Econometric Analysis and Policy Suggestions on the Influencing Factors of Vegetable Industry Development in Maoming

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Abstract. Vegetables are one of the most important foods in people's daily lives. It plays an important role in improving people's living standards, resettling rural labor, increasing farmers' income, and increasing foreign exchange. In order to promote the development of Maoming's vegetable industry, this paper uses econometric methods to carry out a quantitative analysis of the influencing factors of Maoming's vegetable industry development. In this paper, Maoming's vegetable operating income is used as the explained variable and several influencing factors are used as the explanatory variables to establish a multiple linear regression model. The data from 1998 to 2012 were used for regression, and the model was tested for economic significance, statistical test, multicollinearity test, heteroscedasticity test, and autocorrelation test. The regression results show that: Maoming's vegetable operating income has a positive correlation with rural households' per capita net income, per capita cargo transportation volume, and per capita retail sales of consumer goods. Therefore, in order to promote the development of Maoming's vegetable industry, we should vigorously increase farmers' income, increase consumption, and increase the volume of goods transported.

1. Introduction

Shixia Hu, Chaoqun Liu, and Zhenhong Qi (2016) selected several factors including vegetable area, vegetable output, vegetable export volume, and vegetable processing output value in Hubei Province to establish an evaluation model with the disposable income of rural residents. Multivariate regression analysis was used to analyze the influencing factors of disposable income of rural residents in Hubei Province from 2002 to 2013. The model was tested and corrected using multiple methods such as multicollinearity test, modified multicollinearity test and heteroscedasticity test. The model prediction results show that the actual value is basically consistent with the predicted value. Therefore, the disposable income of rural residents in the vegetable industry in Hubei Province has significant correlations with vegetable export volume and vegetable processing output value.

Huishang Li, Fantao Kong, Chen Shen, and Juanjuan Ma (2016) believe that in the context of the current agricultural supply-side structural reform, the vegetable industry still faces major challenges.
The sustainable development capacity of the vegetable industry should be further enhanced to promote the stable operation of the market, promote the integrated development of the primary, secondary and tertiary industries, improve the market control ability of the main operating body, and promote the stable growth of the vegetable industry.

2. Model Setting

2.1. Setting of Econometric Model

There are many factors affecting the development of vegetable industry in selected urban residents per capita disposable income, the degree of marketization (expressed in per capita social retail sales of consumer goods), transportation (with the per capita amount of goods transport, climate conditions (with planting increased value) as explanatory variables to Maoming vegetable business income as explanatory variables. To this end set the following form of econometric model:

\[ y = c + c_1x_1 + c_2x_2 + c_3x_3 + c_4x_4 + c_5x_5 + \mu \]  \hspace{1cm} (1)

Among them, \( y \) is the business income of Maoming vegetable, \( x_1 \) is per capita disposable income of urban residents, \( x_2 \) is per capita net income of rural residents (yuan), \( x_3 \) is the growing value of the planting industry, \( x_4 \) is the per capita amount of goods, \( x_5 \) is retail sales of social consumer goods, \( \mu \) is random perturbation.

2.2. Relevant Test Data

In order to avoid the nonstationary of time series, the model uses cross section data. Data comes from the "Maoming 1950-2012", after a lot of analysis, the sample data are collected.

Table 1. Statistics of Maoming vegetable from 1995 to 2012.

| Year | Y     | X1    | X2    | X3    | X4    | X5    |
|------|-------|-------|-------|-------|-------|-------|
| 1998 | 1375.7| 4283  | 1577.7| 4382  | 629   | 218.71|
| 1999 | 1738.4| 4838.9| 1926.1| 3846  | 639.5 | 256.2 |
| 2000 | 2212.7| 5160.3| 2090.1| 4252  | 644   | 328.06|
| 2001 | 2391.2| 5425.1| 2162  | 6222  | 695   | 345   |
| 2002 | 2831.9| 5854.02| 2210.3| 7326  | 719   | 394   |
| 2003 | 3175.5| 6280  | 2253.4| 8993  | 744   | 426.6 |
| 2004 | 3522.4| 6859.6| 2366.4| 10532 | 784   | 429.5 |
| 2005 | 3878.4| 7702.8| 2475.6| 11552 | 878   | 441.8 |
| 2006 | 3442.3| 8472.2| 2522.2| 13361 | 889   | 395.7 |
| 2007 | 4710.7| 9421.6| 2636.4| 14927 | 1102  | 427.5 |
| 2008 | 5285.9| 10493 | 2954.9| 16846 | 1212  | 436.1 |
| 2009 | 6229.7| 11759.5| 3087  | 17657 | 1394  | 446.9 |
| 2010 | 7770.6| 13785.8| 4140.4| 17943 | 1690  | 482.6 |
| 2011 | 8749.3| 14780.76| 4760.62| 18691 | 1712  | 511.0313|
| 2012 | 10183.7| 16174.65| 5353.17| 21649 | 1902  | 535.4 |

2.3. Model Establishment and Analysis

Observe the correlation diagram of the variable with each explanatory variable, as shown in Figure 1.
Figure 1. Correlation diagram of the explained variable with each explanatory variable. Using Eviews software for data OLS regression, regression results are shown in Table 2.

Table 2. Regression results.

| Variable | Coefficient | Std. Error | t-Statistic | Prob.  |
|----------|-------------|------------|-------------|--------|
| C        | -3488.565   | 223.4219   | -15.61425   | 0.0000 |
| X1       | -0.342877   | 0.136139   | -2.537211   | 0.0319 |
| X2       | 0.842386    | 0.172212   | 4.891571    | 0.0009 |
| X3       | 0.036741    | 0.034787   | 1.027420    | 0.3310 |
| X4       | 5.777354    | 0.792418   | 7.290788    | 0.0000 |
| X5       | 5.399442    | 0.881466   | 6.125523    | 0.0002 |

\[
y = -3488.565 - 0.342877x_1 + 0.842386x_2 + 0.036741x_3 + 5.777354x_4 + 5.399442x_5
\]

\[
Se = (223.4219) (0.135139) (0.172212) (0.034787) (0.792418) (0.881466)
\]

\[
t = (-15.61425) (-2.537211) (4.891571) (1.027420) (7.290788) (6.125523)
\]

\[
R^2 = 0.999124 \quad \bar{R}^2 = 0.998638 \quad F = 2053.482 \quad DW = 1.830946
\]

3. Model Checking

3.1. Economic Significance Test

Estimation of the model results show that under the assumption that the other variables constant, on average, each increase of 1% of the per capita net income of rural residents, income of Maoming vegetable production grew 0.842386%; planting industry added value for every 1% increase in, Maoming vegetable production income increases 0.035741%; people were freight volume growth of
each 1%, Maoming vegetable production and income increase 5.777354%; per capita social retail sales of consumer goods grew by 1%, Maoming vegetable production income on growth 5.399442%. But the per capita disposable income of urban residents increased by 1%, the Maoming vegetable production income decreased by 0.342877%. Theoretical analysis and empirical analysis are not consistent, the model may exist problems.

3.2. Statistical Test

3.2.1. Goodness of Fit. The data in Figure 2 can be obtained, and the coefficient of modification can be obtained, which shows that the model is very good for fitting the sample.

3.2.2. F Test. In the condition of the given significance level, the critical value of k-1=5 and n-k=9 was investigated in the F distribution table. From table 1 can be F=2053.482>3.48, so the rejection of the original hypothesis, the regression equation is significant. That is, the per capita disposable income of urban residents, per capita net income of rural residents, the increase of the planting industry, per capita goods transport, per capita retail sales of social consumer goods and other variables have a significant impact on the production of vegetables in Maoming.

3.2.3. T Test. Under the condition of a given level of significance, the freedom of the t distribution table is the critical value of n-k=9. From table 1, it is known that the absolute value of the t statistic is more than 2.179. This shows that only the explanatory variables, and have a significant impact on the interpretation of the variables.

3.3. Multiple Linear Test

From the above results, the model can be found to be high, the goodness of fit is good, and the F test is significant. But the explanatory variables did not pass the t test, and the coefficient was not in conformity with the economic significance. So the model may have a serious multiple linear. Calculate the correlation coefficient of each explanatory variable, get the correlation coefficient matrix. Results as shown in Table 3.

| Table 3. Correlation coefficient matrix. |
|-----------------------------------------|
|   | X1   | X2       | X3       | X4       | X5       |
|---|------|---------|---------|---------|---------|
| X1  | 1.00000 | 0.964201 | 0.959267 | 0.994099 | 0.845980 |
| X2  | 0.964201 | 1.00000 | 0.869638 | 0.967029 | 0.818249 |
| X3  | 0.959267 | 0.869638 | 1.00000 | 0.935097 | 0.883037 |
| X4  | 0.994099 | 0.967029 | 0.935097 | 1.00000 | 0.805065 |
| X5  | 0.845980 | 0.818249 | 0.863037 | 0.805065 | 1.00000 |

We can know that the correlation coefficient between the explanatory variables is very high, and it is proved that there are serious multiple linear.

3.4. Modified Multiple Linear

Using stepwise regression method, to examine and solve the problem of multiple linear problems. The results are shown in Table 4.

| Table 4. Results of a regression estimate. |
|------------------------------------------|
| variable      | $x_1$ | $x_2$ | $x_3$ | $x_4$ | $x_5$ |
| Parameter estimation | 0.6827 | 2.4081 | 0.4187 | 6.1198 | 26.2499 |
| T Statistic   | 25.6987 | 19.3312 | 9.3223 | 26.2396 | 6.1286 |
| $R^2$         | 0.9807 | 0.9664 | 0.8699 | 0.9815 | 0.74288 |
| $\bar{R}^2$  | 0.9792 | 0.9638 | 0.8599 | 0.9800 | 0.7231 |
Among them, added based on the equation, sequentially adding other variables, stepwise regression. The results are shown in Table 5.

**Table 5. Regression results with new variables added.**

| MODEL   | x4   | x1   | x2   | x3   | x5   | $\bar{R}^2$ |
|---------|------|------|------|------|------|-------------|
| x4      | 6.1198 (26.2396) |      |      |      |      | 0.9800      |
| x4,x1   | 3.2726 (1.5737)  | 0.3196 (0.1936) |      |      |      | 0.9813      |
| x4,x2   | 3.8152 (5.7824)  |      | 0.9451 (3.6119) |      |      | 0.9896      |
| x4,x3   | 5.8310 (8.5857)  |      |      | 0.0224 (0.4548) |      | 0.9787      |
| x4,x5   | 5.2176 (20.6843) |      |      |      | 5.5199 (4.4385) | 0.9918      |

Obviously, the newly added equation $=0.9918$, the improvement is the biggest, and the $t$ test of each parameter is remarkable, the choice of the reservation, and then join other first variable stepwise regression, the result is shown in Table 6.

**Table 6. Regression results with new variables added further.**

| MODEL   | x4   | x1   | x2   | x3   | x5   | $\bar{R}^2$ |
|---------|------|------|------|------|------|-------------|
| x4,x5,x1 | 7.6631 (4.6459) | 0.3196 (0.1936) |      |      | 7.2519 (4.3835) | 0.9926      |
| x4,x5,x2 | 3.6091 (11.9597) |      | 0.9451 (3.6119) |      | 4.5158 (6.8514) | 0.9979      |
| x4,x5,x3 | 6.0877 (20.2763) |      |      | -0.0992 (-3.6036) | 8.0054 (7.1617) | 0.9959      |

On the basis of the above equation, the equation has been reduced, but it is still the largest, and all the parameters of the $t$ test are significant. After the addition, the $t$ test of its parameters is not significant, and the parameters of the $t$ test are significant, but the parameters of the parameters are not reasonable. So keep it out.

Finally, the regression results for the severe multiple linear effects are corrected.

\[
y = -3131.629 + 0.726894 x_1 + 3.609113 x_4 + 4.515757 x_5
\]

\[
Se = (172.6006) (0.123258) (0.301772) (0.659103)
\]

\[
t = (-18.14379) (5.897349) (11.95974) (6.851366)
\]

\[
R^2 = 0.998314 \quad \overline{R}^2 = 0.997855 \quad DW = 2.007286
\]

3.5. **Heteroscedasticity Test**

The variance is described by the discrete degree of random variable, because the variable and U have the same variance, so it can be roughly seen whether the discrete degree of U has a correlation with the correlation image, as shown in Figure 2.
As can be seen from Figure 2, with the increase of the discrete degree is very uniform, a rough judgment does not exist the same variance. The following is verified by White test. White test using Eviews software. The results are shown in Table 7.

Table 7. White test results.

| F-statistic   | Probability | Observations-R-squared | Probability |
|--------------|-------------|-------------------------|-------------|
| 0.347551     | 0.852630    | 3.101500                | 0.796004    |

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 06/17/14 Time: 20:26
Sample: 1998 2012
Included observations: 15

| Variable | Coefficient | Std. Error | t-Statistic | Prob.          |
|----------|-------------|------------|-------------|----------------|
| C        | -188957.2   | 186274.4   | -1.014402   | 0.3401         |
| X4       | 371.0637    | 320.0016   | 1.131286    | 0.2907         |
| X4^2     | -0.190848   | 0.154652   | -1.234052   | 0.2522         |
| X5       | 747.9423    | 1408.993   | 0.530835    | 0.6089         |
| X5^2     | -1.222950   | 2.000584   | -0.611296   | 0.5580         |
| X2       | -74.36270   | 142.3929   | -0.522166   | 0.6157         |
| X2^2     | 0.018676    | 0.020633   | 0.055153    | 0.3918         |

R-squared            | 0.206757 | Mean dependent var | 110.95.80 |
Adjusted R-squared   | 0.388158 | S.D. dependent var | 16850.40  |
S.E. of regression   | 19663.16  | Akaike info criterion | 22.33484 |
Sum squared resid    | 3.15E+09  | Schwarz criterion | 23.26526  |
Log likelihood       | -166.0113 | F-statistic      | 0.347561  |
Durbin-Watson stat   | 2.745291  | Probi(F-statistic) | 0.852630  |

It can be seen from Table 7 by white test. In the next, distribution table can be obtained. So the rejection of the original hypothesis, the model does not exist the same variance.

3.6. Autocorrelation Test
Self correlation test using Eviews software. The results are shown in Table 8.
Table 8. Autocorrelation test.

| Variable | Coefficient | Std. Error | t-Statistic | Prob.  |
|----------|-------------|------------|-------------|--------|
| C        | -3.131.629  | 172.6006   | -18.14379  | 0.0000 |
| X4       | 3.609113    | 0.301772   | 11.95974   | 0.0000 |
| X5       | 4.515757    | 0.859103   | 6.851366   | 0.0000 |
| X2       | 0.726894    | 0.123258   | 5.897349   | 0.0001 |

R-squared: 0.998314        Mean dependent var: 4499.893
Adjusted R-squared: 0.997855  S.D. dependent var: 2666.204
S.E. of regression: 123.0288    Akaikie info criterion: 12.69589
Sum squared resid: 168497.1   Schwarz criterion: 12.87471
Log likelihood: -91.14420     F-statistic: 2171.616
Durbin-Watson stat: 2.007286  Prob(F-statistic): 0.000000

For the sample size of n=15, the model of three explanatory variables, in the significant level, check the DW distribution table, can be a critical value, the model, so that the regression equation does not exist in the relevant.

The regression equation can be high, and the regression coefficient is significant. So the end result of this model is:

\[
y = -3131.629 + 0.726894x_2 + 3.609113x_4 + 4.515757x_5
\]

\[
Se = (172.6006) \quad (0.123258) \quad (0.301772) \quad (0.659103)
\]

\[
t = (-18.14379) \quad (5.897349) \quad (11.95974) \quad (6.851366)
\]

\[
R^2 = 0.998314 \quad \bar{R}^2 = 0.997855 \quad DW = 2.007286
\]

The final result of the model shows that in the other explanatory variables constant, on average, each increase of 1% of the per capita net income of rural residents, the income of vegetable production of Maoming grew 0.726894%; per capita freight volume increases by 1% each, Maoming vegetable production and income increase 3.609113%; per capita social retail sales of consumer goods grew by 1%, Maoming vegetable production income on growth 4.515757%.

4. Conclusion

Through the analysis of the factors affecting the development of vegetable in Maoming, we can understand that the two factors of the per capita social consumer goods retail sales and per capita goods transportation volume have a significant impact on the production of Maoming vegetable. So we have to carry out key vegetable production of financial subsidies to support, will be the life of the masses and directly related to the part of the basic varieties of vegetables production subsidies into the category, the planting area for the units of production factors subsidies, environmental subsidies and the minimum protection price subsidies effective combination of subsidies, or set up by the participation of the national, local government and cooperatives or producer stable prices of vegetables fund, through government subsidies and other means to regulate and control the vegetables planting and market size, to ensure the long-term stability of prices of vegetables. At the same time to actively implement the "vegetable Easy Access" policy, expand the "Easy Access" policy covering vegetable varieties; down the highway toll, the investment cost recovery of the highway to reduce their fees, transportation fees and other clean vegetables; continue to increase "agriculture super docking" mode of operation will lead to the promotion of the scope. The modern circulation of rural integration, the integration of vegetable industry chain; in addition, large and medium-sized city in the winter and
spring vegetables can establish a reserve system, the construction of cold chain logistics to vegetables, use refrigerated trucks to transport, through the pretreatment of cold vegetables, reduce the loss of vegetables in the transport process, strengthening the circulation management of vegetables.

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References
[1] Shixia Hu, Chaoqun Liu and Zhenhong Qi. Research on the Impact of the Development of Vegetable Industry in Hubei Province on the Disposable Income of Rural Residents [J]. Statistics and Decision, 2016.05
[2] Huishang Li, Fantao Kong, Chen Shen and Juanjuan Ma. Research on the Development Strategy of China's Vegetable Industry in the "Thirteenth Five-Year Plan" Period [J]. Economic aspect, 2016.11
[3] Ge Zhenguang. How to adjust the structure of vegetable agriculture industry [J]. Northwest Horticulture. 2002(01):4
[4] Statistics of Maoming City from 1950 to 2012[DB]
[5] Xue Yanbin. The situation and countermeasures of China's vegetable exports after joining the WTO [J]. Insurance and processing. 2002(3):1-2
[6] Zhan Zhenhe. The main problems and countermeasures of vegetable export in China [J]. Beijing Agriculture. 2002(8):25-28.
[7] Zhao Xiaofei. A Study on the Regularity of Vegetable Price Fluctuations——Influencing Factors and Regulation Countermeasures [N]. Contemporary economic management. 2015.2