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Estimation of the Kaleckian Investment Function in Japanese Manufacturing

Taro Abe

名古屋学院大学総合研究所

University Research Institute

Nagoya Gakuin University

Nagoya, Japan

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Taro Abe†

Abstract

The Kaleckian approach assumes that the sensitivity of investment to changes in utilization is relatively small, even in the long run. This approach has been controversial from both the theoretical and empirical points of view. This paper estimates the Kaleckian investment function in Japanese manufacturing using the error term correction model. The result shows that the sensitivity of investment to changes in capacity utilization is quite large, thus questioning whether the investment function is applicable in the long run for the Japanese economy.

***JEL Classification*:** E12, E32
***Key words*:** Kaleckian investment function, Japanese manufacturing, Error term correction model

1 Introduction

Post Keynesians regard the role of investment due to the factors of effective demand as very important. However, there is disagreement in terms of the specifications. We intend to contribute to the discussion from the empirical point of view.

The Kaleckian approach, which has been influential in the Post Keynesian school, has applied the Kaleckian short-run model to long-run models, where capacity utilization freely adjusts to any disequilibrium in a product market. Some heterodox scholars have questioned this approach because it

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†Faculty of Economics, Nagoya Gakuin University, Japan; email taro-abe@ngu.ac.jp

does not account for a firm's goal-oriented behavior. They believe that the inconsistency between actual and desired utilization does not last in the long run. Some Kaleckians responded to the question in two ways.[1] One is the consistency in the long run because of the endogenous change in the desired utilization rate. Second is the discrepancies in the long run because of macroeconomic constraints and competing targets.

Skott(2008, 2012a) outlines the shortcomings of the Kaleckian investment function.[2] He criticizes the assumption that the sensitivity of investment to changes in utilization is relatively small, even in the long run, from both the theoretical and empirical points of view. His simple estimation using Canadian data is at odds with Kaleckian approach. Thus, if this assumption does not hold, then we cannot regard capacity utilization as an adjustment variable in the long run.

There are few empirical studies on this issue, in contrast with those showing the significance of changes in capacity utilization in the short run, so more empirical studies are necessary to support our argument. We investigate the investment function in Japanese manufacturing following Skott(2008, 2012a). We chose manufacturing because the Kaleckian model often assumed that capacity utilization adjusted in these industries and Skott(2008, 2012a) also uses manufacturing data in his analyses.

Recently, Post Keynesian perspectives have been applied to the Japanese economy. Azetsu, Koba, and Nakatani(2010) investigate dynamic patterns of capital accumulation and income distribution in Japan using a vector autoregression Kaleckian model. Nakatani and Skott(2007) discuss Japan's multi-decade recession from a Kaldorian viewpoint. Thus, this paper, which investigates the applicability of the Kaleckian investment function to the Japanese economy in the long run, is related to these heterodox economic analyses of the Japanese economy.

Section 2 derives the model of the Kaleckian investment function. Section 3 investigates data on the Japanese manufacturing industries. Section 4 estimates the investment function. Section 5 concludes.

2 Model

We model our investment function following Skott(2008, 2012a).

The Kaleckian investment function is

$$g_t = \rho_t + \beta(u_t - u_t^d) \tag{1}$$

[1]Refer to Hein, E. et al.(2011) and Skott(2012a).

[2]Skott(2011, 2012b) refers to this problem from a wider macroeconomics' viewpoint.

where g, ρ, u, and u^d are the investment rate,[3] expected growth of demand, actual capacity utilization, and desired capacity utilization, respectively.[4] The subscript t means at time t. This is typical of a Kaleckian investment function where ρ_t and u_t^d are constant.[5]

We assume that the desired capacity utilization and expected growth rate adapt to change. It is also assumed that firms revise their targets on the basis of real values.

$$u_t^d - u_{t-1}^d = \mu(u_{t-1} - u_{t-1}^d) \tag{2}$$

$$\rho_t - \rho_{t-1} = v(g_{t-1} - \rho_{t-1}) \tag{3}$$

We transform these equations to derive an equation consisting only of observable variables.

Substituting (1) for (3), we get

$$\rho_t - \rho_{t-1} = v\beta(u_{t-1} - u_{t-1}^d) \tag{4}$$

Using (2) and (4), we have

$$\rho_t = \frac{v\beta}{\mu}u_t^d + A \tag{5}$$

where $A = \rho_{t-1} - \frac{v\beta}{\mu}u_{t-1}^d$. Following Skott(2008, 2012a), A is a constant.

From (1), (2), and (5),

$$g_t = A + \beta(\frac{v}{\mu} - 1)[\mu u_{t-1} + (1-\mu)u_{t-1}^d] + \beta u_t \tag{6}$$

Subtracting $(1-\mu)g_{t-1}$ from both sides of (6), we get

$$g_t - (1-\mu)g_{t-1} = \mu A + \beta(v-1)u_{t-1} + \beta u_t \tag{7}$$

Thus, we derive an equation consisting only of observable variables.

3 Data

We translate the monthly data of the capacity utilization index for industrial production from the Japanese Ministry of Economy, Trade and Industry to annual data. The edited data is shown in Figure 1.

[3]'Investment' means the investment to capital ratio.

[4]'Desired' means strategic determination regarding well-defined objectives.

[5]Refer to Adachi(2000), Abe(2009), and Ikeda(2006, 2010) for the microfoundation. They derive the investment function under the assumption that the cost function is convex. Skott(1989, Chapter 6) questions this assumption and proposes another derivation.

The change in capacity utilization is shown for the Japanese economy since the early 1980s.[6] In the late 1980s, Japan experienced a 'Bubble Boom' following a recession after the 1985 Plaza agreement. The recovery era after the collapse of the 'Bubble Boom' was negatively affected by an increase in the national debt burden due to the government policy in 1997 and by the 'Asian shock' in 1998. Moreover, after the 'IT Bubble' collapsed in 2001, the recovery continued.

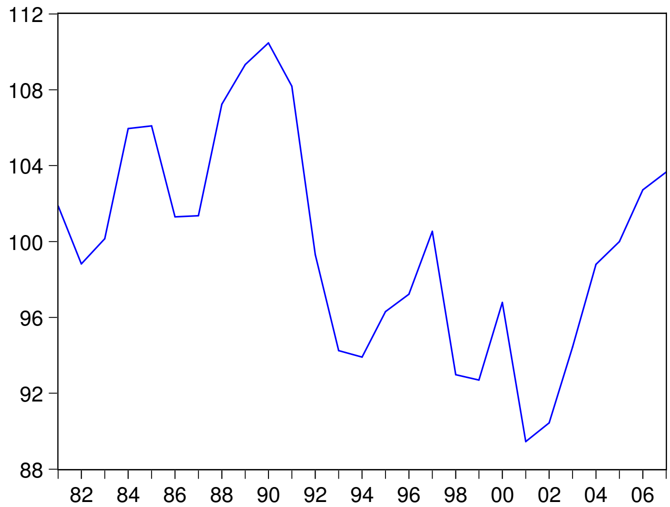


Figure 1: Capacity Utilization Index (years(x-axis), capacity utilization index(y-axis))

We also translated monthly manufacturing data in terms of the gross capital stock of private enterprises from the Cabinet Office to annual data for constructing the private investment index. The data contains construction equipment for both completed and under-construction projects and is based on the United Nations (1993) Systems National Accounts. The edited data is shown in Figure 2.

The period of study is from 1982 to 2007 based on the available data.[7] We take annual data following Skott(2008). The data are seasonally adjusted.

[6]Refer to Nakatani and Skott(2007) for the effects of Japanese economic stagnation since the 1990s.

[7]Using the same criteria, we can get data on capacity utilization from 1978 to 2007 and on investment from 1980 to 2009. We therefore use the data from 1981 to 2007 for the rate of change and the lag.

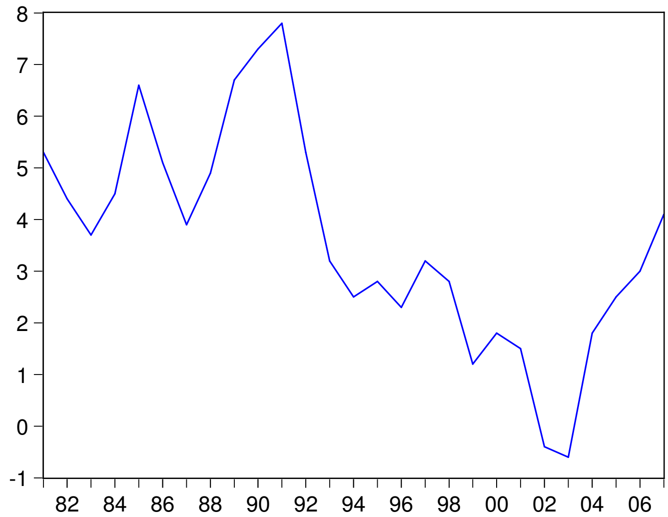


Figure 2: Investment Rate (years(x-axis), investment rate(y-axis))

The descriptive statistics of the data are shown in Table 1.

3.1 Preliminary test results

First, we check for any unit root and the stationarity of variables using an augmented Dickey−Fuller test. The lag length selection is determined by the Schwarz Information Criterion. The result is shown in Table 2,[8] where g and u follow an integrated process of order one.

4 Estimation of the Investment Function

As the first step in estimating the investment function, we incorporate (7) into the error correction model.

$$\Delta g_t = g_0' + \beta \Delta u_t - \mu(g_{t-1} - \theta - \zeta u_{t-1}), \quad g_0' = \mu(A - \theta), \quad \frac{\beta v}{\mu} = \zeta \tag{8}$$

Tus, the equations to estimate are as follows.

$$g_t = \theta + \zeta u_t + \chi_t \tag{9}$$

[8] Δ means the difference of order one. We also take Mackinnon's (1996) one-sided p-value.

	u	g
Mean	99.78549	3.600000
Median	100.0000	3.200000
Maximum	110.4667	7.800000
Minimum	89.45000	-0.600000
Std. Dev.	5.740808	2.128741
Skewness	0.097439	0.078255
Kurtosis	2.193384	2.616591
Jarque-Bera	0.774683	0.192935
Probability	0.678859	0.908039
Sum	2694.208	97.20000
Sum Sq. Dev.	856.8787	117.8200
Observations	27	27

Table 1: Descriptive Statistics of the Data

variable	trend and intercept	t-Statistic
g	none	-0.984578
	include intercept	-3.121447
	include trend and intercept	-2.688515
u	none	-0.010217
	include intercept	-1.765101
	include trend and intercept	-2.550623
Δg	none	-3.864882^{**}
	include intercept	-3.771211^{**}
	include trend and intercept	-3.709758^{*}
Δu	none	-4.331950^{**}
	include intercept	-4.238085^{**}
	include trend and intercept	-4.166179^{*}

** $p < 0.01$, * $p < 0.05$

Table 2: Unit Root Test

$$\Delta g_t = g_0' + \beta \Delta u_t - \mu \chi_{t-1} + \varepsilon_t \tag{10}$$

where χ_t and ε_t are error terms. Equation (9) shows the relationship between investment and capacity utilization in the long run. Equation (10) shows that g changes, correcting the separation from the relationship in the long run.

First, we estimate Equation (9) and conduct an Engle Granger cointegration test.[9] We then estimate Equation (10).

The result of the first step is shown in Table 3. This can be a spurious

Dependent variable: g_{t-1}	
u_{t-1}	0.317289^{*}
	[0.040344]
Constant	-28.03276^{*}
	[4.026321]
Observation	26
R-squared	0.720444

Notes: Standard errors in brackets.
* $p < 0.01$

Table 3: Estimations using Equation (9)

regression because g and u follow an integrated process of order one, as seen in the preceding section.

We examine the stationarity of the error term using an Augmented Dickey−Fuller test to see if there is cointegration. The lag number is determined by the Schwarz Information Criterion. The result is shown in Table 4.[10] In the case

trend and intercept	t-Statistic
none	-2.778536^{**}

** $p < 0.01$

Table 4: Cointegration Test

of no trend or intercept, the null hypothesis respecting a unit root is rejected at the 1% significance level. Thus, it is possible that there is a cointegration relationship between g_{t-1} and u_{t-1}.

We consider how the investment function responds to capacity utilization. Equation (5) and (9) show the relationship between investment and capacity

[9] Refer to Engle and Granger(1987).

[10] Here, we also take Mackinnon's (1996) one-sided p-value.

utilization in the long run. We get coefficient $\zeta = \frac{v\beta}{\mu} = 0.317289$ when estimating Equation (9). This result questions the Kaleckian assumption and supports the position of Skott(2008, 2012a).[11]

Next, we estimate Equation (10) considering the estimation of Equation (9), although it is not very important from the point of view of our main purpose. We adopt a dummy variable in the intercept, which divides the periods before and after 1992, to account for the "Bubble Boom." We presume that the structural changes occurred after the boom ended.

The result is shown in Table 5.

Dependent variable: Δg_t	
Δu_t	0.091938^{**}
	[0.024643]
χ_t	-0.849541^{**}
	[0.118445]
$Constant$	0.356458^{*}
	[0.150900]
$ConstantDummy$	-0.664491^{*}
	[0.265129]
Observation	26
Adjusted R-squared	0.825030

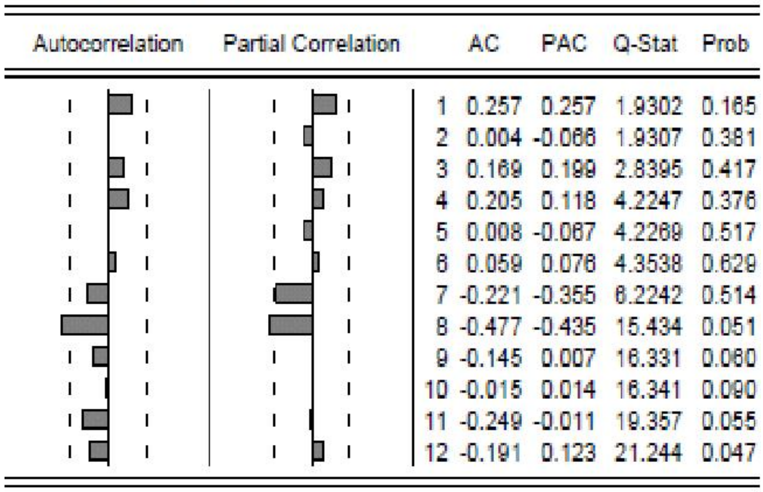
Notes: Standard errors in brackets.
$^{*}\ p < 0.05$, $^{**}\ p < 0.01$

Table 5: Estimations using Equation (10)

We use the Newey−West covariance correction because the White test showed heteroskedasticity.[12] We get good p values and adjusted R-squareds. Figure 3 shows that the error term has no serial correction for the null hypothesis.

[11] According to Skott(2012b), the gross saving rate in most advanced countries lies between 0.15 and 0.25, with an output-capital ratio of about 0.5. Therefore, the sensitivity of the saving rate is between 0.075 and 0.125 because $\frac{S}{K} = su\sigma$, where S, K, and s are saving, capital stock, and the saving rate, respectively. Thus, the sensitivity of investment is restricted to be less than approximately 0.1.

[12] Refer to White(1980) and Newey and West(1987).



Sample: 1982 2007
Included observations: 26

	AC	PAC	Q-Stat	Prob
1	0.257	0.257	1.9302	0.165
2	0.004	-0.066	1.9307	0.381
3	0.169	0.199	2.8395	0.417
4	0.205	0.118	4.2247	0.376
5	0.008	-0.067	4.2269	0.517
6	0.059	0.076	4.3538	0.629
7	-0.221	-0.355	6.2242	0.514
8	-0.477	-0.435	15.434	0.051
9	-0.145	0.007	16.331	0.060
10	-0.015	0.014	16.341	0.090
11	-0.249	-0.011	19.357	0.055
12	-0.191	0.123	21.244	0.047

Figure 3: Correlogram of Residuals

5 Conclusion

We investigate how investment responds to capacity utilization in Japanese manufacturing. The result questions the underlying assumption of the Kaleckian investment function and supports the argument of Skott(2008, 2012a). The responsiveness of investment to capacity utilization is greater than that assumed by the Kaleckian approach. The significance of this paper is that one must be very careful when applying the Kakleckian model to the Japanese economy in the long run. However, in this preliminary paper, we use annual data and only capacity utilization as an explanatory variable following Skott(2008). We should also include quarterly data and other explanatory variables in our research. These tasks remain.

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