УДК 330.43

ПРИМЕНЕНИЕ МОДЕЛИ МУЛЬТИПЛИКАТОРА-АКСЕЛЕРАТОРА ДЛЯ ПРОГНОЗИРОВАНИЯ ИНВЕСТИЦИЙ В КИТАЕ

Каримов Э.О.

Магистрант,

Финансовый университет при Правительстве Российской Федерации,

Москва, Россия

Аннотация

Китайская Народная Республика за последние десятилетия укрепилась в статусе одной из самых быстрорастущих и влиятельных стран на мировой экономической арене. В связи с этим, анализ и прогнозирование экономических показателей Китая представляет собой важное направление исследований для Российской Федерации, как торгового и политического союзника. На основании модели мультипликатора-акселератора была построена регрессионная модель отражающая степень влияния величины валового национального дохода и потребления на величину инвестиций в основные средства. Регрессионная модель была построена с использованием метода наименьший квадратов и проверена на соответствие основным условиям теоремы Гаусса-Маркова. Для оценки качества регрессионной модели были использованы тесты Дарбина-Уотса, Стьдента и Голфелда-Кванта. На основании проведенного анализа было выявлено, что модель мультипликатора-акселератора имеет высокую предсказательную способность, однако тест Дарбина-Уотса свидетельствует, о том, что в модели была упущена важная независимая переменная. Объём инвестиций в наибольшей степени объясняется изменением валового национально дохода, и в меньшей степени изменением в расходах на потребление.

Ключевые слова: модель мультипликатора-акселератор, прогнозирование инвестиций, Китайская Народная Республика, регрессионная модель, эконометрическое моделирование.

APPLICATION OF MULTIPLIER-ACCELERATOR MODEL FOR FORECASTING OF INVESTMENT LEVEL IN CHINA

Karimov E.O.
Master student,
Financial University under the government of the Russian Federation,
Moscow, Russia

Annotation

People's Republic of China over the past decades became one of the fastest growing and powerful countries at global economic arena. Thus, analysis and forecasting of major economic parameters of Chinese economy is an important field of investigation for Russian Federation, as a major trade and political counterparty. Regression model was constructed, basing on multiplier-accelerator model. Ordinary least square technic was used for determining coefficients of the model. Model was checked for matching Gauss-Markov conditions and assessed with use of Durbin-Watson, Student and Goldfeld Quandt tests. High predicted capacity of regression model based on multiplier-accelerator was revealed, however Durbin-Watson test indicates that during construction of econometric model some important independent variable was missed. Investment in fixed assets is explained mostly by change in Gross National Income and in smaller degree by change in consumption expenditures.

Keywords: multiplier-accelerator model, investment forecasting, People's Republic of China, regression model, econometric modeling.

I. Introduction

China is one of the biggest economic players all over the world, it comprises about 15,88% of global GDP. At 2018 Chinese GDP was estimated to be 13 trillion dollars. It became the leading production force, and it seems that many countries can't afford to compete with their countries' capacities and effectiveness of their production. And, as investment is the major driver of production, this article would examine on which factors it relays on and to what degree. In order to construct regression, we would use ordinary least square technic based on multiplier-accelerator model. This model was elaborated by famous American economist Paul Samuelson and has as its base a Keynesian multiplier concept and Neoclassical accelerator phenomena.

II. Specification of the model.

In econometrics, model specification is a translation of economic law from verbal to mathematical level. There are four principles of specification: (1) model should be represented via mathematical language, (2) number of equations should be equal to number of dependent variables, (3) each variable must be dated and clearly defined, (4) behavioral equation should include disturbance term.

Model 1 – Initial form of the multiplier-accelerator model

$$\begin{cases} C_t = a_0 + a_1 Y_t + a_2 + a_3 C_{t-1} + \varepsilon_t \\ I_t = b_{0+} b_1 (Y_t - Y_{t-1}) + \mu_t \\ Y_t = C_t + I_t \\ E(\varepsilon_t) = 0, E(\mu_t) = 0 \\ \sigma(\varepsilon_t) = const, \sigma(\mu_t) = const \end{cases}$$

$\mathrm{C_t} - \text{consumption}, \mathrm{Y_t} - \text{GNI}, \mathrm{I_t} - \text{investment},$

As we could see in model 1, multiplier accelerator model is in compliance with all four principles of specification, 4^{th} and 5^{th} line represent Gauss-Markov conditions. However, it is only an initial form, so we can't use it in our calculations. In order to construct reduced form, we should exclude independent variable Y_t from all equations, by setting it up as $Y_t(C_t; I_t)$ and the same for C_t and I_t. Thus, we would get a reduced form of the econometric model with different parameters under variables.

Model 2 – Reduced form of the multiplier-accelerator model

$$\begin{cases} C_t = z_0 + z_1 Y_{t-1} + z_2 C_{t-1} + \varepsilon_t \\ I_t = k_{0+} k_1 Y_{t-1} + k_2 C_{t-1} + \mu_t \\ Y_t = u_{0+} u_1 Y_{t-1} + u_2 C_{t-1} + \omega_t \\ E(\varepsilon_t) = 0, E(\mu_t) = 0, E(\omega_t) = 0 \\ \sigma(\varepsilon_t) = const, \sigma(\mu_t) = const, \sigma(\omega_t) = const \end{cases}$$

Now, as we transformed our econometric model into reduced form we could use its investment function $I_t(Y_{t-1}; C_{t-1})$ as a basic function for our analysis: Table 1 – **Construction of regression model**

Basing on data from table 1 collected for China in period 1990-2017 we could estimate the coefficients and characteristics of the regression model using ordinary least square technic.

Table 2 – Characteristics of the regression model

	Coefficients	*Standart error*	*t-statistics*	*P-value*
Y-cross-section	-41210,80823	7331,495093	-5,621064696	8,71092E-06
GNI	0,706094308	0,346154087	2,039826581	0,052520766
Consumption	0,381372421	0,692884217	0,550412914	0,587123231

By setting up the estimations of coefficients into the regression model we get:

$$\widehat{I_t} = -41210 + 0{,}71 Y_{t-1} + 0{,}38 C_{t-1}$$

III. Testing and assessing the quality of regression model

To estimate the quality of the model we would use common statistics technics as F-test, Durbin-Watson test, Goldfeld-Quandt test, T-statistics:

$$R^2 = 0{,}9874; F_{act} = 1027{,}6662; F_{crit} = 3{,}40; T_{crit} = 1{,}71$$

$R^2 = 98{,}74\%$ shows that 98,74% of variation of investment in fixed assets is explained by variation in Y_{t-1} and variation in C_{t-1}. That is the first sign of the appropriate model construction.

Then, we should conduct F-test, in order to understand whether the R^2 is distributed randomly or not and asses the quality of specification. Probability of mistake is 5%. Number of observations = 27.

$F_{crit} = 3{,}40 < F_{act} = 1027{,}6662$, so we could conclude that R^2 indeed distributed not randomly and quality of specification is high.

Now we should check regression coefficients against T-test in order to assess their significance in the model:

T-statistics for k_0 = -5,62 < $T_{crit} = 1{,}71$, this means that k_0 is insignificant; *T-statistics* for k_1 = 2,039 > $T_{crit} = 1{,}71$, this means that k_1 is significant; *T-statistics* for k_2 = 0,55 < $T_{crit} = 1{,}71$, this means that k_2 is insignificant;

So, we could conclude, that among all parameters k_0, k_1, k_2, only k_1 shows proper significance according to the *T-statistics*. k_1 is a parameter for gross national income, so the change in GNI has a major influence on the endogenous variable – investment in fixed assets.

Gauss-Markov conditions fulfillment tests:

To test the first Gauss-Markov condition, we should check whether the mathematical expectation of disturbance term is equal to zero. Indeed, if we calculate an average of residuals among all observations we would get that $E(\mu_t)$ equals to zero.

To check whether our regression model fulfill the criterion of second Gauss-Markov condition, we should conduct Goldfeld-Quandt test. First step, to calculate absolute sum of value of dependent variables. Second, to sort all data by increase of that absolute sum. Find estimated sum of squares for first and third part of data set. Thus, we would get, that: ss_1 =771110892, ss_2 =252837130305. GQ value would be:

$$\begin{cases} GQ = 0{,}003 \\ \frac{1}{GQ} = 327{,}86 \\ F_{crit} = 3{,}787 \end{cases} ; \begin{cases} GQ = 0{,}003 < F_{crit} = 3{,}787 \\ \frac{1}{GQ} = 327{,}86 > F_{crit} = 3{,}787 \end{cases}$$

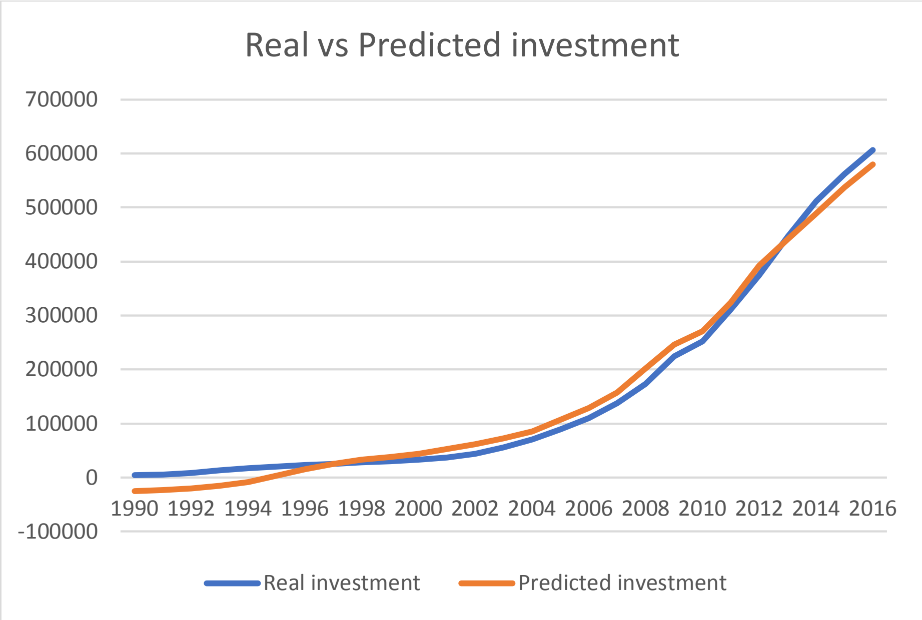
As long as, $\frac{1}{GQ}$ is of higher value, than F_{crit}, we make a conclusion that second Gauss-Markov condition is not fulfilled. It means that residuals are not homoscedastic, but heteroscedastic. That indicates that some variable was missed during construction of the model.

To check if there are an autocorrelation between residuals we should use Durbin Watson test. DW_{act} =0,128162024. DW test criterion of assessment is as follows:
If DW_{act} lies between 0 and d_{low}, then there are autocorrelation between residuals;
If DW_{act} lies between d_{low} and d_{up}, then there are moderate autocorrelation between residuals;
If DW_{act} lies between d_{low} and $4 - d_{low}$, then there are no autocorrelation between residuals;
If DW_{act} lies between $4 - d_{low}$ and $4 - d_{up}$, then there are no autocorrelation between residuals;

In our case, d_{low} = 1,25 and d_{up}=1,55. DW_{act} lies between 0 and DW_{low}. Third Gauss-Markov condition is not fulfilled, because autocorrelation between residuals take place. That also indicates that some variable was missed during construction of the model.

Adequacy of the model and confidence interval:

Graph 1 – Actual and predicted value of investment



To check adequacy of the model we should check whether it could predict future value of endogenous variable (investment in fixed assets):

$$I_{pred} = 631747;\ I_{real} = 641238;\ \theta_{mistake} = 1{,}5\%$$

As we could the model represents high predicting capacity, with relatively low value of mistake = 1,5%. Confidence interval would look like:

$$\left(I_{pred} - t_{crit}\delta \middle| I_{pred} + t_{crit}\delta\right)$$

Confidence interval for investment: (595682 | 667812). ; $I_{real} = 641238$ fit into the confidence interval with the probability of 95%.

IV. Conclusion

After completing econometric study, we can conclude that multiplier-accelerator model partially works for modelling an amount of investment in Chinese economy. The model seems to be adequate and have high predicting capacity, but it hasn't passed all tests. T-test showed that free variable and consumption level in the previous year is insignificant. F-test showed that determination coefficient R^2 is not random and quality of the model is high. R^2 showed that variation of GNI was accurately explained by variation in dependent variables. Golfeld-Quandt test was not passed, so the second Gauss-Markov conditions were satisfied, and the dispersion of residuals are not constant. Durbin-Watson test also wasn't passed, so we could conclude that autocorrelation takes place. Durbin-Watson and Golfeld-Quandt indicates that some variable was missed or that the whole system of equations should be used, rather than only investment equation. However, model prediction fits the confidence interval and mistake of approximation is relatively low = 1,5%. Basically, we could say that one unit increase in gross national income or consumption would lead to an increase of investment in 0,75 units of investment or 0,38 units respectively.

References

1. Трегуб И.В., Математические модели динамики экономических систем монография.- М.: Финакадемия. 2009, 50-57с.
2. Сайт статистического отдела Мирового банка [Электронный ресурс]. http://data.worldbank.org
3. National Bureau of Statistics of China [Электронный ресурс]. http://data.stats.gov.cn/
4. Tregub I.V. Econometric studies. Practical examples. M.: Lan’. 2018. 164 p.
5. Tregub I.V. Econometrics G. Mange's model for the BRICS countries // В сборнике: Forum for Reseach in Empirical Internation Trade Сан Рафаэль, 2015.
6. Dougherty C. Introduction to Econometrics. LSE. 2011. 135p.
7. Angrist D.J. Mostly harmful econometrics: an empiricist companion. Princeton University Press. 2009. 109p.
8. Coughlin C., Segev E. Foreign Direct Investment in China: A Spatial Econometric Study. RePEc. 2000. 2p.
9. Go Yano, Maho Shiraishi. Financing of Physical and Intangible Capital Investments in China. 2019. RePEc. 2019. 4p.

Оригинальность 97%