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Cyclical patterns in Japanese manufacturing and post-Keynesian models

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Abstract

This paper examines cyclical patterns of employment, capacity utilization, and profit share in Japanese manufactuaring of the period 1978-2007. It estimates significant behavioral equations to determine whether year-specific and trend data confirm the three notable post-Keynesian macroeconomic models of Kaldorian, Robinsonian, and Kaleckian. Some stylized facts about relationships among the bivariate variables are observed. Results of the output growth equation on employment and profit share are statistically significant, and signs are consistent with the Kaldorian model. Conversely, the Robinsonian price adjustment is not supported. Results of the investment function do not support the Kaleckian model.

JEL Classification: E12, E32, O41
Key words: growth, business cycles, aggregate demand, income distribution, utilization rate, investment function, pricing

1 Introduction

Recent global economic crise have stimulated interest in post-Keynesian economics as alternative because it showed effective demand and income distribution are critical to understand the capitalism economy. Post-Keynesian economics adopts some singular views, the most striking of which are its attention to effective demand and income distribution in the short and long runs. Among the several strands of post-Keynesian thought, the Kaleckian model supposes capacity utilization as a means of adjustment in the goods market and assumes that the coefficient of saving is larger than for investment in determining capacity utilization. Several heterodox schools like Kaldorian and Robinsonian have researched macroeconomic growth and business cycles simultaneously. In the Kaldorian scheme, firms reduce investment plans when the economy exceeds capacity, whereas in the Robinsonian model, firms reduces their markup to increase revenues. Kaldor assumes that prices adjust faster than output; Robinsonian, the reverse. Their interpretations conflict with mainstream theories, which seemingly ignored long-run effective demand and did not examine the growth and business cycles simultaneously.

Skott and Zipperer (2012) apply the Kaleckian, Robinsonian, and Kaldorian models to cyclical patterns in the United States, finding that the Kaldorian model is empirically

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supported. Such research is nessesary to build coherent and consistent post-Keynesian theories. Recently, Japanese economy scholars have adopted post-Keynesian perspectives. Azetsu, Koba, and Nakatani (2010) investigate dynamic patterns of capital accumulation and income distribution in Japan using a VAR Kaleckian model. Nakatani and Skott (2007) discuss Japan's multi-decade recession from a Kaldorian viewpoint.[1] However, these post-Keynesian approaches have not made it apparent which of the three models best pertains to Japan's economy.[2] The Kaleckian model Azetsu, Koba, and Nakatani (2010) adopted does not have endogenous cycles. Nakatani and Skott (2007) did not engage in an econometric analysis. We examine cycles in Japanese manufacturing and assess which heterodox model best applies.

Section 2 presents the cyclical patterns in observed variables. Section 3 discusses regression results. Section 4 concludes.

2 Cyclical patterns

2.1 Data

This study utilizes official time-series data from Japanese governmental publications for firms classified as manufacturers from 1978 to 2007.

Employment and capacity utilization data are monthly, but profit share data are seasonal. Therefore, monthly employment and capacity data are seasonally adjusted to impose uniformity using X-12-ARIMA programs. Because of data availability, the sample period spans 1978Q1-2007Q4 for the employment rate, capacity utilization, and profit share. The sample for the investment rate and real value added covers 1981Q2-2007Q4.

Profit share is obtained by dividing the net surplus by the net surplus plus compensation in manufacturing, drawing data from Financial Statements Statistics of Corporations by Industry from Japan's Ministry of Finance. Figure 1 displays a real time series alongside short- and long-run trends subjected to Hodrik-Prescott Filtering.[3] The short-run trend excludes some abnormal values in peaks. We dropped data in the beginning and end in order to avoid a bias.

The long-run trend declines gradually from the early 1980s, falls sharply from the early 1990s, and begins rising from the early 2000s.

Capacity utilization data are obtained from the Ministry of Economy, Trade and Industry. Figure 2 shows the decreasing constantly since 1990s.

The employment rate is obtained by subtracting the unemployment rate from one. Unemployment data are obtained from the Ministry of Health, Labour and Welfare. We consider Japan's national unemployment rate, not the unemployment rate in manufacturing, because the former better indicates the balance of power between workers and capital. Figure 3 shows that movements in the employment rate coincide with capacity utilization rate.

In the following section, we consider data involving output Y and the investment rate g. Output is the sum of net surplus compensation divided by the GDP deflator. The investment rate is calculated using data for manufactures from Gross Capital Stock

[1] Sonoda (2007) investigated Japanese manufacturing using Goodwin's model.

[2] Refer to Zipperer and Skott (2011, p.25) for an explanation of each models.

[3] The parameter of short-run trend is 6.25 and that of long-run trend is 1,600. We apply the same parameters to trends in capacity utilization and employment rate.

Figure 1: Quarterly profit share: actual, and short-run, and long-run trends

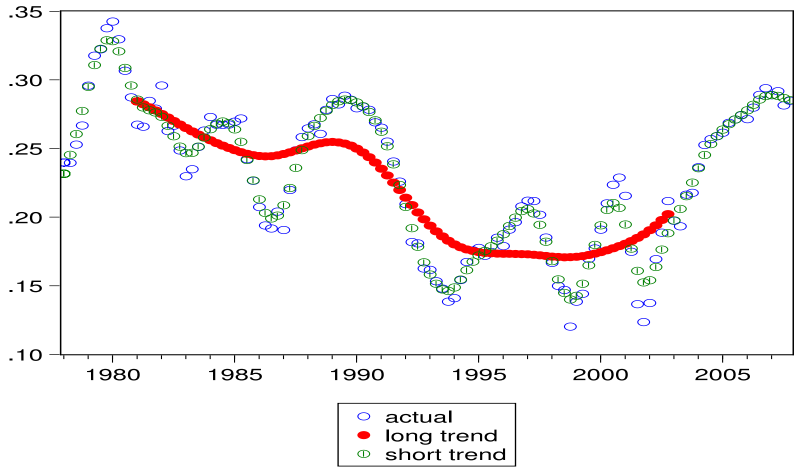


Figure 2: Quarterly utilization rate: actual, short-run, and long-run trends

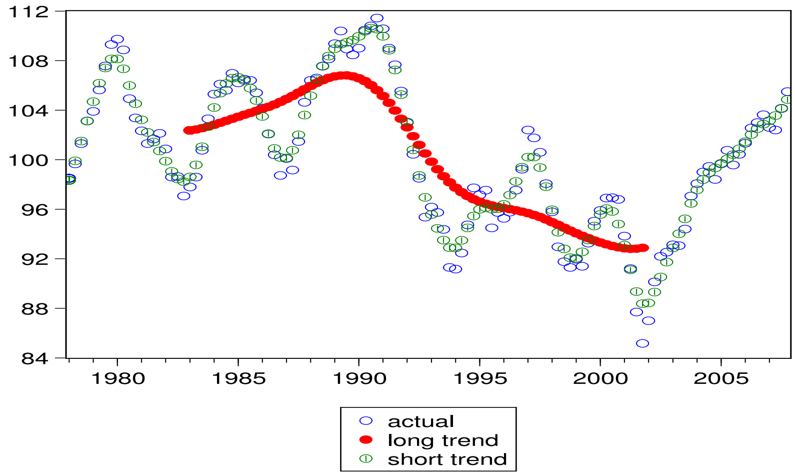
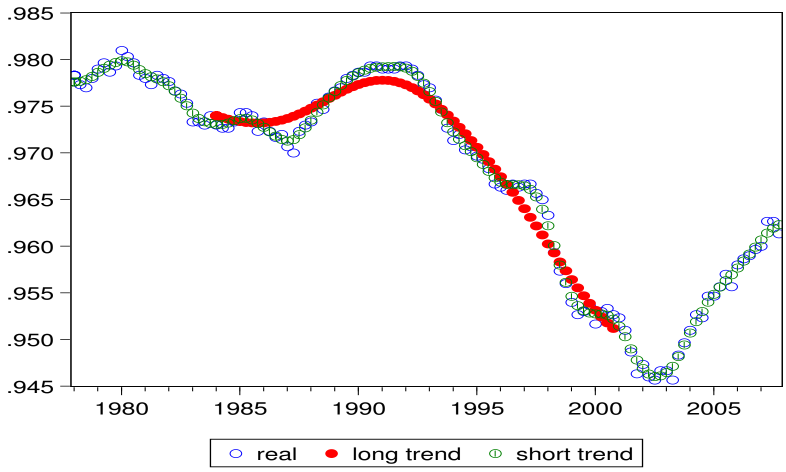


Figure 3: Quarterly employment rate: actual, short-run, and long-run trends



of Private Enterprises published by the Cabinet Office. These variables are seasonally adjusted.

2.2 Cycles

First, we examine short-run trends to identify motion across the period examined. Then, we examine each cycle's deviations from the long-run trend.

2.2.1 Short-run trends

We use slightly smoothed data in computing all short-run trends. The points identified by year include data for the first quarter of each year.

First, we examine scatter graphs of the employment rate e, profit share π, and capacity utilization u. Next, we present scatter graphs of these three variables and output growth $\hat{Y}$ and investment rate g.

Figure 4 shows the employment rate e and profit share π. The x axis is employment, and the y axis is profit share. The overall direction of movement is clockwise and westward.

Figure 5 shows the employment rate e and capacity utilization rate u. The x axis is employment, and the y axis is capacity utilization. The movement resembles that of Figure 4.

Figure 6 shows capacity utilization u and profit share π. The x axis is capacity utilization, and the y axis is profit share. The motion is complex, displaying clockwise and counter-clockwise rotations, and short-run deviations from the long-run trend warrant further examination. We need to examine these deviations from the long trends in any case.

Next, we see the relationship between output growth rate $\hat{Y}$ and e, π, and u. Figure 7 which is slightly smoothed, primarily shows clockwise rotations.

Figure 8 similarly shows the relationship between investment rate g and e, π, and u. The rotation is clockwise.

Figure 4: Smoothed (e, π)-plane cycles

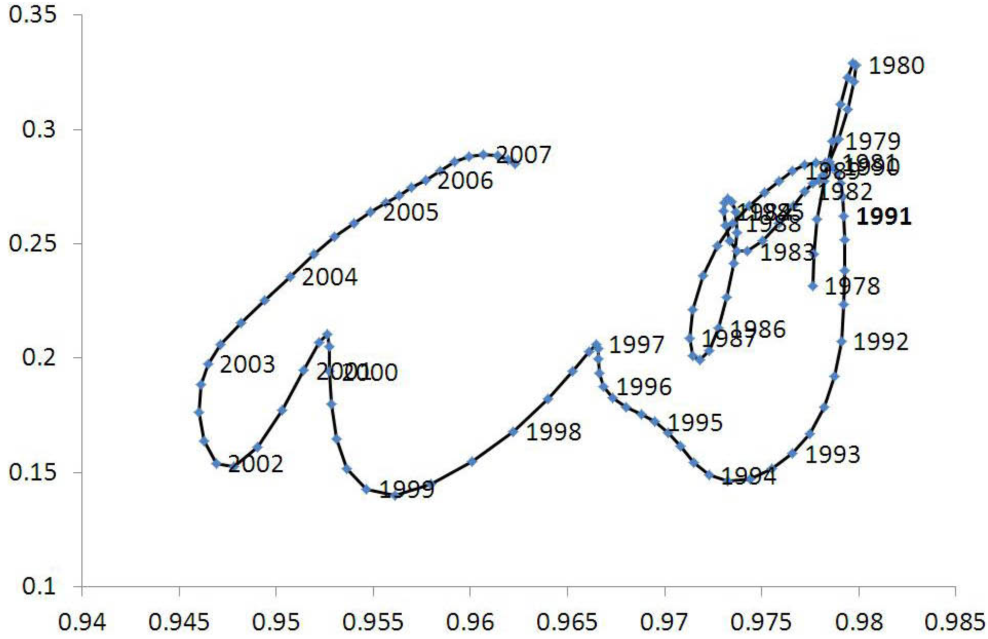


Figure 5: Smoothed (e, u)-plane cycles

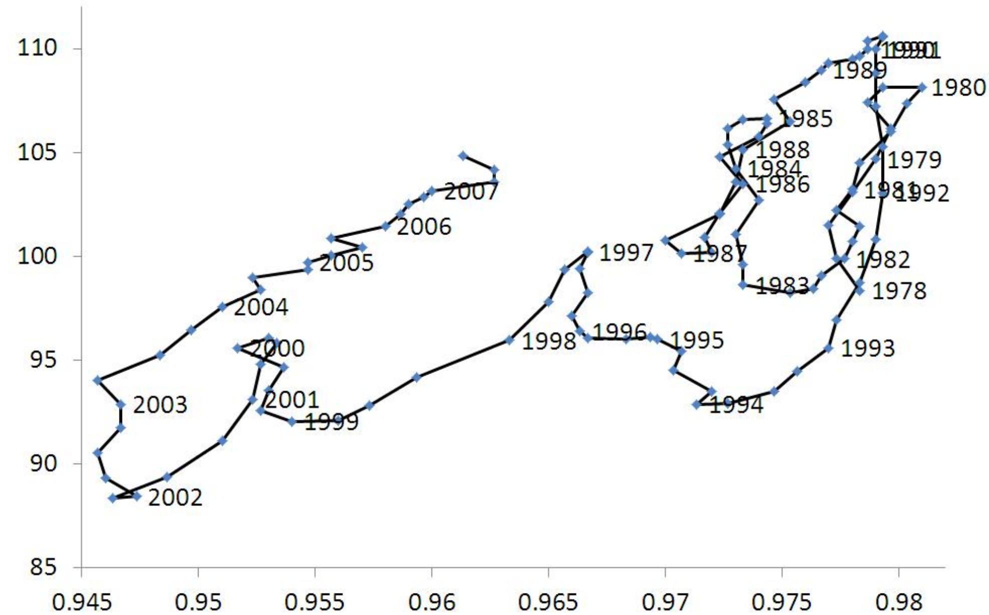
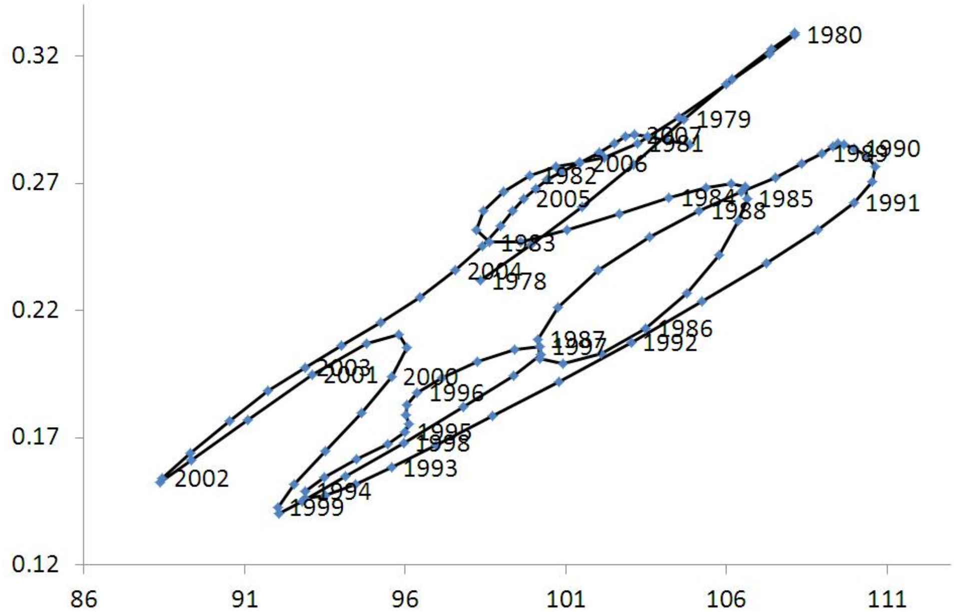


Figure 6: Smoothed (u, π)-plane cycles



2.2.2 Deviations from the long-run trend

This subsection examines how extensively the raw data deviate from the long-run trend. Each graph in Figures 9∼11 shows the deviation and corresponds to business cycle date of the Japanese government. However, observations from one year after second peak are included to show the cycles clearly.

Figure 9 graphs the deviation of e and π. All cycles display clockwise rotations.

Figure 10 graphs the deviation of u and π. Three cycles feature clockwise rotations:1983Q1-1987Q4, 1986Q4-1994Q4, and 1993Q4-2000Q1. Three cycles feature counter clockwise rotations:1978Q1-1984Q1, 1999Q1-2003Q3, and 2002Q1-2007Q4.

Figure 11 graphs the deviation of e and u. All cycles show clockwise rotations.

Skott and Zipperer (2012, 2010) showed clockwise rotations of these variables in the US economy and reproduced the same motions in simulations involving the Kaldorian and Robinsonian models. [4] Therefore, currently, it is undetermined which model is suitable for the Japanese economy;thus, econometric investigations is needed.

3 Regression

We estimate the output growth, growth rate of profit share, and investment function in Japanese manufacturing. These factors are included to assess the relevance of each major post-Keynesian model to Japanese manufacturing. The Kaldorian model assumes that output growth depends on profitability and employment. The Robinsonian model

[4] In the Kaldorian model, the u and π motion is clockwise, while in the Robinsonian model, it is counter-clockwise. However, Skott and Zipperer (2012, 2010) pointed out that these results can be modified by appropriate extensions. In both model, cycle patterns depend on parameters. Therefore, we have only to make sure that observed cycles can be reproduced by a simulation for the present.

Figure 7: Smoothed cycles $(e, \hat{Y})$-, $(\pi, \hat{Y})$-, and $(u, \hat{Y})$-planes

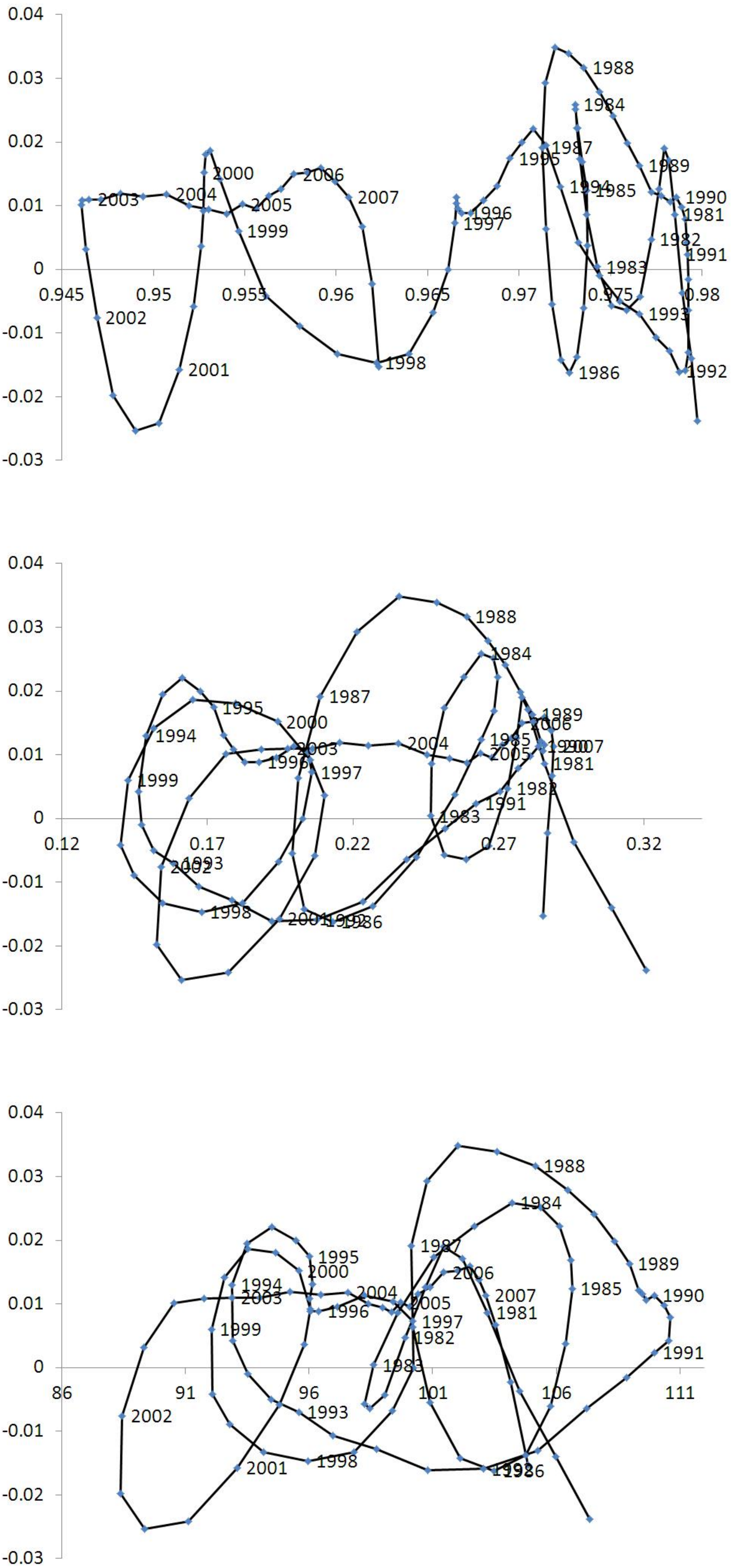


Figure 8: Smoothed cycles $(e,\, g)$-, $(\pi,\, g)$-, and $(u,\, g)$-planes

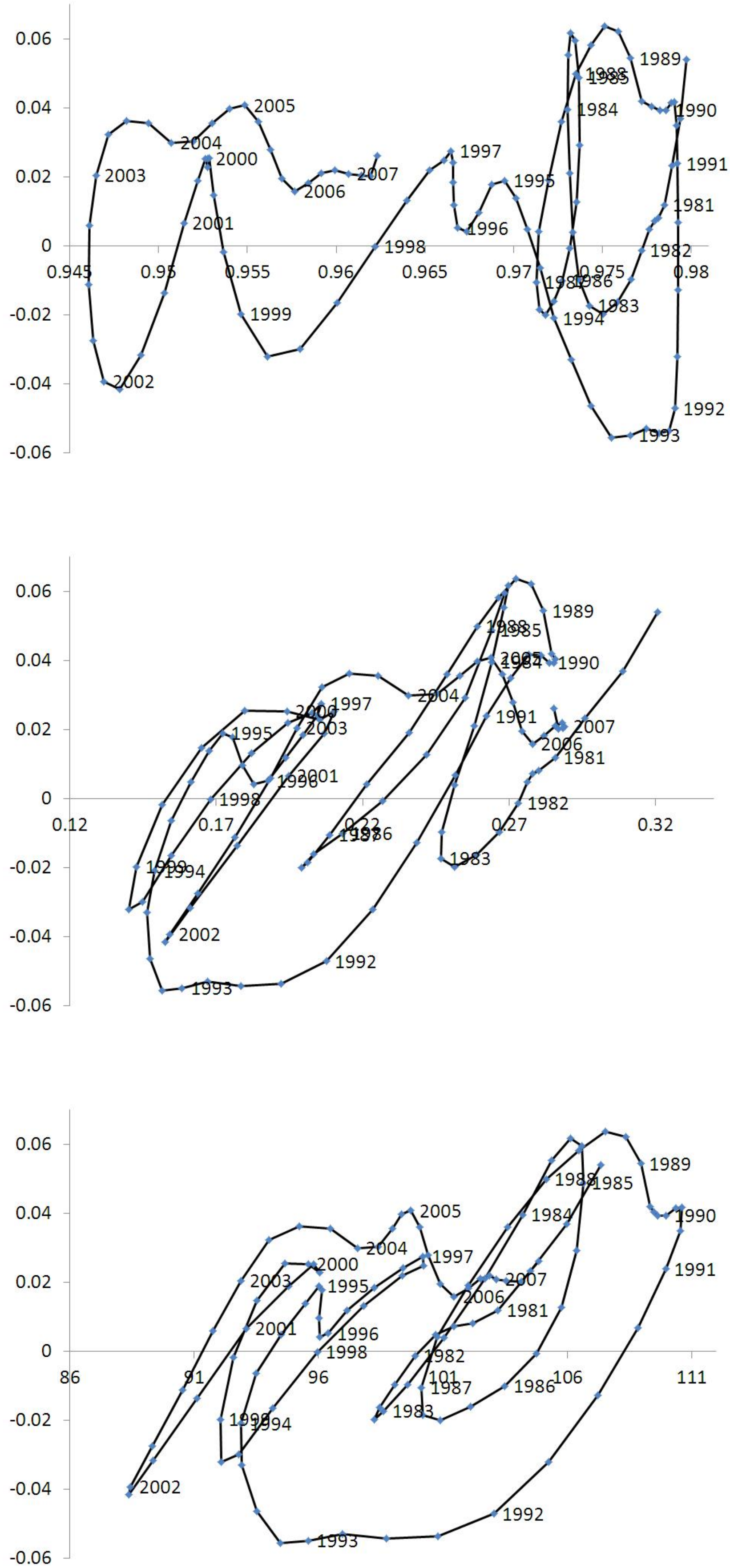


Figure 9: Deviation of e and π from their long-term trends: e(x axis), π(y axis)

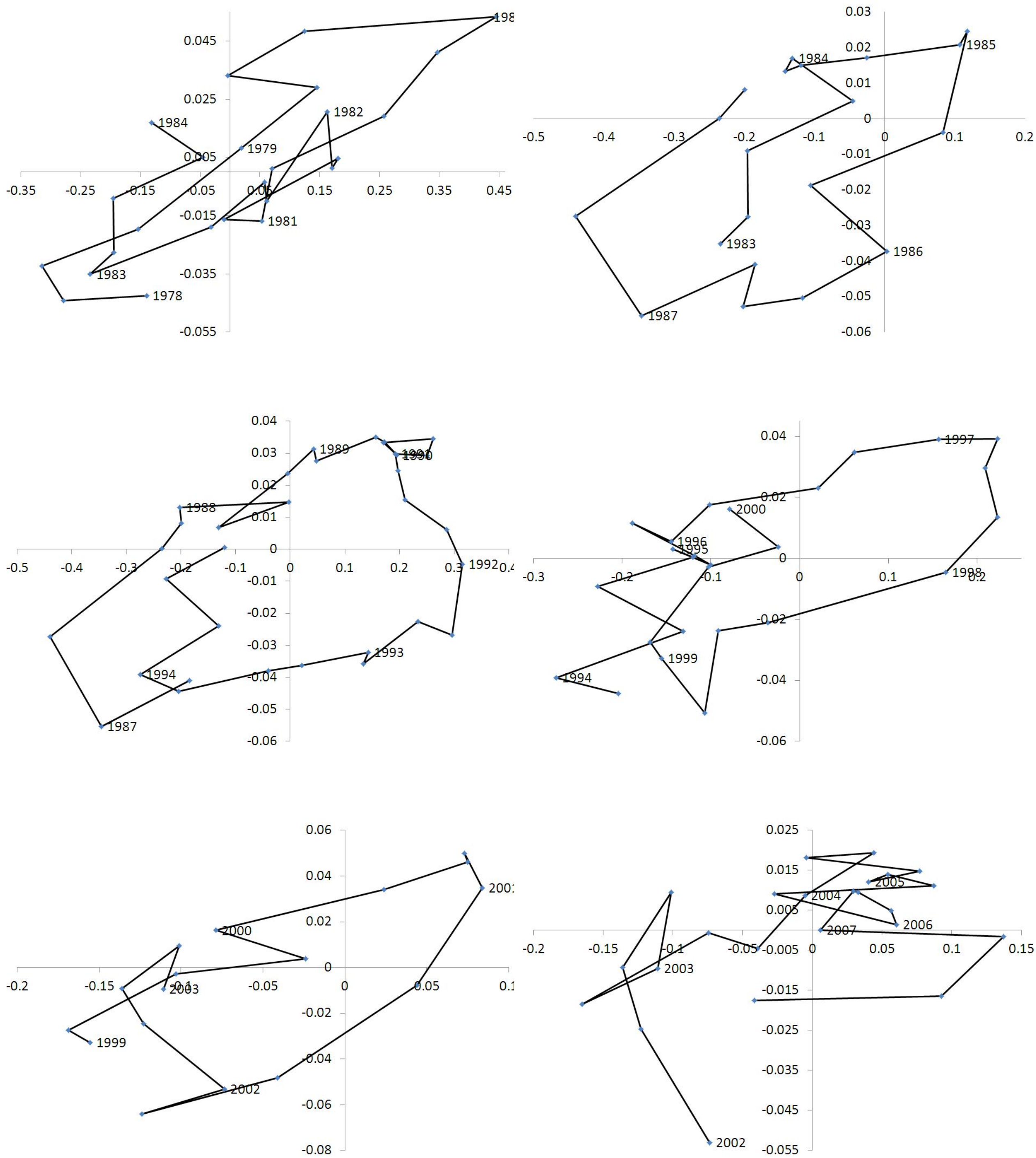


Figure 10: Deviation of u and π from their long-term trends: u(x axis), π(y axis)

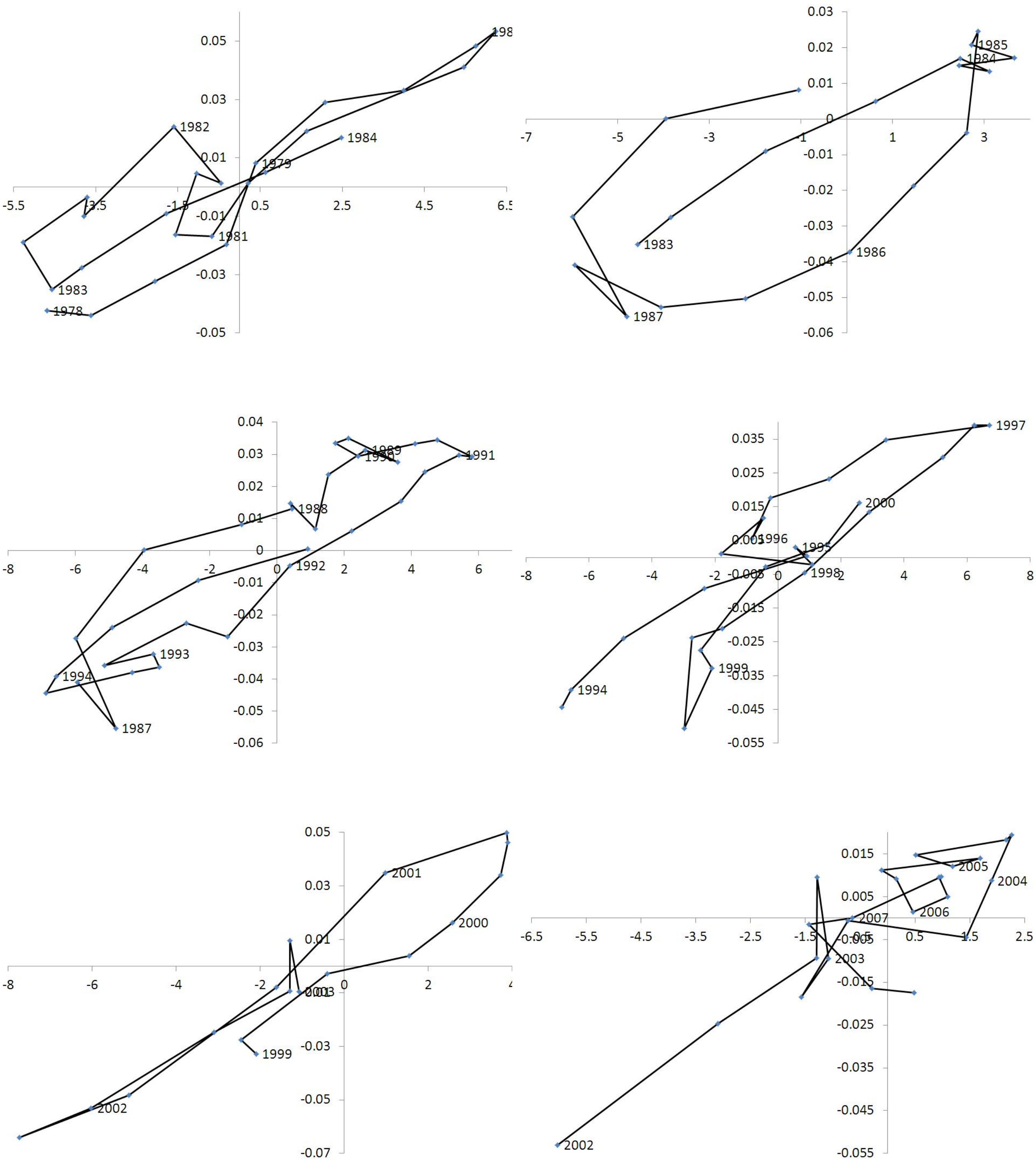
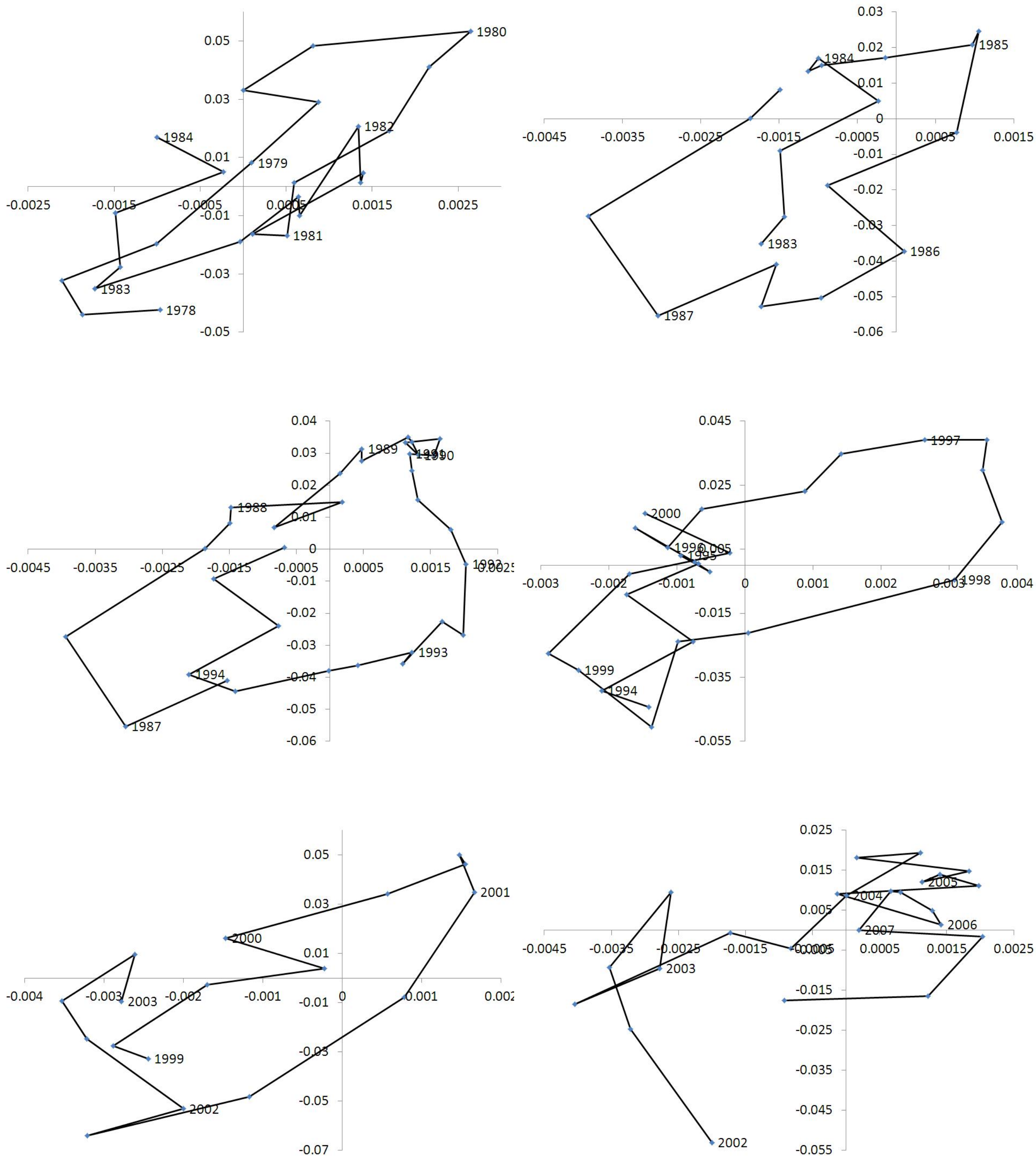


Figure 11: Deviation of e and u from their long-term trends: e(x axis), u(y axis)



assumes that growth rates of profit share depends on capacity utilization. An investment function is important to evaluate the Kaleckian model, which regards utilization rates as an accommodating variable, although the Kaldorian and Robinsonian model assume that the the desired utilization rate is structurally determined in the long-run.

3.1 Output growth

Table 1 shows results of estimations in output growth. e_dev, π_dev, and u_dev are the deviation of $(1-e)^{-0.5}$,[5] profit share, and capacity utilization rate from their long-run trends. $\hat{Y}_i$ is the i term lag of output growth. We correct all estimations except (4) and (7) using the Newey-West method because they have heteroscedasticity and auto correlation. We omit the results of (1) and (5) because their adjusted R-squared values are low.

e_dev and π_dev are statistically significant and their signs are consistent with the Kaldorian model. A 1% increase in the employment rate makes the output growth decrease by 3.2-4% yearly, while a 1 % increase in the profit share makes the output growth increase by 2.8-4% yearly.

Table 1: Output growth

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	$\hat{Y}$	$\hat{Y}$	$\hat{Y}$	$\hat{Y}$	$\hat{Y}$	$\hat{Y}$	$\hat{Y}$
e_dev	-0.075404^{***}	-0.111883^{***}	-0.105621^{***}	-0.098149^{***}	-0.064138^{***}	-0.094904^{***}	-0.088309^{***}
π_dev	0.504635^{***}	0.855967^{***}	0.724163^{***}	0.864518^{***}	0.793037^{***}	0.970437^{***}	1.090879^{***}
$\hat{Y}\_1$		-0.661357^{***}	-0.523167^{***}	-0.300326^{***}		-0.509501^{***}	-0.289301^{***}
$\hat{Y}\_3$				-0.487798^{***}			-0.484313^{***}
$\hat{Y}\_4$			0.189491^{**}	0.062919		0.201794^{**}	0.075181
u_dev					-0.003051^{*}	-0.002722	-0.002513^{*}
Constant	0.006437^{**}	0.011196^{***}	0.009033^{***}	0.011340	0.006298^{**}	0.008734^{***}	0.011048
Observations	107	107	107	107	107	107	107
Adjusted R-squared	0.093245	0.482336	0.495541	0.620600	0.100591	0.503559	0.628001

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

3.2 Price adjustment

Table 2 shows results of the estimation in price adjustment. Almost all variables lack statistical significance, and the adjusted R-squared values are small. Thus, we find no evidence supporting Robinsonian price adjustment.

3.3 Investment

Table 3 shows the results of the estimation of the investment function. A one percentage point increase in u_dev, e_dev_1, π_dev, and $\hat{Y}$ prompts a change in the steady growth value of the annual accumulation rate of about 2.8-4, -0.4-0.45, 4.2-4.6, and 1.4-1.5 percentage points, respectively. We consider only coefficients with p values within 5 %. Signs of the e_dev and π_dev coefficients are minus and plus, respectively. These results fit the Kaldorian, Robinsonian, and Kaleckian models with labor constraints. However, the coefficient of u_dev is substantial, indicating these results do not support the Kaleckian model. According to Skott (2012), the gross saving rate lies between 0.15 and 0.25 and the

[5] This specification is from the simulation in Skott and Zipperer (2010).

Table 2: Price adjustment

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	$\widehat{\pi\_dev}$	$\widehat{\pi\_dev}$	$\widehat{\pi\_dev}$	$\widehat{\pi\_dev}$	$\widehat{\pi\_dev}$	$\widehat{\pi\_dev}$
u_dev	-0.056180	0.664622	0.466954	0.388304	0.167550	0.634702
u_dev_1		-0.806644^{*}	-1.284032	-1.082686		-0.641924
π_dev				1.236217		
e_dev				-6.133613	-7.531544	-3.947769
π_dev_1			88.85283	99.09066		
Constant	0.714158	0.682470	0.675241	0.684414	0.714184	0.688954
Observations	119	119	119	119	119	119
Adjusted R-squared	-0.007882	0.013814	0.031094	0.023878	0.003227	0.009447

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

output-capital ratio is about 0.5. in most advanced economies. Therefore, the sensitivity of investment should be less than 0.1 to support the Kaleckian model.

Table 3: Investment

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	g	g	g	g	g	g
u_dev	0.004708	0.004415	0.012407^{***}	0.011013^{***}	0.008277^{***}	0.007435^{***}
e_dev_1	-0.125402^{***}	-0.111857^{***}	-0.125535^{***}	-0.106311^{**}		-0.641924
π_dev	1.156767^{***}	1.051537^{***}				
g_1	-0.289675^{***}	-0.269554^{***}	-0.225294^{**}	-0.205382^{**}	-0.178678^{*}	-0.165342^{*}
g_2		0.057678		0.080092		0.083276
g_4		-0.109984		-0.155982^{*}		-0.191954^{**}
$\hat{Y}$					0.389501^{***}	0.359564^{***}
Constant	0.012440^{**}	0.012779^{**}	0.011583^{**}	0.012196^{**}	0.009920^{*}	0.010931^{**}
Observations	103	103	103	103	103	103
Adjusted R-squared	0.303568	0.307579	0.246033	0.258740	0.237727	0.265004

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

4 Conclusion

We have investigated cyclical patterns in Japanese manufacutuaring and estimated severe behavioral equations to examine whether the post-Keynesian models of Kaldorian, Robinsonian, and Kaleckian apply to the Japanese economy.

We observed clockwise rotations of (e, π), (e, u), ($\hat{Y}$, e), ($\hat{Y}$, π), ($\hat{Y}$, u), (g, e), (g, π) and (g, u) in the short-run trend and (e, π) and (e, u) in the deviation from the long-run trend. On the other hand, (u, π) in the short-run trend and the deviation from the long-run trend rotate clockwise and counter-clockwise rotations, respectively. Skott and Zipperer (2012, 2010b) reproduce these cycles by simulations using the Kaldorian and Robinsonian models.

We estimated three equations to examine the cycles more accurately. Results of the output growth equation on employment and profit share are statistically significant and the signs are consistent with the Kaldorian model. Meanwhile, Robinsonian price adjustment is not supported by our estimation because the statistical significance and adjusted

R-squared value are poor. The coefficient of capacity utilization is larger than that supposed by the Kaleckian model, and results for the investment function do not support the model.

Our findings remain preliminary because we have not yet included the public, exports-imports, and financial sectors. In particular, we must address that Japan's public sector is larger than in the US situation investigated by Skott and Zipperer (2012, 2010). Furthermore, other segments of Japanese industry need to be included in future studies.

References

[1] Azetsu, K., Koba, T., and Nakatani, T. (2010) "Empirical analysis of a Kaleckian-type model of growth and distribution", *Political Economy Quarterly*, vol. 47, No. 1, pp. 56-65.(in Japanese)

[2] Nakatani, T., and Skott, P. (2007) "Japanese Growth and Stagnation", *Structural Change and Economic Dynamics*, vol. 18, No. 3, pp. 306-332.

[3] Skott, P. (2012) "Theoretical and empirical shortcomings of the Kaleckian investment function", *Metroeconomica*, vol. 63, No. 1, pp. 109-138.

[4] Skott, P. (2008) "Theoretical and empirical shortcomings of the Kaleckian investment function", WP 2008-11, Department of Economics, University of Massachusetts Amherst.

[5] Sonoda, K. (2007) "Growth cycles in Japanese manufacturing after WW2", *Political Economy Quarterly*, vol. 44, No. 3, pp. 55-64.(in Japanese)

[6] Skott, P. and Zipperer, B. (2012) "An empirical evaluation of three post Keynesian models", *Intervention*, vol. 9, No. 2, pp. 277-308.

[7] Skott, P. and Zipperer, B. (2010) "Dynamic patterns of accumulation and income distribution", *Political Economy Quarterly*, vol. 46, No. 4, pp. 34-53.(in Japanese)

[8] Zipperer, B. and Skott, P. (2011) "Cyclical patterns of employment, utilization, and profitability", *Journal of Post Keynesian Economics*, Fall vol. 34, No. 1, pp. 25-57.