-oriented sectors.

Similarly, one can estimate the contribution of distribution sector made to the regional economic growth with the Feder-model. According to the Feder- model, the paper divides the economic of Fujian province into distribution sector and non-distribution sector, and the production function of those two sectors are as below:

$$D = f(L_C\ K_C), \tag{2}$$

$$N = g(L_N\ K_N\ d), \tag{3}$$

where D are outputs of distribution sectors, N means outputs of non-distribution sectors, L are corresponding sector labour forces stocks, and K stands for the respective sector capital stocks. In Equation (2), it supposes that the outputs of distribution sector will affect the outputs of non- distribution sectors.

In Equation (2) and (3), the factors L and K can be expressed as below respectively:

$$L = L_D + L_N, \tag{4}$$

$$K = K_D + K_N. \tag{5}$$

Suppose that the ratio of marginal factor productivities in the two sectors derivate from unity by a factor δ, i.e.

$$\frac{F_L}{G_L} = \frac{F_K}{G_K} = 1+\delta, \tag{6}$$

where, the subscripts denote partial derivatives.

In the absence of externalities, and for a given set of prices, a situation where $\delta = 0$ means an allocation of resource which maximizes national output. However, the marginal factor productivity of distribution sector is likely to be lower than that of the non- distribution sector (i.e. $\delta < 0$) due to a number of reasons.

Denoting the GDP by Y and since it follows:

$$Y = D + N. \tag{7}$$

For the variable K doesn't exist in the statistical calibre of China, but it's similar to the domestic investment (i.e. I). So, the paper denotes I to replace the variable K. Using Equation (4-6) in Equation (7) yields

$$\frac{\mathrm{d}Y}{Y} = \alpha\left(\frac{I}{Y}\right) + \beta\left(\frac{\mathrm{d}L}{L}\right) + \gamma\left(\frac{\mathrm{d}D}{D}\right)\left(\frac{D}{Y}\right), \tag{8}$$

where, dY/Y, dL/L and dD/D labels the growth rate of GDP, labour forces and distribution sector. The variable D/Y represents the proportion of the products of distribution sector in the GDP and the variable I/Y gives the proportion of fixed asset investment in the GDP. In Equation (8), the coefficient γ reflects all effect (including direct and indirect) of distribution sector generated to the economic growth.

In order to estimate the externality effect of the distribution sector and the differences amongst sectorial factor productivities, suppose that the product elasticity of non-distribution sector is constant, i.e.:

$$N = g(L_n, K_n, D) = D^{\theta}{}_K(L_n, K_n), \tag{9}$$

where θ is a parameter that reflects the externality effect of the distribution sector. One can show

$$\frac{\partial N}{\partial E} = \vartheta\left(\frac{N}{E}\right). \tag{10}$$

Using Equation (9) and (10), Equation (8) can now be rewritten as:

$$\frac{\mathrm{d}Y}{Y} = \alpha\left(\frac{I}{Y}\right) + \beta\left(\frac{\mathrm{d}L}{L}\right) + \left[\frac{\delta}{1+\delta} + \vartheta\left(\frac{N}{C}\right)\right]\left(\frac{\mathrm{d}C}{C}\right)\cdot\left(\frac{C}{N}\right). \tag{11}$$

Therefore, Equation (11) can be rearranged as

$$\frac{\mathrm{d}Y}{Y} = \alpha\left(\frac{I}{Y}\right) + \beta\left(\frac{\mathrm{d}L}{L}\right) + \left[\frac{\delta}{1+\delta} - \vartheta\right]\left(\frac{\mathrm{d}C}{C}\right)\cdot\left(\frac{C}{Y}\right) + \vartheta\left(\frac{\mathrm{d}C}{\mathrm{C}}\right). \tag{12}$$

Adding a constant term and a random error term to the Equation (8) and Equation (12) respectively, the formulation in Equation (8) and Equation (12) will be the basis of the empirical work in the next section. In Equation (12) the coefficients ϑ and δ reflect the externality effect of the distribution sector and the derivation of marginal factor productivities from inter-sector.

3.2 EMPIRICAL ANALYSIS OF THE ALL EFFECT

In order to estimate the above equations, the paper collects the relevant data for Fujian Province from 2001 to 2009, as shown in Table 2, where the variable dY/Y is the growth rate of GDP, I/Y means the rate of fixed asset investment, dL/L represents the growth rate of labour force, dC/C is the growth rate of the added value of distribution sector, and C/Y represents the proportion of distribution sector's added value in the GDP. To eliminate the autocorrelation between variables, a lagged variable is introduced into Equation (8). The regression results of Equation (8) are shown in Table 3.

TABLE 2 Relevant data of distribution sector of Fujian province, 2001-2009

Years	dY/Y(%)	I/Y	I/Y (-1)	dL/L	dL/L (-1)	(dC/C)*(C/Y)	dC/C
2001	8.7	0.279	0.276	0.011	0.018	1.29	0.0601
2002	10.2	0.275	0.279	0.02	0.011	1.25	0.0612
2003	11.5	0.303	0.275	0.027	0.020	1.95	0.0971
2004	11.8	0.33	0.303	0.033	0.027	2.62	0.1334
2005	11.6	0.357	0.330	0.03	0.033	-1.3	0.0585
2006	14.8	0.411	0.357	0.043	0.030	2.52	0.0049
2007	15.2	0.467	0.411	0.034	0.043	3.33	0.2112
2008	13.0	0.49	0.467	0.032	0.034	2.42	0.1553
2009	12.3	0.52	0.490	0.043	0.032	0.95	0.0645

TABLE 3 Regression results for distribution industrial effect to the economic growth in Fujian Province, 2001-2009

Dependent Variable: *dY/Y*
Method: Least Squares
Sample: 2001-2009
Included Observations: 9

Variable	Coefficient	Std. Error	t-Statistic	Prob.
I/Y	-4.953242	7.371890	-0.671909	0.2385
dL/L	110.7671	52.91133	2.093449	0.1044
dL/L（-1）	114.8827	61.81218	1.858577	0.1366
dC/C*C/Y	0.493903	0.263963	1.871107	0.1347
C	6.660647	1.481671	4.495362	0.0109
R-squared	0.885111	Mean dependent var		12.12222
Adjusted R-squared	0.770222	S.D. dependent var		2.049864
S.E regression	0.982606	Akaike info criterion		3.102965
Sum squared resid	3.862061	Schwarz criterion		3.212534
Log likelihood	-8.963341	*F*-statistic		7.704046
Durbin-Watson stat	1.933727	Prob (F-statistic)		0.036566

After calculating coefficients of Equation (8) by Table 3, the expression of Equation (8) can be written as below:

$$\frac{\mathrm{d}Y}{Y} = -4.953\frac{I}{Y} + 110.497\frac{\mathrm{d}L}{L} + 114.883\frac{\mathrm{d}L}{L}(-1) + 0.494\frac{\mathrm{dC}}{C}\cdot\frac{C}{Y} + 6.661 \quad .$$

From the regression results, one can see that the adjusted $R^2 = 0.770$ and *F*-statistic=7.704, which indicate the fitting of data in Equation (8) is excellent and the regression result of Equation (8) is linear significant on the whole. Moreover, all coefficients of dependant variables (except I/Y) are statically significant ($\geq \mathrm{t}_{0.05}(5) = 1.476$). Thus, it can be estimated that the contribution of the distribution sector generated to the economic growth in Fujian is 0.494 of one percentage point (the coefficient γ reflects the all effect of distribution sector generated to the economic growth as explained earlier), which means that 1 percentage growth of distribution sector will drive 0.494 percentage growth of GDP in Fujian in the absence of other factors.

3.3 SPECIFYING THE EXTERNALITY EFFECT

To eliminate the autocorrelation between variables, a lagged variable $I/Y(-1)$ is introduced in Equation (12). The regression results adopting Equation (12) are shown in Table 4.

TABLE 4 Regression results for Fujian Province with specific inter-sectoral externality, 2001-2009

Dependent Variable: *dY/Y*
Method: Least Squares
Sample: 2001-2009
Included Observations: 9

Variable	Coefficient	Std. Error	t-Statistic	Prob.
I/Y	65.64538	32.49180	2.020367	0.1366
I/Y(–1)	–62.72183	30.88382	–2.030896	0.1352
dL/L	41.89287	76.81486	0.545375	0.3234
dC/C*C/Y	0.209636	0.317796	1.702656	0.1566
dC/C	2.288329	7.629913	2.307543	0.1713
C	7.470922	1.561390	4.784790	0.0174
R-squared	0.917616	Mean dependent var		12.12222
Adjusted R-squared	0.780309	S.D. dependent var		2.049864
S.E regression	0.960797	Akaike info criterion		2.992613
Sum squared resid	2.769391	Schwarz criterion		3.124096
Log likehood	–7.466760	F-statistic		6.682948
Durbin-Watson stat	2.314723	Prob (F-statistic)		0.074423

According to Table 4, the expression of Equation (12) is:

$$\frac{\mathrm{d}Y}{Y} = 66.645\frac{I}{Y} - 62.722\frac{I}{Y}(-1) + 41.893\frac{\mathrm{d}L}{L} + 0.210\frac{\mathrm{d}C}{C}\cdot\frac{C}{Y} + 2.288\frac{\mathrm{d}C}{\mathrm{C}} + 7.471 .$$

From the regression results, it can be seen that the adjusted- $R^2 = 0.780$ and F-statistic=6.683, which indicate the fitting of data in Equation (12) is excellent and the regression of Equation (12) is linear significant on the whole. Moreover, all the coefficients of dependant variables (except dL/L) are statically significant ($\geq \mathrm{t}_{0.05}(4) = 1.533$). Thus, it can be estimated that the externality effect of distribution sector generated to non-distribution sector in Fujian is 2.288 (the coefficient ϑ =2.288 reflects the externality effect of the distribution sector as explained earlier) of one percentage point, which means that 1 percentage growth of distribution sector will drive 2.288 percentage growth of non-distribution sector in Fujian in the absence of other factors, i.e., distribution sector generates externality effect(or indirect contribution) to the growth of non-distribution sector in Fujian Province. Additionally, it can be calculated from the expressions of Equation (8) and (12) that $\delta = -1.359 < 0$. It indicates that the marginal productivity of distribution sector is lower than non-distribution sector, which constrains the externality effect of distribution sector in Fujian province.

4 Concluding remarks

Evidence from Fujian province confirmed that distribution sector strongly correlated to the regional economic growth, i.e., distribution sector directly contributes to the regional economic growth and has significant externality effect to the non-distribution sector. An efficient and perfect distribution system is significant premises for producer to obtain factors of production, sell products and achieve the value of goods. With the improvement of productivity and the development of market economy, the function of distribution sector will evaluate from weak to strong, from simple to complex due to the demands of the regional economic operation, the externality effect of distribution sector will be more and more indispensable.

However, the externality effect of distribution sector has not fully played due to its lower marginal productivity. One can attributed this phenomenon to the following reasons: firstly, the technical level of distribution sector is low for a long time, which results in the modernization and informationization of distribution sector is incompatible with the industrialization of regional economy. Secondly, the distribution sector is a labour-intensive sector due to its own characteristics, which means it need more input than non-distribution sector to product the same level of output, i.e., the production efficiency of distribution sector is lower natively. So, in order to give full play to the externality effect of distribution sector, we should enhance the level of modernization and informationization of distribution sector and converse distribution sector from labour-intensive to technology-intensive as soon as possible.

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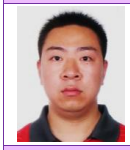

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