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Do Wild Fluctuations in Quarterly Inventory Investment Data Matter?:
A Study of Japanese GDP Statistics, 1994~2010 (1)

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Abstract

For more than half a century, inventory investment has attracted wide attention as a major cause of short-term macroeconomic fluctuations, and the mechanisms involved have been the focus of many major studies. Yet microeconomists and business people familiar with corporate behavior have frequently expressed misgivings about the enterprise.

Using Japanese quarterly GDP inventory investment statistics both by commodity and by category, 1994~2010, I investigate the nature of quarterly inventory statistics and the inventory investment behavior, and draw two conclusions. First, statisticians estimate the quarterly statistics under severe time constraints, and their resulting figures incorporate seasonal variations which dominate the quarterly fluctuations. This fluctuation mostly disappears in annual data. Secondly, when I examine the inventory variation after the Lehman Shock in the autumn of 2008, I find neither a notable increase in inventory stock nor a long-run stock adjustment process. Given the size of this unforeseen exogenous shock, most observers expected a large inventory stock accumulation to follow. That the accumulation did not follow suggests that the focus on inventory variation may be misplaced.

For inventory investment data estimation, Japan is an ideal OECD country, with generous statistics availability. The conclusions of this research, drawn from the quarterly GDP inventory statistics, will stimulate the interest both in the study of inventory data in other countries focusing on its estimation process and source statistics, and in the great variety of inventory investment. At the same time, the conclusions pose a grave implication not only for re-evaluation of the literature in inventory investment variations but also for other research topics in macroeconomics like monetary transmission mechanisms including "financial accelerator" theory.

[1]. Introduction

Fashions in economic research, as in other discipline, often run in cycles. Such is the case with inventories. Modern interest in inventory behavior was stimulated by Metzler's [1941] demonstration that an inventory-accelerator mechanism can produce cycle in simple Keynesian models. Empirical and theoretical aspects of inventory behavior became hot topics in the 1950s and early 1960s, a period when the U.S. economy's cyclical fluctuations looked much like Metzlerian inventory cycles. (Blinder and Maccini, 1991, p. 73)

Symbolically since "Metzler's [1941] illuminating analysis of the inventory accelerator process and Abramovitz's [1950] fundamental empirical analysis of inventory behavior" (Feldstein and Auerbach,

1976, pp. 351–2), inventory investment has attracted wide attention of macroeconomists as a major cause of short-term macroeconomic fluctuations, and the mechanisms involved have been the focus of many major studies. Yet microeconomists and business people familiar with corporate behavior have frequently expressed misgivings about the enterprise.

Wen [2005, p. 1534] begins: "Understanding inventory fluctuations is a key step towards understanding the business cycle. Blinder and Maccini [1991] show that the drop in inventory investment accounts for 87% of the drop in total output during the average postwar recession in the U.S."[2] Also Romer [2012] in its latest edition calls attention to wild fluctuations of inventory investment.[3]

Studies of past quarterly data often conclude that too high or too low inventory stock took on average 8 or 12 quarters for adjustment, with which the processes and mechanisms involved have attracted wide attention. Also the financial accelerator theory emphasizes as a monetary transmission mechanism the effectiveness of transmission channel through inventory variations.[4]

Studies of mechanisms in inventory investment fluctuations, primarily using quarterly GDP statistics, have been under severe constraints in data availability. Many inventory studies use another type of data set on manufacturing firms' inventory, which provide no information on inventories non-manufacturing firms hold, for example, distributors' inventory of manufactured products or non-manufacturing firms' raw material stock and goods-in-process inventory. Blinder and Maccini [1991] conclude that the size of the latter is larger than the former.[5]

Of their five basic characteristics of the inventory data, Feldstein and Auerbach [1976, p. 356] points, "[T]he first, of particular importance, is that even major changes in inventories represent the outputs and inputs of only very short time periods", raising questions about the dominant view that the adjustment of too much (or too small) inventory stock takes eight or twelve quarters.[6] Yet, no other paper than mine has asked: "what will happen if the estimation method and process is a major cause of wild inventory fluctuations in quarterly GDP statistics?"

Most studies of inventory investment use the US data. The OECD dataset suggests that the data availability condition seems basically similar everywhere.[7]

As an empirical microeconomist, I have long studied firm behaviors, industries and markets, primarily in Japan, feeling misgivings about the enterprise. Basically, it sharply deviates from what I have observed routinely and confirmed upon microdata about the corporate behaviors in Japan.

It is irrational and implausible to leave for no reason too much or too small inventory stock as it is. When it is too much or too small, the adjustment process will be prompt and complete in a short period. It is irrational and implausible to take a tremendously long time, 8 quarters for instance.

Some rather see, "individual agents, firms in particular, may behave rationally, aiming prompt response and adjustment. Market mechanism, interaction of individual agents' choices, may not be so prompt and efficient." For some, the long duration of inventory adjustment implies that the adjustment speed of the market is not so prompt and efficient as many microeconomists assume.[8]

The subject and method of the study, and the data

As shown below, in addition to the data type typically used in countries like the U.S., in Japan a rich variety of other data are available for the inventory cycle studies.[9] At the center of the sets of data I use in this study is the quarterly GDP inventory investment statistics both by commodity and by category, the

original series of the final estimates (*kakuho*, detailed below in [3]), that I have an opportunity to use.

With a long time series of aggregate quarterly GDP inventory investment estimates, it is hard to draw relevant information about the causes and mechanisms of its wild fluctuations frequently observed. As a consequence, subjects of most studies are: How was the adjustment process for the consequences of variations?; What fluctuation patters and relations with other variables we observe in inventory investment? Symbolically they are: Is inventory investment fluctuation pro-cyclical or counter-cyclical?; Are they realization of single-wavelength or of synthetic form of multiple-wavelengths?

In this research, for studying an inventory stock accumulation and long-run stock adjustment process to follow, I investigate in detail an unforeseen exogenous shock (a surprise change in variables). As an experimental laboratory I choose the Japanese economy after the Lehman Shock in the autumn of 2008. At the beginning of this period, recognizing the serious financial crisis occurred in the U.S. and developed to European countries, most Japanese expected its influence to Japanese financial markets and institutions rather small, and to the Japanese economy not so serious. As shown in [2], however, in terms of the fall in GDP and export, its influence to the Japanese economy was the severest of major developed countries. The speed and the range of fall was the severest of the depressions in Japan since the 1970s, not only than the ones in "the Financial Crisis" since 1997 and at the beginning of the 1991s after the "Bubble Burst" but also the one after the Oil Shock in 1974. Some might expect it serious, but for most economic agents in Japan such a rapid and huge fall in demand and shipment including export was an unforeseen exogenous shock (or "innovations").

Given the size of this unforeseen exogenous shock, most observers expected as "an impulse response" a large inventory stock accumulation to follow and a long-run stock adjustment process, providing solid information for studying the reality of stock accumulation and the speed and duration of adjustment process. I find, however, neither a notable increase in inventory stock nor a long-run stock adjustment process, both in aggregate and in most individual industries (to be precise, individual commodities as detailed in [3]). The same applies also to the study of the period during the "Financial Crisis" after the end of 1997.

That the accumulation did not follow suggests that the focus on inventory may be misplaced. It is consistent both with the misgivings microeconomists and business people familiar with corporate behavior have frequently expressed and observations in relevant micro data.

For inventory investment data estimation, Japan is an ideal OECD country, with generous source statistics availability. The conclusion of this research, drawn from the quarterly GDP inventory statistics, will stimulate the interest both in the study of inventory data in other countries focusing on its estimation process and basic statistics, and in the great variety of inventory investment. If noises, tics, or errors incorporated and mixed in through the estimation process is a major source of variations in quarterly statistics and its deviation from the reality, the long-lasting wide attention to wild fluctuations of quarterly inventory investment statistics as a major cause of short-term macroeconomic fluctuations may be adequately expressed as much ado about nothing.

The two subjects of the study

Inventory investment is the aggregate of variations in inventory stock mostly held by individual firms. Basic information for the inventory investment statistics comes from individual firm's accounting

information. Firms collect information and fix figures, following both the Accounting Standards and their own rules determined taking management policies and accounting customs into consideration. Upon request, each firm, taking various factors including the timing of reports into consideration, selects and reports figures to statistics offices. Aggregating those figures statistics offices estimate the source statistics including inventory investment statistics, upon which quarterly GDP inventory investment statistics are estimated. Therefore, compared to other items like production, sales, and equipment investment, inventory investment statistics is more vulnerable to mixing in noises, tics, and errors. Wild fluctuations in quarterly GDP inventory investment data may not primarily reflect the violent variations of investigation object.

Many observers share a basic view that inventory investment fluctuates wildly, that forms a common basis of inventory investment behavior studies. The conclusion of the first study subject raises a grave doubt on the validity of this basic view. Long-term time series aggregate quarterly GDP statistics widely used in inventory investment studies do not easily allow investigation of specified causes and mechanisms of fluctuations. As the second study subject, focusing on the period after Lehman Shock in the fall of 2008, I investigate the consequences of a large unforeseen exogenous shock, in which most observers expected to find notable increase in inventory stock and long-run stock adjustment process. The focus of the study is the size and content of stock accumulation, and the pattern and depth of the adjustment process and its length of time.

The first subject of the study

In addition to a huge variety of rich public data, I have the opportunity to use detailed inventory investment data by commodity (91 commodities) and by category (4 categories) that are estimated on the process for quarterly GDP QE (quick estimate, on the *kakuho*[10] stage) statistics.[11] Together with detailed public information on the estimation process of quarterly data, I draw the following five conclusions from the study of quarterly GDP inventory investment statistics.

(1) Quarterly GDP inventory investment statistics shows sharp and stable regular seasonal fluctuations (hereafter, I call it M-shaped).

(2) Its investigation by category reveals more or less in inventory investment of every category regular seasonal fluctuations, of which those of goods-in-process inventory is the sharpest and most remarkably regular. The dominant portion of regular seasonal fluctuations in total inventory investment is due to those of goods-in-process inventory investment.

(3) Annual inventory investment statistics, the sum of four quarterly estimates (or their annual average), shows a dramatic decrease in the size of fluctuations.

(4) Because of sharp regular seasonal fluctuations, I classify quarterly data into four groups, from the first quarter (Q_1) to the fourth quarter (Q_4), and examine the fluctuations respectively. The standard deviation of inventory investment in each group is dramatically smaller everywhere than that of quarterly inventory investment throughout the period. Moreover, this standard deviation in each group is still all larger than that of the annual average.

(5) Annual statistics shows the biggest factor of total inventory investment fluctuations in the distribution inventory, where those of goods-in-process become a figure in the background.

SNA (System of National Accounts) estimates, demanded "accuracy" in describing the national economy, is published annually. At the time of SNA annual estimates publication, quarterly SNA QE estimates (called *sokuho*, or preliminary) are revised (*kakuho*, or final). *The Census of Manufactures* (*kogyo tokei chosa*), an annual census survey, is the most basic to the SNA in Japan, with which SNA statistics are estimated annually, and quarterly GDP inventory investment statistics are finalized. As detailed in [3], however, "adjustment" conducted on the finalizing process is just to allocate evenly to each quarterly preliminary estimate a quarter of the difference between the annual estimate and the aggregate of four quarterly preliminary estimates. As a result, regular seasonal fluctuations observed in preliminary estimates of quarterly GDP inventory investment statistics, which reflect noises, tics, and errors in estimation, remain as it is after the finalization. Conclusions from (1) to (5), together with the above story, I draw a speculation that wild fluctuations in quarterly GDP inventory investment statistics rise out of the estimation process of quarterly data.

From the study of the first subject, I draw the following conclusion. Aside from the SNA annual estimates for accurate description of the national economy, quarterly SNA (GDP) statistics are published in response to strong demand for quickness as a basis of characterizing the state of the economy. Wild fluctuations in quarterly inventory investment are observed in the quarterly estimates, and in the SNA annual estimates the inventory investment variations dramatically decrease. Studies of inventory investment variations and their mechanisms, including the studies mentioned above, with little necessity of quickness, should make the shift from the quarterly GDP inventory investment data to annual SNA data, also using other micro data such as IIP (Indices of Industrial Production) and *Hojin kigyo tokei* (Corporate Enterprise Statistics, quarterly and annual). In using quarterly GDP inventory investment statistics, we should be more careful about the regular seasonal fluctuations.

The second subject of the study

As the second subject of this study, I investigate the too much or too small inventory stock accumulation as an impulse response to a surprise change in variables and stock adjustment process that follows. Focusing on the period after Lehman Shock in the fall of 2008, I examine the impulse response in the Japanese economy to a large unforeseen exogenous shock, dramatic fall in demand and shipment. The conclusion is clear and succinct, summarized below in five points. It raises grave doubts to the basic picture and mechanisms of inventory stock accumulation and its long-run adjustment process that many researches focusing on the wild fluctuations in inventory investment assume implicitly.

(1) At the manufacturers stage, in many industries monthly data show that a dramatic fall in shipment paralleled a fall in production of an almost equal size and speed. Dramatic shipment fall observed many industries ended in a short period, and shipment made a sharp recovery that paralleled production recovery of almost an equal size and speed. During this time, the manufacturers' stock level remained almost unchanged.

(2) Examination of quarterly GDP inventory investment statistics by commodity, either by individual quarters independently or by accumulation over sequence of quarters, reveal that in or around the 4th quarter of 2008 rarely I find large inventory stock accumulation. In the 1st quarter of 2009 I find almost everywhere a dramatic fall in inventory investment (a huge negative investment) and

huge accumulation of negative inventory investment since then.

(3) Above two points of observations, (1) and (2), apply not only to total inventory investment but also to each of four inventory category, product-, goods-in-process-, raw material-, and distribution inventory. With few exceptions this applies also to inventory investment by commodity.

(4) For comparison I also studied the Financial Crisis period of Japan, from the end of 1997 to the beginning of 1999, and draw the similar conclusion.

(5) In the first subject of the study, as a part of M-shaped regular seasonal fluctuations, I point that inventory investment is the largest in the 4th quarter and the smallest in the 1st quarter. Because of this, both the increase in inventory stock accumulation in the 4th quarter of 2008 and its fall in the 1st quarter of 2009 pointed in four conclusions above tend to be exaggerated.

The conclusion of the second subject of the study, focusing on the situation of Japanese economy, raises a grave doubt to the validity of the view of large unforeseen exogenous shock as a major cause of observed wild fluctuations in quarterly GDP inventory investment data.

The view that a large unforeseen exogenous shock causes wild inventory variations that accompany a long-run adjustment process has activated the study of inventory investment fluctuations, attracting the interest of macroeconomists. This conventional wisdom often leads to a claim that this slow stock adjustment process badly needs active government intervention into the market for macroeconomic stability. This conclusion raises grave doubts to the basic picture and mechanisms of inventory stock accumulation and its long-run adjustment process.[12)]

Some argue that, although individual agents, firms in particular, may behave rationally and try prompt response and adjustment, the market, as interactions of individual agents, does not necessarily work promptly and efficiently. My conclusion raises grave doubts also to this view.

For inventory investment data estimation, Japan is an ideal OECD country, with generous statistics availability. The conclusion of this research, drawn from the quarterly GDP inventory statistics, will stimulate the interest both in the study of inventory data in other countries focusing on its estimation process and basic statistics, and in the great variety of inventory investment (see below section [10]). Few careful readers feel a sense of relief, saying, "So we use seasonally adjusted figures."[13)]

The conclusions of this research, drawn from quarterly GDP inventory investment statistics which are commodity-based, are consistent with those drawn from other groups of statistics including *hojin kigyo tokei* (Corporate Enterprise Statistics) which are firm and industry based.

Roadmap

I investigate the first subject of study in Sections [4]~[6], and the second subject in Sections [7]~[9]. Sections [2] and [3] prepare the study of those two subjects. For an aperitif for readers, Section [2] first shows that the situation of the Japanese economy after Lehman Shock was unforeseen, and with monthly IIP (Indices of Industrial Production) illustrates that shipment and production moved almost perfectly in parallel, inventory remaining unchanged. Section [3] briefly introduces the estimation methods and their source statistics of inventory investment estimates both of quarterly GDP quick estimates (QE, *sokuho*) and of annual SNA estimates, together with their mutual relations, the place of *kakuho* (final report) of quarterly QE published at the same time with annual SNA figures, and relations

between *sokuho* and *kakuho* quarterly QE with method of their "coordination".

Section [4] examines the quarterly GDP inventory investment statistics, focusing on its variation patterns and their generation sources. Section [5] further studies the variation patterns and their generation sources found in [4]. In Section [6] I first focus on a likely candidate of the generation source of wild but regular seasonal fluctuations in quarterly inventory investment estimates, and then with the inventory data from the Corporation Enterprise Quarterly Statistics (CEQS) I confirm that the regular seasonal fluctuations at the center of attention do not arise on the process of converting firm-and-industry based inventory data into commodity based SNA (GDP) inventory data.

In Section [7] I investigate the corporate inventory investment by commodity around the period of Lehman Shock. Our data provides information not only by category but also by commodity. In Sections [7] and [8], using the information by commodity I study the inventory investment in eight major selected commodities. Section [7] still treats inventory investment in each quarter basically as an independent observation or decision making. Instead, viewing inventory investment to be a continuous adjustment process, Section [8] focuses on its accumulation process. Entitling 'Inventory Adjustment Process as a Consequence of Exogenous Shock and its Adjustment: Summary and Supplement', Section [9] first summarizes [7] and [8], then like in [6] shows that the same conclusions are drawn with CEQS data, and finally presents data that suggest in detail prompt manufacturers' responses to a large unforeseen exogenous shock.

Section [10] discusses the implications of the conclusions of this research based on the Japanese quarterly GDP inventory investment statistics. Judging from the estimation methods and basic information involved, Japan is an ideal OECD country for quarterly inventory statistics estimation. Those conclusions about Japan suggest the similar observations to be found in other countries and will stimulate the interest both in the study of inventory data in other countries focusing on its estimation process and source statistics, and in the great variety of inventory investment. At the same time, the reality of inventory investment statistics and the conclusion that variation patterns of actual inventory investment significantly deviates from what the conventional wisdom has supposed strongly suggests the need to evaluate the basic assumptions of research and policy discussions on many fronts. Section [11] concludes briefly. Section [12] is an Appendix entitled 'Inventory Investment Decision-making Process, Inventory Investment Function, and Data Availability Constraint'.

[2]. Aperitif: The Japanese Economy around the Period of Lehman Shock

In this research, for studying an inventory stock accumulation and long-term stock adjustment process as a consequence of specific cause, I focus on the Japanese economy after Lehman Shock in the fall of 2008.

This financial instability of the US origin rapidly spread from the US to other countries, European countries in particular. Partly because of the Japanese financial institutions' small investment balance on the much-talked-about realty-related investment securities, at first most Japanese anticipated not to be affected so seriously. However, with dramatic decrease in demand, particularly export, dramatic fall in shipment, production, and GDP became reality, which was unforeseen for most Japanese, a surprise change in variables. As the second subject of the study, I investigate in Sections [7]~[9] the large inven-

tory stock accumulation and long-run stock adjustment process observers expected to find as a consequence of this exogenous shock.

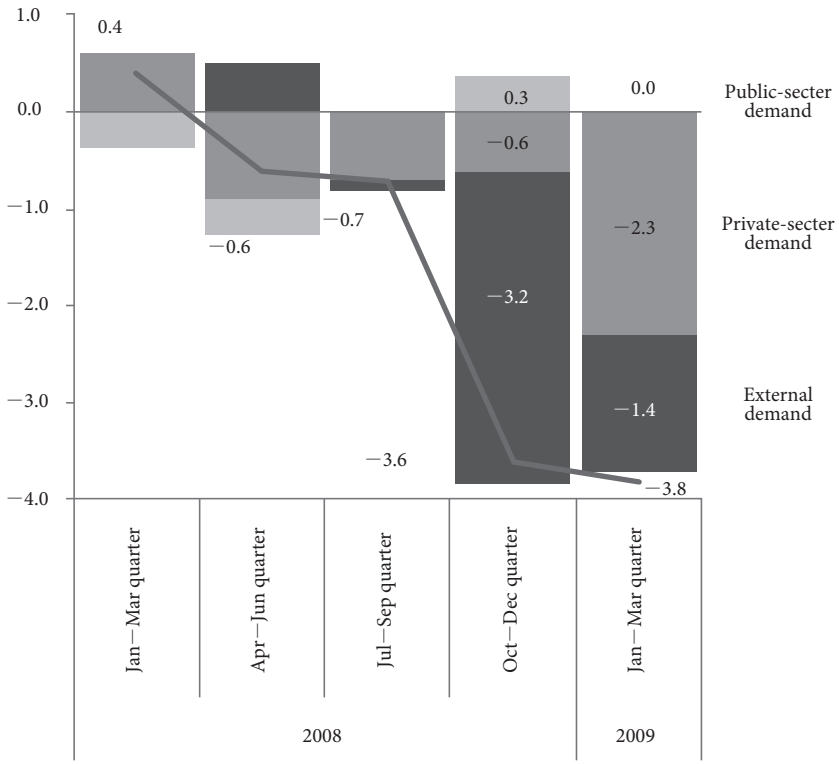
In Section [2], I first show why and how the Japanese economy after Lehman Shock was in the unforeseen situation caused by a large exogenous shock. Next, referring to monthly indices on shipment, production, and inventory reflecting the accumulation of the gap between shipment and production, I show that shipment and production moved almost perfectly in parallel, and despite their dramatic movement the inventory remained almost unchanged.[14)]

The Japanese Economy after Lehman Shock: Unforeseen Situation

I begin with figures of dramatic changes in the Japanese economy caused by an unforeseen situation. The first one is contributions to Japan's real GDP growth by type of demand (seasonally-adjusted quarter-to-quarter basis, %), from *White Paper on International Economy and Trade 2009* (Figure 1-1-2-13). After the collapse of Lehman Brothers Co. in September 2008, Japan's GDP fell dramatically, −3.6% in the 4th Quarter of 2008 (hereafter, 2008Q4) and further −3.8% in the 1st Quarter of 2009. The dominant factor of drastic decline in 2008Q4 is external demand (this time, export).

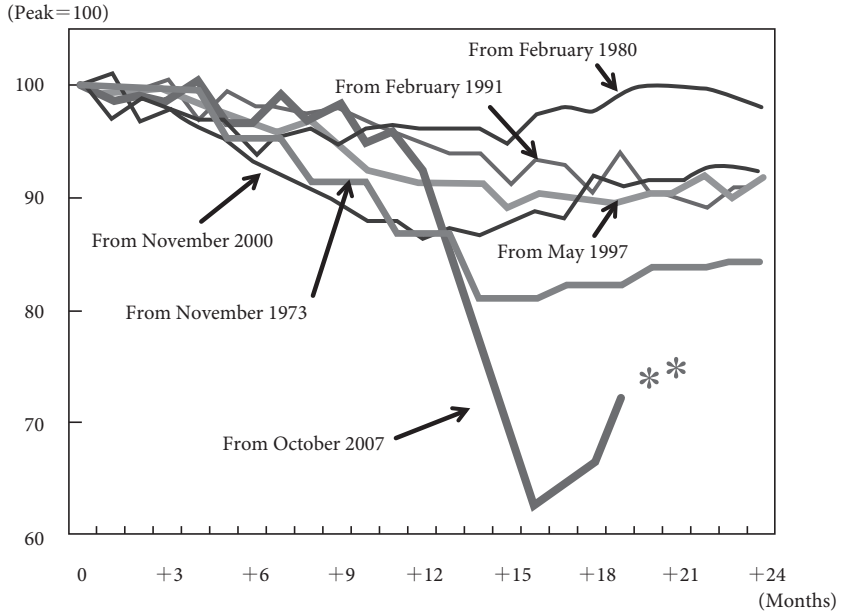
The production (also GDP) decline was record-quick speed and "deep", among the recessions after

Figure 1 Contributions to Japan's real GDP growth by type of demand
(seasonally-adjusted quarter-to-quarter basis, %, % points)



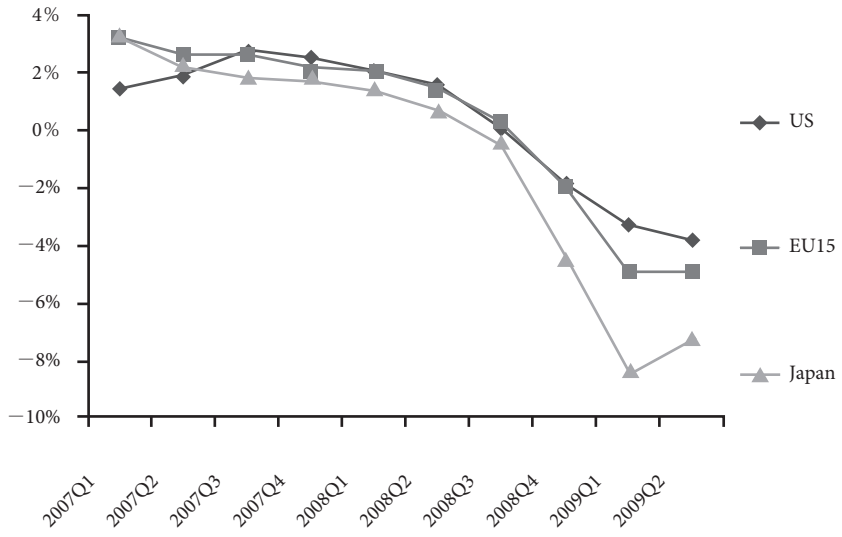
Notes: Quarterly estimates of GDP for the first quarter of 2009 (The Second Preliminary).
Source: *System of National Accounts* (Cabinet Office), adapted from METI's *White Paper* 2009.

Figure 2 Comparison with Recession Phase of Production



Source: "Industrial Production Index", Ministry of Economy, Trade and Industry.
Adapted from *The Annual Report of the Japanese Economy and Public Finance 2009*.

Figure 3 The current recession, OECD nations and G3, 2007Q1~2009Q2



Note: G3 is US, EU and Japan.
Source: OECD online data base, adapted from Baldwin ed., 2009, Figure 7, p. 5.

the 1970s including the one after the Oil Shock as shown in the next Figure 2 (from *The Annual Report of the Japanese Economy and Public Finance 2009*, Figure 1-1-4 (2)).

The figure shows the level of monthly indices of industrial production in each recession. The recession of this time started in October 2007 (=100), and began drastically declining in October 2008 (+12). In February 2009 (+16) it fell to the level lower than 2/3 of 100. During the recession after the Oil Shock, the level even at the bottom was higher than 80.

The GDP decline in Japan was the severest among the major developed countries (Figure 3 from Baldwin ed., 2009, Figure 7, p. 5).

Indices of Industrial Production and others

The recession began as an impulse response to a large exogenous shock to be called an unforeseen situation. Observers anticipate and expect to find phenomena as follows: Sudden and dramatic decline in shipment, particularly export, comes first, and production decrease starts a little late; At least temporarily inventory stock, both in total and in each of four inventory categories of distribution, product, goods-in-process, and raw material, accumulates as a remarkable rate, and a long and deep stock adjustment process follows. If I find neither notable increase in inventory stock nor long-run stock adjustment process even in such an extreme situation of serious decline in GDP and production generated by a large unforeseen shock of this time, where else wild fluctuations of inventory investment will occur, they would ask?

Preparatory to studies below, using IIP (Indices of Industrial Production) most frequently used in those studies in Japan,[15] I show that observations almost completely violate those anticipations and expectations.[16] For more details see *The Analysis of All Industrial Activities* (quarterly and annual) by METI (Research and Statistics Department, Economic and Industrial Policy Bureau, Ministry of Economy, Trade and Industry).

First, Figure 4 shows the industrial production, shipment, inventory, and inventory ratio (=inventory/shipment): quarterly, 2005~2011, 2005=100, and seasonally adjusted. The next Table 1 shows the relevant indices for 2008 and 2009. Both are adapted from *The Review of the Year 2009*, *Analysis of All industrial Activities*, p. 3.

Figure 4 Industrial Production, Shipment, Inventory, and Inventory Ratio: quarterly, 2005~2011, 2005=100, seasonally adjusted

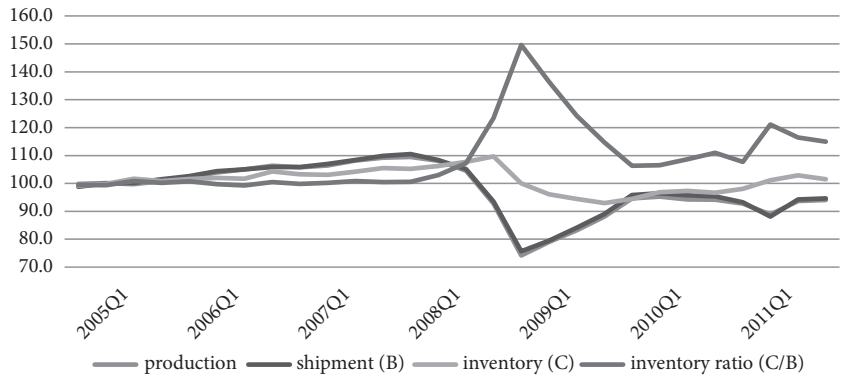
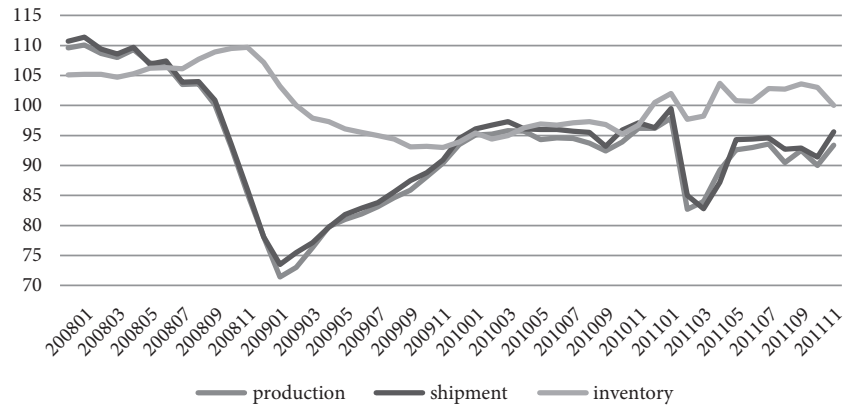


Table 1 Industrial Indices: quarterly, 2008~2009, 2005=100, seasonally adjusted

	2008				2009			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Production	109.5	108.1	104.6	92.8	72.3	78.3	84.1	87.9
Shipment	110.5	108.4	105.1	93.5	73.9	78.6	85.2	89.6
domectic	106.8	104.6	101.8	92.8	74.1	77.9	84.3	87.8
export	126.4	122.6	117.8	98.5	72.8	80.4	88.5	99.9
Inventory	105.2	106.2	107.7	109.7	99.8	95.3	94.7	93.6
Inventory Ratio	100.6	103.0	107.3	123.5	153.0	138.3	121.2	112.7
Capacity Utilization Ratio	105.6	104.0	100.4	87.1	63.4	71.4	78.8	82.6

Adapted from *Analysis of Industrial Activities, Year Book 2009*, METI.

Figure 5a Industrial Production, Shipment, and Inventory: monthly, 2008~2011, 2005=100, seasonally adjusted



Note two points. First, production moves in perfect harmony with shipment during the period. Following a gradual decline from the 1st quarter to the 3rd quarter of 2008, both dramatically fell both in the 4th quarter of 2008 and the 1st quarter of 2009, and then from the 2nd quarter of 2009 and after they rapidly increased. As shown soon, this holds true also in monthly data.

Second, during the period the inventory index remains almost unchanged. At the end of 2008Q4 when production and shipment fell dramatically it was 109.7, +1.9 compared with the previous quarter and +4.8 in year-over-year basis, and at the end of 2009Q1 it was 99.8, −91 compared with the previous quarter and −5,2 in year-over-year basis.

Using monthly IIP, let's see in more detail. I begin with Figure 5a on the whole industrial sector, and then three commodity sectors to make the image more specific (Figures 5b~5d).[17)]

IIP is based on *The Current Survey of Production* (*Seisan dotai tokei*, monthly) of METI. Therefore, for example, steel products inventory is steel manufacturer's product inventory. It includes neither manufacturer's material inventory like iron ore and coal nor their goods-in-process. It does not include distribution stock distributors possess or steel product stock construction companies hold as construction material, either.[18)]

I show in turn the figures on steel products, general machinery, and passenger cars. In all three cases, monthly data show that the production index moves in perfect harmony with the shipment index.

Figure 5b Industrial Production, Shipment, and Inventory:
monthly, 2008~2011, 2005=100, steel product

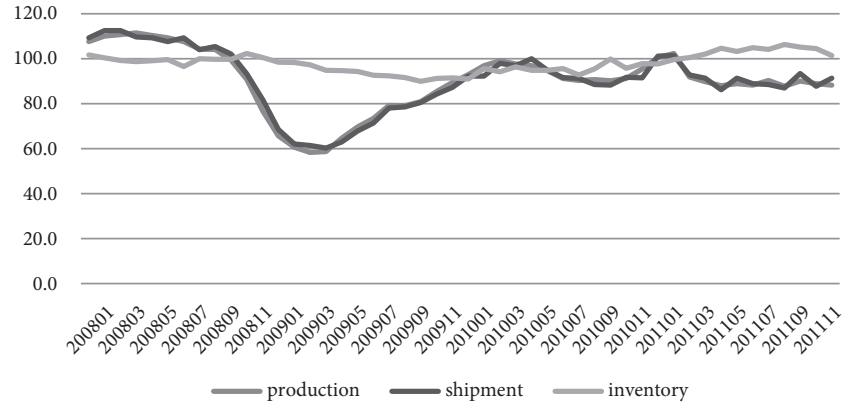


Figure 5c Industrial Production, Shipment, and Inventory:
monthly, 2008~2011, 2005=100, general machinery

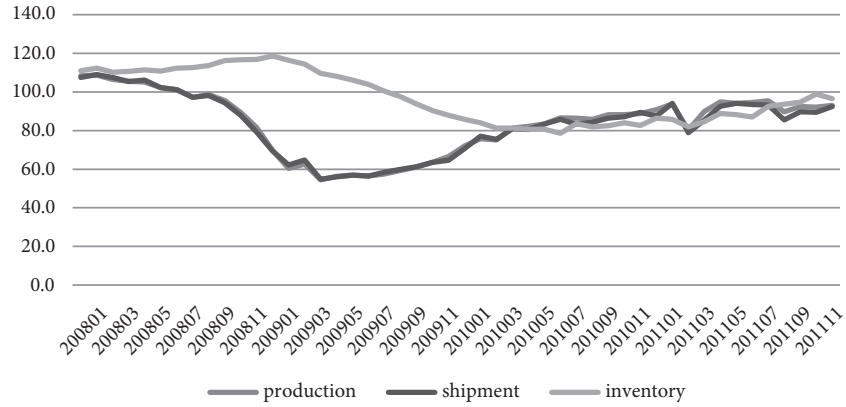
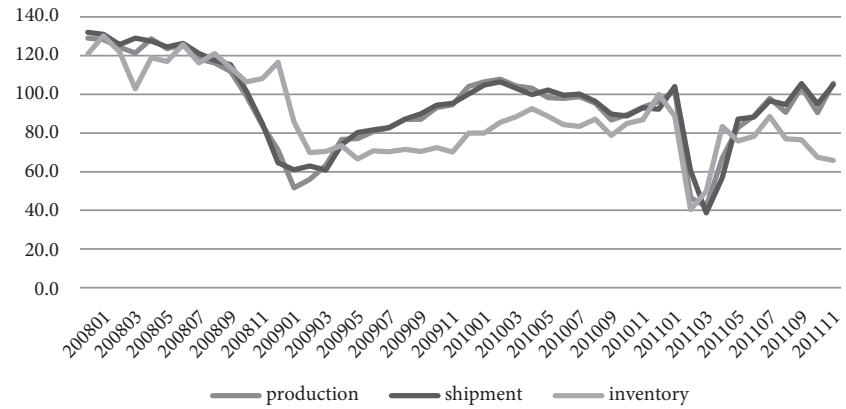


Figure 5d Industrial Production, Shipment, and Inventory:
monthly, 2008~2011, 2005=100, passenger car



Except for passenger cars, the inventory index remains almost unchanged.[19] The conclusions hold true during the period after the Great East Japan Earthquake in March 2011.

Export vs. Domestic Shipment

The quarterly SNA (GDP) statistics I primarily use in this research estimates inventory investment as changes in value of domestic inventory stock. Upon a very strong picture that the primary cause of the drastic GDP decline in Japan since 2008Q4 after the Lehman Shock is a dramatic decline in export demand,[20] readers may be concerned or dissatisfied about the choice of this estimates confined to domestic inventory.

Yet, as shown below, comparison of export vs. domestic shipment in industrial products, this choice of estimates confined to domestic inventory does not greatly influence the discussion and conclusions.

The breakdown list of industrial shipment (of the base year 2005, METI) tells that, of the total in-

Figure 6a Export vs Domestic Shipment:
whole industrial sector, montly, 2008~2011, 2005=100, seasonally adjusted

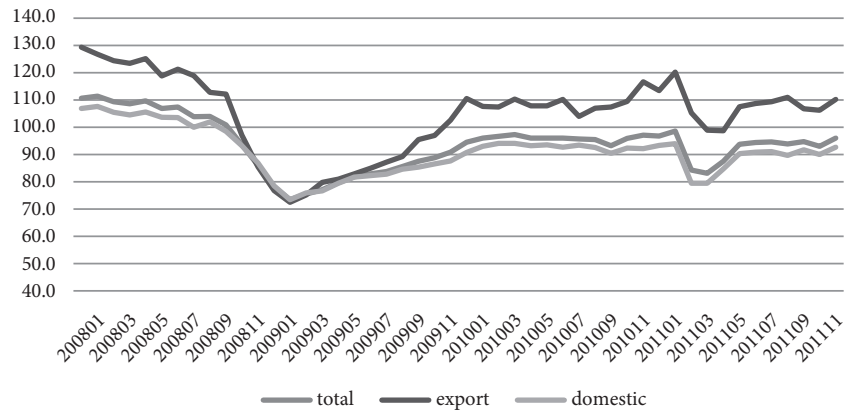


Figure 6b Export vs Domestic Shipment:
steel products, monthly, 2008~2011, 2005=100, seasonally adjusted

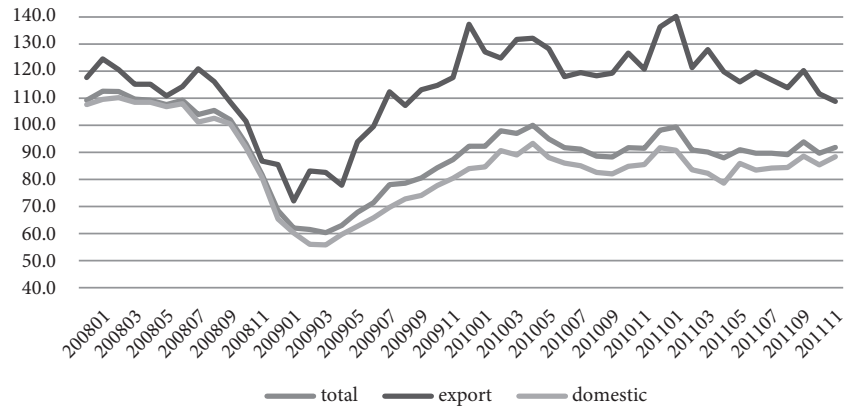


Figure 6c Export vs Domestic Shipment:
general machinery, monthly, 2008~2011, 2005=100, seasonally adjusted

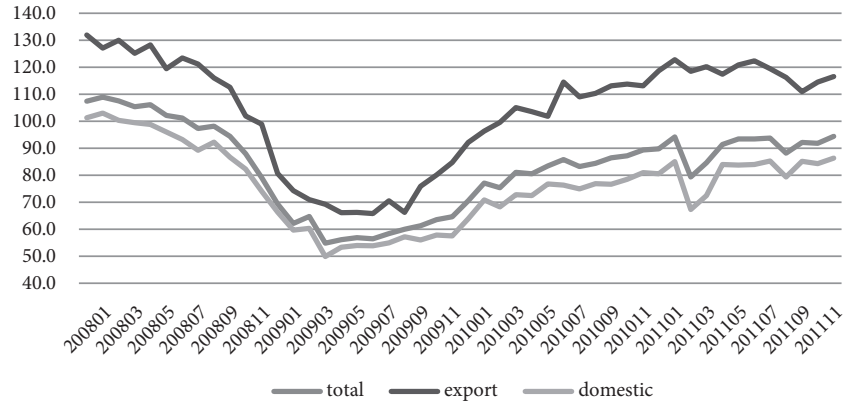
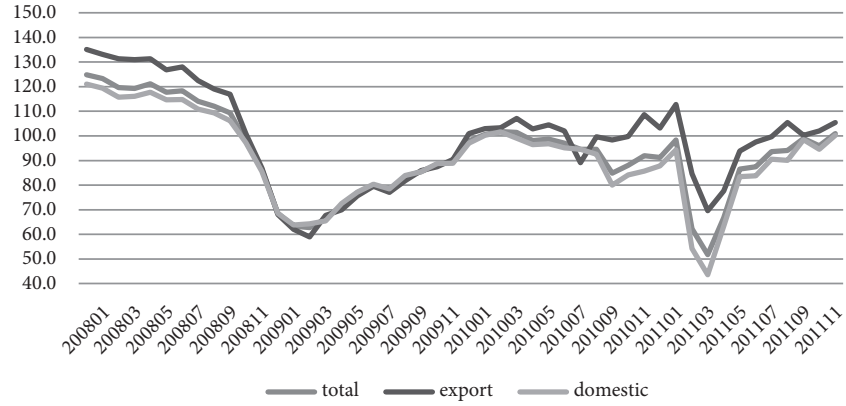


Figure 6d Export vs Domestic Shipment:
transportation machinery, monthly, 2008~2011, 2005=100, seasonally adjusted



dustrial shipment (=10,000), 1,917.3 is for export and 8,082.7 for domestic market. In Steel product (weight, 547.4), 95.9 for export and 451.6 for domestic, in general machinery (1,159.9), 286.2 and 873.7, and in transportation machinery including automobiles (2,014.7), 530.9 and 1,483.8. Thus, even in those three relatively export-oriented sectors, export ratio does not notably exceed the 25% level.

I present the figure on export vs. domestic shipment first on the whole industrial sector, and then three sectors, steel products, general machinery, and transportation machinery. All those figure show that export shipment reveals little notably peculiar movement, and that its recovery began earlier and the speed faster than the domestic shipment.

[3]. Inventory Investment Estimates in Quarterly GDP Statistics: estimation process and source statistics

In Japan, SNA (System of National Accounts) statistics is estimated for systematically reporting in an internationally comparable form the whole picture of the Japanese economy. Upon the international stan-

dards recommended by the UN, as a backbone statistics of the Statistics Act it is worked out following the SNA estimation manuals and methods.

SNA statistics is estimated as indices to see multidimensionally and comprehensively the activities of national economy, that is requested not only accuracy in the description of the economy but also promptness for understanding the economic outlook. In this perspective, in order to make reports on the SNA, particularly its expenditure series such as GDP (expenditure side) which is the aggregate of value added generated by domestic economic activities and private final consumption, as soon as possible, quarterly SNA statistics is estimated using source statistics available earlier and revise it step by step in response to the availability of more accurate and reliable statistics, improving the accuracy of statistics (CAO, "System of SNA Estimation").

SNA consists of *Quarterly GDP Preliminary* (*sokuho*) and *SNA Final* (*kakuho*). The former, emphasizing promptness, publishes quarterly estimates of expenditure side series including GDP eight times a year, twice for each quarter. The latter publishes once a year estimates both on flow side including production, distribution, expenditure, and capital accumulation and on stock side including assets and liabilities (CAO's Home Page).

Annual estimates is published at later than the end of the next year of the reference year as the Final, and the Second Final (*kakukakuho*) at the end of the following year when the Final of the next reference year is published. Those two Finals are different in source statistics available. For example, the source statistics for estimating shipments in the manufacturing sectors is for the Second Final *The Census of Manufacturers: Report by Commodity* (METI), but at the stage of the Final it is not available yet and instead *The Census of Manufacturers: Report by Industry* is used.[21)]

As quarterly GDP statistics including inventory investment estimates that I use in this research, two Preliminaries and two Finals are published for each quarter. The First Preliminary, so-called the first QE (quick estimate), is published approximately one month and two weeks after the end of the reference quarter, and the Second Preliminary, the second QE, two months and ten days after the end of the reference quarter.[22)] In addition, the Final- and the Second Final quarterly estimates are also published respectively at the time of the Final- and the Second Final annual estimates publication. For the quarterly inventory investment estimates in 2008Q1, the First Preliminary and the Second Preliminary are published in mid-May and mid-June, respectively, and the Final at the end of 2009 and the Second Final at the end of 2010.

When compared to the Finals, Preliminaries are estimated with scarcer source statistics, placing more emphasis on demand-side statistics from individual agents. At once, in order to improve the compatibility with the Final estimates and reduce the width of revision from the Preliminary to the Final, it also depends on supply-side statistics taking the advantage of the basic process of the Final estimates, thus integrating the demand-side and supply-side estimation.[23)]

The commodity-flow method (hereafter, CF method) first estimates the whole domestic supply-side by assessing production, export and import, change in inventory stock, and so on by commodity in the reference year, and then on each stage of distribution it allocates by value among demand items like consumption and investment. The existing CF method is a core framework of Japan's SNA estimation on which about 80% of nominal GDP (expenditure side) except government's consumption and investment is determined. Understanding that the finer the commodity classification is, the more precisely it

can specify the allocation destination, leading to the more accurate estimates, and the CF method adopts a commodity classification of approximately 2,100. The accuracy of Japan's GDP estimates depends on this fineness. More than 80% of commodities are in the manufacturing sector, most of which are surveyed by *The Census of Manufacturers.* As production values are unavailable except on benchmark years, the existing CF method estimates the total supply values by adjusting shipment values by commodity adding export-import and change in inventory stock, on which it estimates the final values by allocating destination of each commodity on distribution channels.[24)]

Quarterly inventory investment statistics attracts attention primarily in relation to short-term economic fluctuations, and the Second Preliminary estimates is most frequently referred to as its representative. *The Census of Manufacturers* which is a core framework of Japan's SNA estimation becomes partly available even at the stage of the Final, and the Second Preliminary is estimated under a grave constraint that key source statistics like *The Census of Manufacturers* is entirely unavailable. Japan's quarterly inventory investment statistics included in the OECD database is this Second Preliminary, which is frequently used for international comparison study like Wen [2005].[25)]

In this research I use primarily the Final of annual and quarterly estimates of each year.

The CF method in annual accounts, upon about 2,100 commodity classification, identifies distribution channels in detail for each commodity and estimates values for each allocation destination. The supply-side estimation on quarterly accounts, in principle, adopts another classification of 91 commodities, and simplifies the distribution channels. The estimation method is as follows (CAO, 2012, p. 12).

(1) Making consistent with the definition of annual shipment values in 91 commodity classification of the CF method for annual Final estimates, subsidiary series that show the movement of quarterly shipment is created from monthly or quarterly source statistics.
(2) With the quarterly ratios in this subsidiary series, the Final annual estimates are divided into the Final quarterly ones.
(3) The Preliminary values are estimated by extrapolating the last available values of the Final quarterly estimates by the quarter-over-quarter ratio of the subsidiary series. With that, we obtain the quarterly estimates of shipment values based on the 91 commodity classification of the CF method.
(4) After adding transportation cost, margins, and export-import adjustment on the shipment values, the domestic total supply values are estimated by deducting net increase both in distribution inventory and raw material inventory values which are estimated separately.
(5) Domestic household final consumption expenditure and gross fixed asset formation are estimated by multiplying to the total domestic supply values the allocation ratios among demand items obtained from the latest Final annual accounts (p. 12).

As part of this estimation process, quarterly inventory investment (increase in private inventory stock) values are estimated in four categories of product-, goods-in-process-, raw material-, and distribution stock, and are calculated by adding together. For the periods the Final already exists, the quarterly Final values are estimated by adding equally to each quarterly Preliminary value a quarter of the difference between the aggregate of four quarterly Preliminary values during the year and the annual Final value obtained by the CF method. For the periods the Final does not exist (QE Preliminary periods), the quarterly Final values are estimated by adding to the quarterly Preliminary values the same amount

added in the periods the Final already exists (p. 26).[26)]

What matters for this research is that the adjustment given to the quarterly Preliminary estimates at the time of the annual Final's publication, leading to the quarterly Final, is equally add to the Preliminary a quarter of the difference between two annual values. The adjustment does not affect the fluctuations within each year at all. Unless the values added at this adjustment differs greatly across years, the causes of variations in inventory investment values are either the variations in inventory investment or in the process estimating quarterly changes in inventory stock values from source statistics.

Quarterly inventory investment (increase in private inventory stock) values are estimated in four categories of product-, goods-in-process-, raw material-, and distribution stock, and are calculated by adding together. Even on the manufacturing sector, the estimation method greatly differs across categories. In addition *The Census of Manufacturers*, a core source statistics of the annual Final estimation, is not available at the time of the quarterly Preliminaries.[27)]

This research uses quarterly inventory investment values for 17 years, from 1994 to 2010, separately in four categories and in 91 commodities, which is estimated as part of estimating the quarterly Final values. The data is estimated along the existing estimation method revised at the time of publishing the quarterly First Preliminary of 2002Q2. In what follows, I place special focus on real inventory investment values and nominal shipment values.

Three points for avoiding confusion

Note three points for avoiding confusion.

First, for example, the estimation method of existing quarterly GDP Preliminaries was adopted at the time of the quarterly First Preliminary of 2002Q2, one purpose of which is to improve the consistency with the estimation method of the annual Final.[28)] Despite the efforts for improving the consistency, however, the quarterly GDP Preliminaries and the annual SNA (GDP) accounts are estimated separately upon different source statistics with different methods. No change on this key point occurs with the revision from the Preliminary to the Final. The annual GDP Final using *The Census of Manufacturers* improves accuracy, but no additional information on the more accurate and appropriate allocation of the annual values to each quarter seems to be obtained on this estimation process. The quarterly Final values are not newly estimated by other method than the one for quarterly Preliminaries to replace the latter, but are estimated by equally added a quarter of the difference in the two annual values (explained above).

Second, upon the CF method, SNA accounts estimate the total domestic supply values by commodity, deducting export and import, and changes in inventory stock from production or shipment value. Naturally, inventory investment values (=net increase or decrease in inventory stock values) are estimated by commodity, that is, commodity-based. Neither firm nor industry is the estimation unit. Therefore, for example, raw material inventory of steel products is not iron ore and coal steel manufacturing companies possess but steel products construction companies or shipbuilders and machine makers possess as production materials. Likewise, raw material inventory of petroleum products is not crude oil manufacturers possess but petroleum products firms like power companies possess as raw fuel.[29)]

Third, by definition inventory investment value is the change in investment stock value. It is not the change in inventory stock volume, for example the number of machines-in-process or quantity of steel product stock in tons, but the change in their value. With fair-value adjustments at the end of account-

ing period, for example, without any change in inventory stock volumes, the inventory stock values may decrease dramatically, recording a huge negative value in inventory investment. As I show below, the dominant portion of wild fluctuations in quarterly GDP inventory investment could have been the result of regularly conducted fair-value adjustments.[30)]

[4]. Investigation of Quarterly GDP Inventory Investment Estimates

[4-1]. Investigation of All Industries Inventory Investment Movement

This research uses the quarterly GDP (SNA) inventory investment estimates for 1994~2010, sixty eight quarters over seventeen years, in ninety one commodities and in four categories (to be precise, I use data on 59 commodities, excluding commodities with consistently 0 inventory investment like commodities in service sectors). Although Sections [7]~[9] focus on the years after 2003 including the period around Lehman Shock, Sections [4]~[6] study primarily the inventory investment movement over the whole period. In preparation for the detailed examination, this section presents its whole picture and stimulates interests on the issues in the next section and after.

Together with the estimates by category, the availability of estimates by commodity (furthermore by commodity-category) is an advantage of this research. Sections [7]~[9] use the data by commodity, and sections [4]~[6] confine the use to inventory investment data on all industries. Conclusions of the study in [7]~[9] of inventory investment by commodity are consistent with those of all industries inventory investment in [4]~[6].

Following the study of all industries inventory investment movement in [4-1], [4-2] and [4-3] investigate the quarterly and annual movement of total industries real inventory investment, respectively, of which [4-2] is central.

First is Table 2 of each quarter's values (unit: billion yen) of all industries: from nominal sales (nsales) and total nominal inventory investment (ntotal) to total real inventory investment (rtotal) and real inventory investment in four categories, that is, product(rfinal), good-in-process (rprocess), distribution (rdistribution), and raw material (rraw). I draw a horizontal line below the 4th quarters, under which are values of each year's 1st quarter.

The foci of investigation are first the size of real inventory investment values and their variation patterns, and second the size of values and variation patterns by inventory category.

First, what is the most impressive is that rtotal repeats extremely regular seasonal fluctuations in big scale every year. It starts from a big negative value in Q1, jumping up to a big positive value in Q2, falling to a value around 0 in Q3, and again jumping up to a big positive value in Q4.

Second, inventory investment by category (rfinal, rprocess, rdistribution, and rraw) more or less repeats similar kinds of regular seasonal fluctuations. In strong regularity, synchronism and the size of fluctuations, the association of rprocess with rtotal stands out.

The next Figure 7 highlights these two points, and shows that the rprocess fluctuation is the dominant factor of the rtotal fluctuation. As the above Table 2 shows, both rtotal and rprocess radically fall to a big negative value in Q1, and remarkably jump up to a big positive in Q2 and Q4.

Table 2 Quarterly values of all industries: from nominal sales to real inventory investment by category, 1994~2010

	nsales	ntotal	rtotal	rfinal	rprocess	rdistr~n	rraw
1994Q1	180,440	−3,139	−2,645	−25	−1,539	−619	−462
1994Q2	174,646	775	879	−83	910	−40	92
1994Q3	185,699	−685	−836	−79	−404	−235	−119
1994Q4	184,984	2,104	1,883	−255	945	1,232	−39
1995Q1	182,438	−3,250	−2,937	267	−2,034	−874	−296
1995Q2	176,543	2,015	1,893	450	1,206	−47	284
1995Q3	183,449	60	114	−87	−129	207	123
1995Q4	185,010	2,963	2,494	−21	1,317	1,069	130
1996Q1	185,756	−3,500	−3,213	−34	−2,451	−651	−77
1996Q2	179,935	2,812	2,476	426	1,480	498	73
1996Q3	189,955	−172	−90	−346	32	279	−56
1996Q4	192,184	3,337	2,874	−12	1,377	1,376	134
1997Q1	195,775	−4,129	−3,794	−498	−2,180	−737	−379
1997Q2	187,293	2,835	2,602	906	1,207	397	92
1997Q3	194,689	478	592	−263	−143	889	109
1997Q4	190,473	3,715	3,501	184	1,361	1,579	378
1998Q1	192,096	−3,227	−3,007	−53	−2,317	−349	−289
1998Q2	180,070	2,516	2,213	457	1,326	380	51
1998Q3	187,537	−677	−638	−517	−92	53	−82
1998Q4	184,330	2,913	2,683	−84	1,236	1,607	−75
1999Q1	185,150	−4,918	−4,606	−418	−2,303	−1,669	−216
1999Q2	173,601	1,286	1,100	324	1,556	−780	−0
1999Q3	185,303	−1,777	−1,758	−330	−489	−729	−210
1999Q4	183,988	1,440	1,224	−75	1,217	211	−129
2000Q1	188,809	−4,369	−4,190	−109	−2,462	−1,336	−284
2000Q2	179,661	2,481	2,355	343	1,534	200	278
2000Q3	189,295	−974	−1,014	−332	−307	−298	−77
2000Q4	189,961	2,321	2,103	−2	1,432	544	129
2001Q1	189,813	−3,522	−3,410	−35	−2,621	−751	−3
2001Q2	179,907	2,699	2,719	685	1,722	226	85
2001Q3	184,472	−1,190	−1,188	−377	−910	35	65
2001Q4	181,011	2,049	2,000	−106	1,275	919	−88
2002Q1	181,995	−4,667	−4,441	−485	−2,618	−1,231	−106
2002Q2	173,891	1,505	1,298	175	1,538	−354	−61
2002Q3	182,875	−1,047	−1,158	−222	−725	−170	−41
2002Q4	182,221	2,004	1,885	128	1,341	564	−148
2003Q1	183,212	−3,919	−4,000	−278	−2,510	−1,125	−87
2003Q2	173,555	1,891	1,863	437	1,527	−233	131
2003Q3	181,355	−76	−73	−151	−222	211	89
2003Q4	183,331	1,601	1,506	−163	1,181	622	−134
2004Q1	185,188	−3,106	−3,102	−138	−2,097	−808	−60
2004Q2	177,065	2,297	2,301	501	1,261	397	142
2004Q3	184,970	143	129	−225	−323	534	143
2004Q4	186,339	2,315	2,311	−153	1,156	1,304	5
2005Q1	187,959	−3,417	−3,435	−128	−2,404	−793	−109
2005Q2	181,339	2,552	2,563	549	1,647	245	123
2005Q3	188,609	−152	−148	−43	14	−46	−73
2005Q4	190,805	1,679	1,693	−47	1,178	621	−59
2006Q1	193,357	−3,405	−3,366	−218	−1,984	−1,103	−62
2006Q2	186,388	1,723	1,708	369	1,314	−298	323
2006Q3	193,686	−172	−103	−31	28	−61	−39
2006Q4	196,950	1,877	1,832	146	1,356	428	−99
2007Q1	199,305	−2,945	−2,918	−363	−2,087	−407	−61
2007Q2	193,171	2,386	2,382	357	1,735	80	211
2007Q3	200,579	−132	100	−26	−157	453	−170
2007Q4	204,034	2,373	2,383	235	982	1,035	131
2008Q1	204,917	−2,838	−2,795	−154	−2,007	−175	−459
2008Q2	196,305	2,631	2,642	626	1,080	737	200

Table 2 Continued

	nsales	ntotal	rtotal	rfinal	rprocess	rdistr~n	rraw
2008Q3	204,857	−414	−269	−77	151	−37	−306
2008Q4	191,144	3,450	3,216	35	726	1,607	848
2009Q1	173,387	−4,207	−4,278	−1,000	−2,377	−967	66
2009Q2	166,360	265	332	53	577	−123	−176
2009Q3	176,568	−1,769	−1,752	−140	−274	−887	−452
2009Q4	179,966	104	297	77	239	71	−89
2010Q1	181,305	−4,012	−4,131	−338	−2,289	−1,259	−245
2010Q2	176,356	1,026	1,338	457	1,199	−259	−59
2010Q3	184,160	−183	−120	−284	227	−40	−24
2010Q4	182,870	1,582	1,760	225	779	593	164

Figure 7 rtotal vs. rprocess: 1994~2010, quarterly, all industries

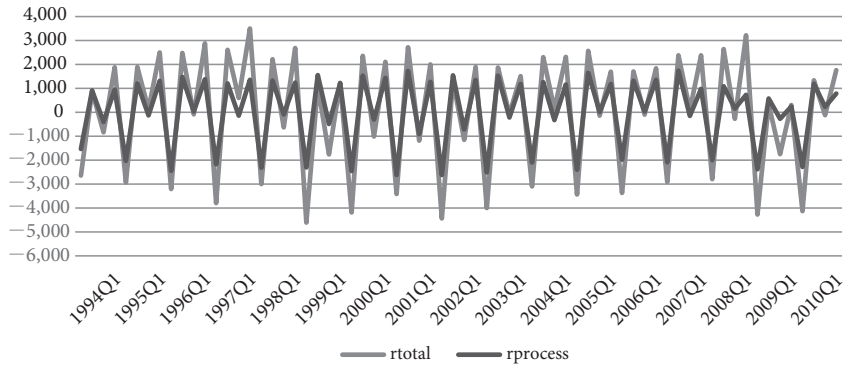
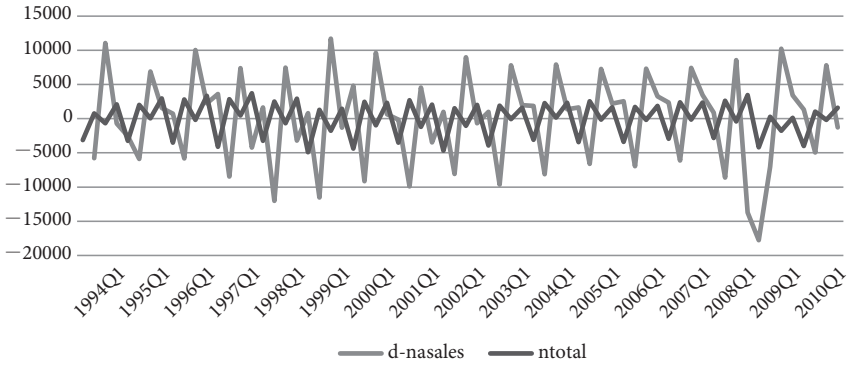


Figure 8 d-nsales vs. ntotal: 1994~2010, quarterly, all industries



Variations in nsales and values in ntotal

As reference to studying the connection between the level of overall economic activity and the inventory investment, the next figure illustrates by quarter the quarter-over-quarter change in nominal sales (d-nsales) and the total nominal inventory investment (ntotal).[31)]

The nominal sales does not drastically decrease in the 1st quarters, and d-nsales does not move strongly in tandem with ntotal. Ntotal exhibits far less volatility than d-nsales.

[4-2] Quarterly Real Inventory Investment Movement in All Industries

Limiting the period to eight years (32 quarters), 2003~2010, including the period around Lehman Shock, [4-2] studies in greater detail the quarterly real inventory investment movement in all industries.

The next Figure 9 illustrates the quarterly real inventory investment both in total and by category.

First, particularly rtotal and rprocess show in parallel stably regular seasonal fluctuations in spectacular scale. Second, nowhere I find either a notable increase in inventory stock or a long-run stock adjustment process after Lehman Shock. As consequence of the latter, the inventory investment, falling in 2009Q1 to an extremely low level, exhibited a singular pattern staying at by far lower level (not the opposite) than the previous years.

As the above Figure 9 is rather complicated, next I illustrate four figures with each of inventory investment by category together with rtotal. Comparison with the rtotal in common makes the inter-categorical inventory investment comparison easy.

rtotal vs. rprocess

First comes the comparison of rprocess with rtotal, which clearly shows that the fluctuation in rprocess overwhelms that of rtotal. This regular seasonal fluctuation, which I call M-shaped, is observed

Figure 9 Inventory Investment: all industries rtotal and by category, 2003~2010, quarterly

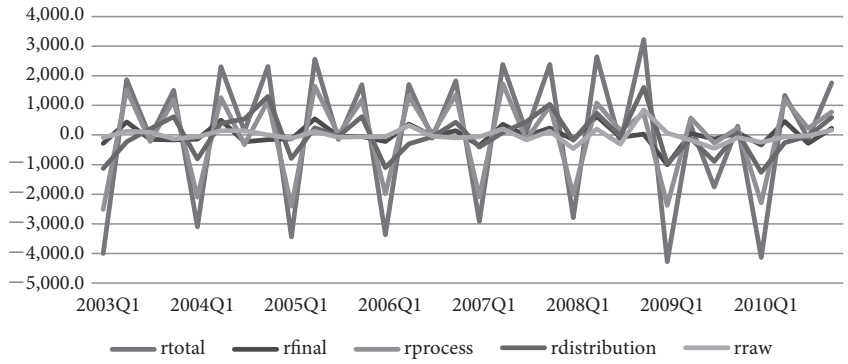


Figure 10a Inventory Investment: all industries rtotal vs. rprocess, 2003~2010, quarterly

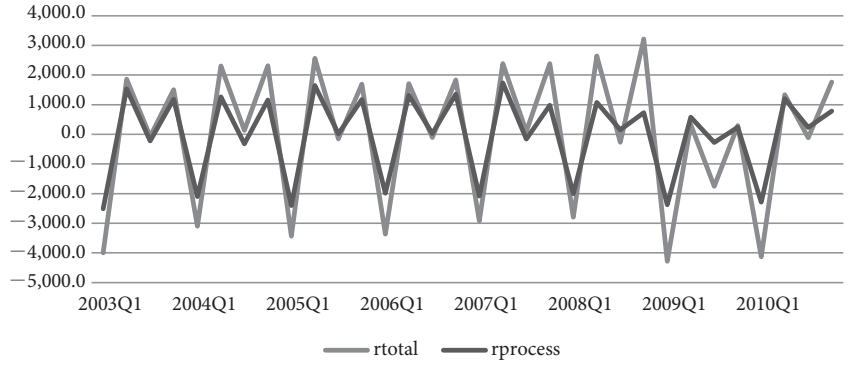


Figure 10b Inventory Investment: all industries rtotal vs. rfinal, 2003~2010, quarterly

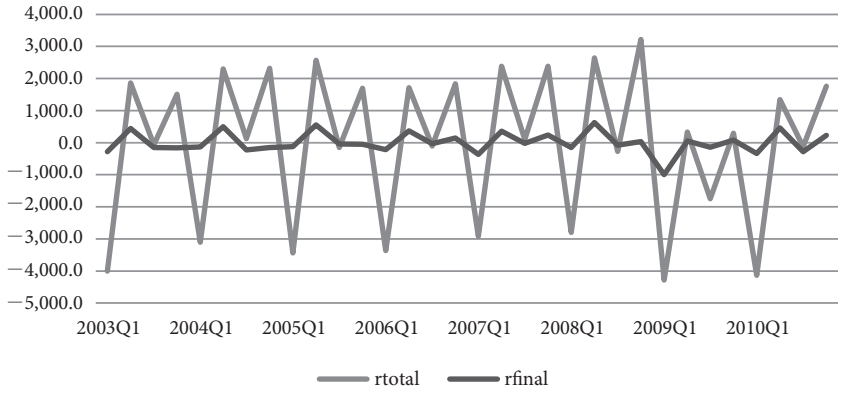


Figure 10c Inventory Investment: all industries rtotal vs. rdistributiion, 2003~2010, quarterly

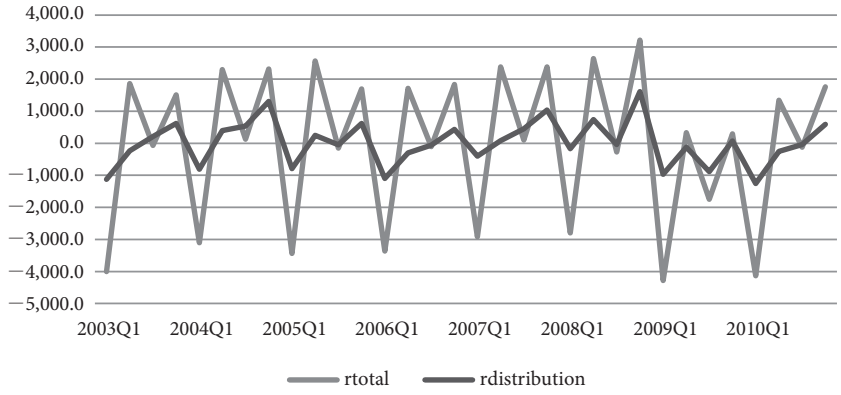
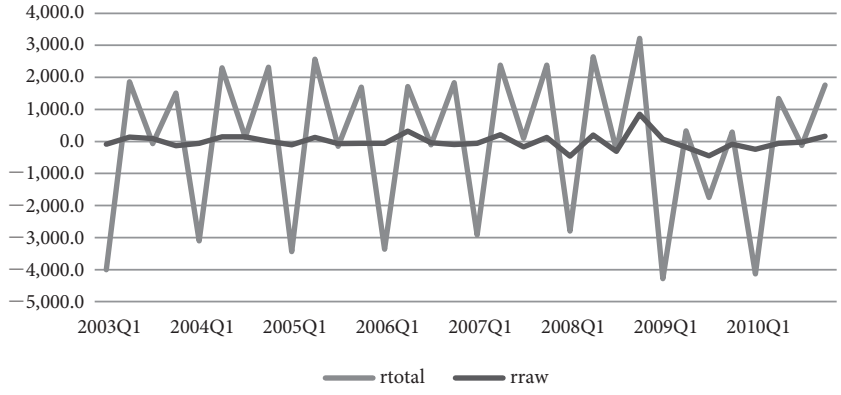


Figure 10d Inventory Investment: all industries rtotal vs. rraw, 2003~2010, quarterly



consistently without any alteration in basic pattern. Yet, not only in 2009Q1 but also in 2008Q4 rprocess's influence on rtotal decreased.

rtotal vs. rfinal

Next comes the comparison of rfinal with rtotal. The rfinal fluctuation only slightly influences rtotal. Yet, its temporary fall (not the opposite) after the Lehman Shock is slightly eye-catching.

rtotal vs. rdistribution

Next to rprocess, rdistribution fluctuation has big influence on rtotal movement. Every year rdistribution starts from the bottom of a big negative value in Q1 and ends at a big positive value in Q4, repeating a regular seasonal fluctuation. Its fluctuation range is much smaller than that of rprocess, which affects the rtotal fluctuations less strongly than rprocess.

Its increase in 2008Q4 and the size of negative values in the following quarters, together with its length, may be modestly impressive. Yet, the size of its 2008Q4 increase is not much greater than the previous Q4 values, 2004Q4 for instance.

rtotal vs. rraw

Comparing with the rtotal the rraw is consistently by far smaller, the smallest among four inventory categories. Its fluctuation has little influence on rtotal fluctuation, with the exception of its small increase in 2008Q4.

[4-3]. Annual Real Inventory Investment Movement: 1994~2010

Bearing in mind the study of the quarterly inventory investment data, from 2003Q1 to 2010Q4 in [4-2], [4-3] investigates the annual inventory investment data for the entire period of study, 1994~2010. The primary focus is placed on the relation between the regular seasonal fluctuations observed in quarterly rtotal, rprocess, and rdistribution and the annual inventory investment fluctuations.

Note that in [4-3] the study period is 1994~2010 to which that of [4-2] is the second half. The sequence of figures is the same as in [4-2].

Figure 11 Inventory Investment: all industries rtotal and by category, 1994~2010, annual

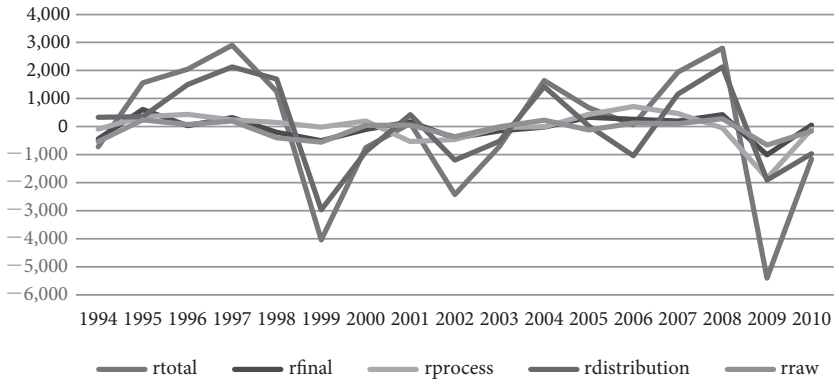


Figure 12a Inventory Investment: all industries rtotal vs. rprocess, 1994~2010, annual

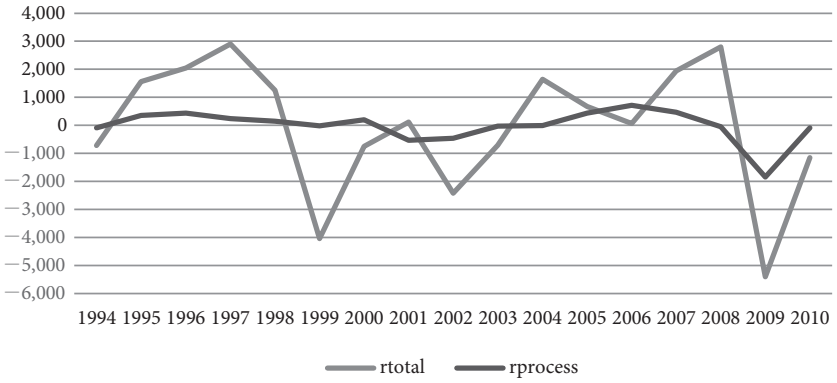


Figure 12b Inventory Investment: all industries rtotal vs. rfinal, 1994~2010, annual

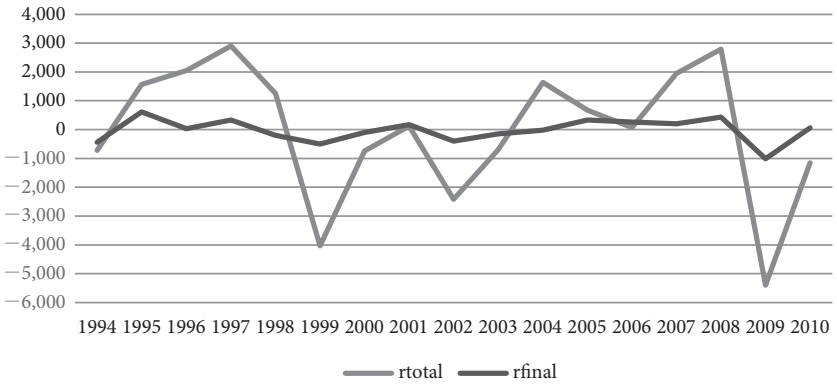


Figure 12c Inventory Investment: all industries rtotal vs. rdistribution, 1994~2010, annual

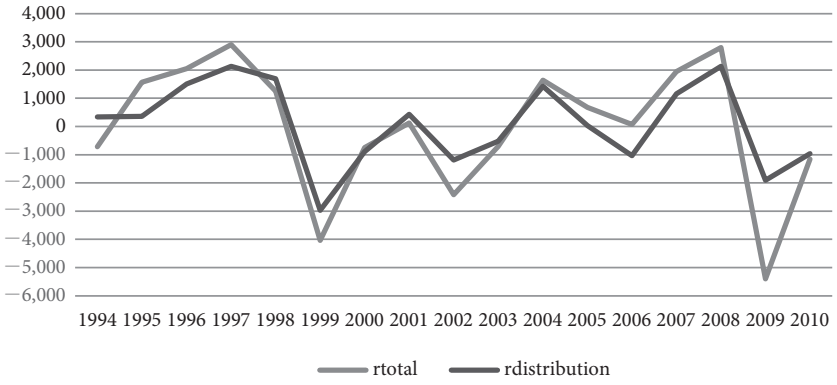
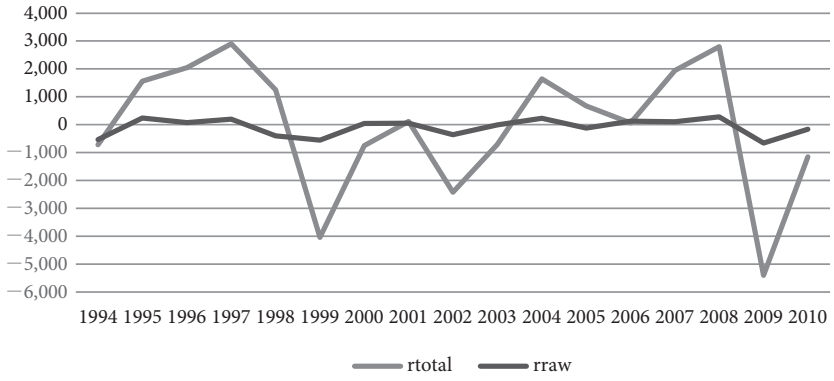


Figure 12d Inventory Investment: all industries rtotal vs. rraw, 1994~2010, annual



As explained in [3], the quarterly GDP inventory investment Final statistics is estimated by allocating according to the predetermined rules the annual SNA inventory investment (Final) statistics obtained from *The Census of Manufacturers* data.

In the annual data, it is not the goods-in-process inventory but the distribution inventory whose fluctuations have overwhelming influence on the annual total inventory investment fluctuations.

[5]. Study of Regular Seasonal Inventory Investment Fluctuations and its Interpretation

Focusing on the wild and spectacular, M-shaped, regular seasonal fluctuations in all industries quarterly inventory investment estimates observed in [4], Section [5] further investigates the quarterly inventory investment data, particularly its fluctuations, and presents its interpretation with a way on how to deal with it.

A major part of M-shaped regular seasonal fluctuations in quarterly inventory investment statistics seem to arise from its estimation process (estimation methods and source statistics). It is noteworthy particularly for the goods-in-process inventory which is the dominant factor of total inventory investment fluctuations. When the regular seasonal fluctuations are eliminated, the wild and spectacular quarterly inventory investment fluctuations decrease radically. Moreover, the fluctuations in goods-in-process inventory which is the dominant factor of quarterly total inventory investment fluctuations almost entirely disappear in annual statistics (or the annual average of four quarterly estimates of the year, which is the same thing).

Upon all these observations, I draw two conclusions. It will be an important research issue in the future to investigate the sources and generating mechanisms of the M-shaped wild inventory investment fluctuations and adopt appropriate countermeasures.[32)]

(1) Wild fluctuations in quarterly inventory investment statistics do not accurately and appropriately reflect the economic reality of inventory investment and its fluctuations, the dominant portion of which arises on the estimation process of the quarterly GDP statistics.

(2) Aside from annual SNA accounts for accuracy demand for reporting accurately the economic reali-

ty, quarterly GDP accounts is published in response to promptness demand for diagnosing the state of the economy. Wild quarterly inventory investment fluctuations are observed in quarterly GDP accounts published for promptness demand, and inventory investment fluctuations radically decreased in annual SNA accounts for accuracy demand. Therefore, in investigating the reality of inventory investment and the fluctuation generating mechanisms where promptness is inessential, we should switch focus from the quarterly GDP estimates to the annual SNA estimates, and make active use of micro-based source statistics like IIP and *Corporate Enterprise Statistics.* In using the quarterly GDP inventory investment statistics, we should take account of wild and spectacular regular seasonal fluctuations.

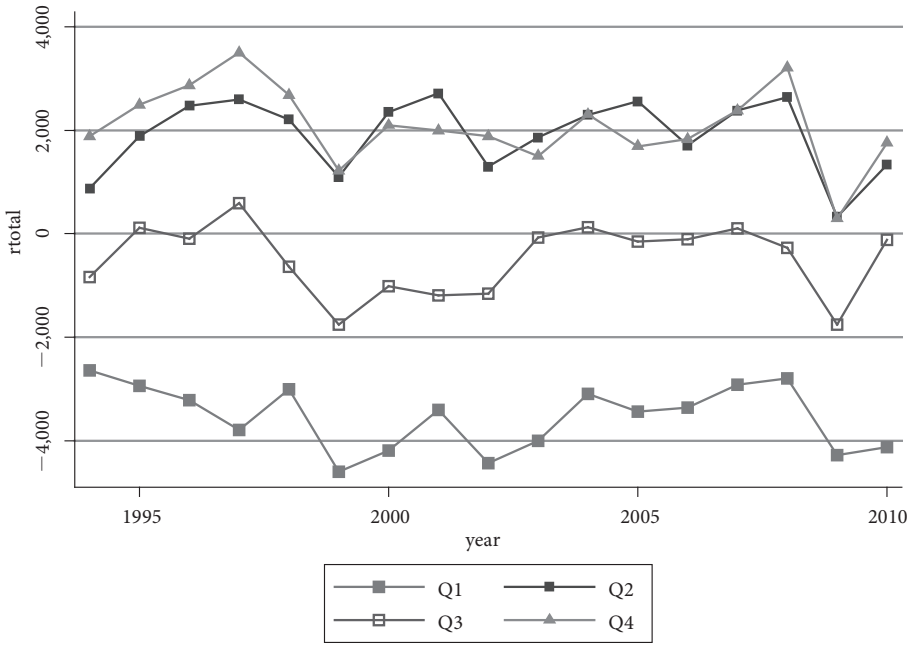
Movement by quarter of all industries rtotal and inventory investment by category

I begin with Figure 13 that emphasizes the importance of quarterly regular seasonal fluctuations that shows the all industries rtotal by quarter, from Q1 to Q4 separately. The line with large black box (■) consistently at the bottom indicates the Q1 estimates, the line with small black box (■) on the top the Q2, the line with large white box (□) at the middle the Q3, and the line with small black triangle (▲) also at the top the Q4.

Every year all industries rtotal starts from the bottom with big negative value of Q1, jumps up to the top with big positive value of Q2, comes down to the middle with small absolute value of Q3, again jumps up to the top with big positive value of Q4, and then dives to the next value on the bottom line of next year's Q1. Each line never intersects with the line of neighboring quarters.

The distance from Q1 line to Q2 or Q4 line for example always by far surpasses the vertical distance of two points on the same line (year-over-year change). For example, a big decrease from the Q4 value to the next year's Q1 is almost completely offset by an increase from the Q1 value to the Q2, and simi-

Figure 13 Movement by quarter of all industries rtotal



larly somewhat smaller decrease from the Q2 value to the Q3 is offset by an increase from the Q3 value to the Q4. Because of this, wherever the beginning, with few exceptions, change in the aggregates of 4 quarter values, that is change in annual values, is by far smaller than change in quarter values or year-over-year change in quarter values. Thus, the M-shaped regular seasonal fluctuations shown in [4] dominate the fluctuations in quarterly GDP inventory investment estimates. This applies also to the years of inventory investment decrease over quarters like in 1999 and 2009.

Whatever are the causes (in my view, a major cause is due to accounting rules and firm's accounting customs),[33] it is obvious that this regular seasonal fluctuations exert a dominant influence on the fluctuations in quarterly GDP inventory investment (Final) estimates. For studying the reality and influence of other factors including stock adjustment behaviors of relevant firms, it is of definite importance to eliminate the influence of this regular seasonal fluctuation.

I find no notable time trend either in any quarter lines or in the whole picture.

Next is the summary table by quarter of inventory investment values both in total (rtotal) and by category, showing mean, sd (standard deviation), p50 (median), p25 (25 percentile) and p75 (75 percentile) over 17 years.

The feature (1) suggests that the above observations on rtotal with little change apply also to all inventory investment categories.

(1) Neither p25–p75 deviation nor mean-median deviation is huge. The figures suggest that with few exceptions a line representing any quarter's inventory investment value either in total or in any category does not intersect with the ones on neighboring quarters. Thus, all industries quarter GDP inventory investment statistics either in total or in any category every year starts from the bottom

Table 3 Summary table by quarter of inventory investment in total and by category

	N	rtotal	rfinal	rprocess	rdistribution	rraw
		17	17	17	17	17
Q=1	mean	−3,545.0	−235.7	−2,251.7	−873.7	−184.0
	sd	626.9	277.5	275.3	386.3	158.6
	p50	−3,409.7	−153.7	−2,303.1	−807.5	−109.0
	p25	−4,130.9	−363.4	−2,451.0	−1,124.9	−288.6
	p75	−3,006.8	−53.1	−2,086.9	−650.5	−61.5
Q=2	mean	1,921.5	413.6	1,342.3	60.3	105.2
	sd	708.7	229.8	303.4	379.8	132.6
	p50	2,213.4	437.1	1,325.7	79.8	91.8
	p25	1,337.7	343.4	1,206.1	−232.8	51.1
	p75	2,476.4	500.7	1,538.1	379.7	200.1
Q=3	mean	−483.1	−207.6	−219.0	9.4	−65.8
	sd	689.3	143.9	296.9	429.2	157.2
	p50	−147.9	−221.9	−157.4	−37.3	−55.7
	p25	−1,013.5	−330.2	−323.3	−170.4	−118.5
	p75	−73.1	−78.6	13.7	211.1	64.9
Q=4	mean	2,096.7	6.4	1,123.2	904.9	62.1
	sd	760.5	142.7	307.9	492.6	248.0
	p50	1,999.5	−12.4	1,216.6	919.2	−39.3
	p25	1,760.2	−84.3	981.5	563.9	−89.0
	p75	2,494.3	128.2	1,340.7	1,304.4	130.5

with big negative value of Q1, jumps up to the top with big positive value of Q2, comes down to the middle with small absolute value of Q3, again jumps up to the top with big positive value of Q4. They repeat regular seasonal fluctuations.

(2) Share values of each category's variations to the total inventory investment variation {=(sd of rprocess)/(sd of rtotal), for instance} in each quarter shows that it is the rdistribution rather than rprocess that has the biggest influence on the sd of rtotal. This is then followed by rprocess, rfinal, and rraw in that order. This sharply contrasts with the picture of all the quarters, shown above in [4] and again below soon.

In addition to actively using annual GDP statistics (or annual average of four quarter values) instead of quarterly GDP statistics, I suggest an alternative of using revised values to be obtained by deducting the average value from the original by category,[34] for example rtotal or rprocess of all industries inventory investment in Q1. In this research, particularly in [7]~[9], I place enormous importance on the study of inventory investment both by category and by commodity, this choice of revision is extremely useful.

For comparison, next is the summary table for the whole study period on three series of quarterly GDP inventory investment figures: First, the original, that is the quarterly Final; Second, the revised values obtained by deducting the average value by category from the original, for example Rrtotal corresponding to rtotal of the original series; Third, year-to-year change in quarterly inventory investment series, for example L4rtotal to the rtotal, which is widely used as a seasonal adjustment method.

The sd (standard deviation) of Rrtotal is less than the 30% level of rtotal's, and that of L4rtotal is less than 40% of rtotal's. In particular, the sds of Rrprocess and L4rprocess, goods-in-process inventory investment value series, are just around 20% that of the original, rprocess whose fluctuations dominate the rtotal's fluctuations.

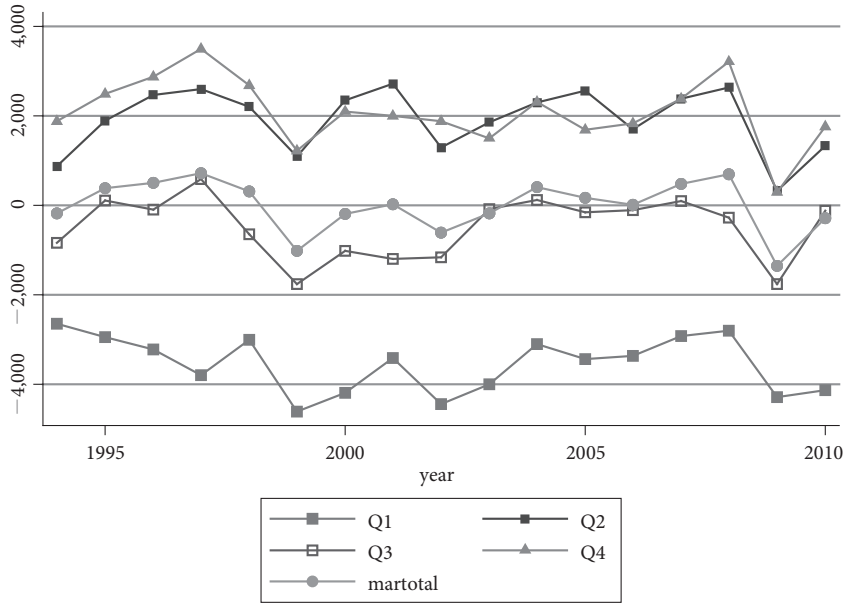
Table 4 Summary tables of quarterly inventory investment values: original and their revised values

quarterly inventory investment value		rtotal	rfinal	rprocess	rdistr~n	rraw
	N	68	68	68	68	68
	mean	−2.5	−5.8	−1.3	25.2	−20.6
	sd	2,401.2	330.5	1,469.6	757.5	209.4
	p50	314.5	−50.0	232.9	−1.4	−57.3
	p25	−2,201.3	−220.0	−1,224.4	−513.2	−113.8
	p75	2,051.1	204.5	1,267.6	516.3	115.8
revised quarterly inventory investment value		Rrtotal	Rrfinal	Rrproc~s	Rrdist~n	Rrraw
	N	68	68	68	68	68
	mean	0.0	0.0	0.0	0.0	0.0
	sd	682.2	202.0	289.4	414.7	175.5
	p50	157.1	15.0	56.3	16.9	−9.0
	p25	−557.1	−107.8	−148.2	−300.1	−116.6
	p75	546.6	130.1	215.8	294.6	103.6
year-to-year change in quarterly inventory investment value		L4rtotal	L4rfinal	L4rpro~s	L4rdis~n	L4rraw
	N	64	64	64	64	64
	mean	−6.8	7.8	0.0	−20.3	5.7
	sd	910.3	276.2	303.8	573.0	244.0
	p50	142.7	10.8	8.3	43.3	7.4
	p25	−383.6	−138.8	−185.0	−332.4	−129.4
	p75	650.9	189.6	223.3	384.8	165.2

Table 5 Summary table of martotal and others

annual average of four quarterly GDP inventory investment estimates		martotal	marfinal	marpro~s	mardis~n	marraw
	N	17	17	17	17	17
	mean	−2.5	−5.8	−1.3	25.2	−20.6
	sd	578.3	100.9	143.3	368.4	76.2
	p50	30.2	8.5	−1.1	84.5	11.6
	p25	−186.6	−49.4	−21.2	−241.0	−89.1
	p75	409.8	66.3	90.0	357.0	31.0

Figure 14 Movement by quarter of all industries rtotal, with martotal



Next is the summary table of annual average of four quarterly GDP inventory investment estimates (quarterly Final), for example, martotal to the rtotal.

Naturally, the mean value of martotal, −2.5, is the same as that of the rtotal in the previous table. The sd of martotal is a little over 80 percent of the Rrtotal's in the previous table, which is smaller than that of either rtotal or L4rtotal.

The Figure 14 simply adds the martotal to the previous Figure 13. The martotal hovers around the Q3 value, with smaller sd. It is the annual average of four quarterly values, average of four values on the same vertical line.

As a useful reference to confirm the preceding discussion, next I present four figures on each category of all industries inventory investment estimates by quarter, in the order corresponding to rfinal, rprocess, redistribution, and rraw. Note that the vertical scale is not always the same.

Both in the unambiguity of the patterns and in the length of vertical deviations, the regular seasonal fluctuation in quarterly inventory investment is the most spectacular in rprocess, and next in rdistribution. Although not so spectacular as in those two categories, regular seasonal fluctuations are observed also in rfinal and rraw.

Figure 15a Movement by quarter of all industries rfinal

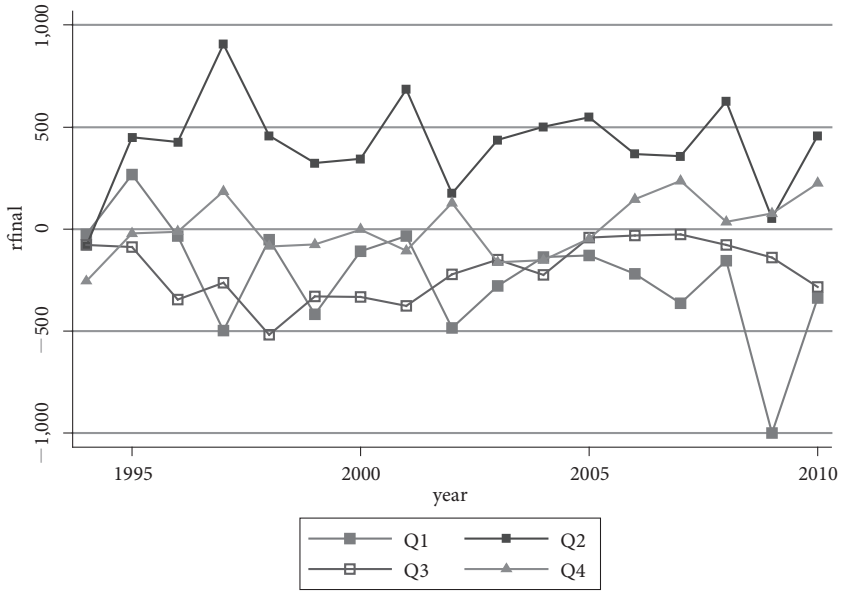
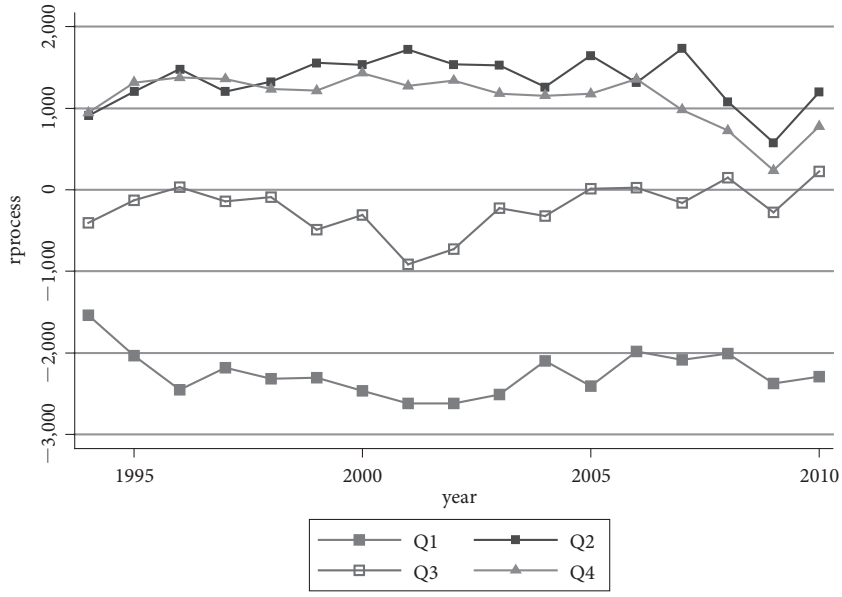


Figure 15b Movement by quarter of all industries rprocess



Rrtotal and others: Revised quarterly real inventory investment estimates series

Emphasizing wild seasonal fluctuations in quarterly GDP inventory investment (Final) estimates, in this paper I think it a useful and appropriate adjustment method to deduct the average value by category from the original ones in each relevant category. As shown above in the second group of summary

Figure 15c Movement by quarter of all industries rdistribution

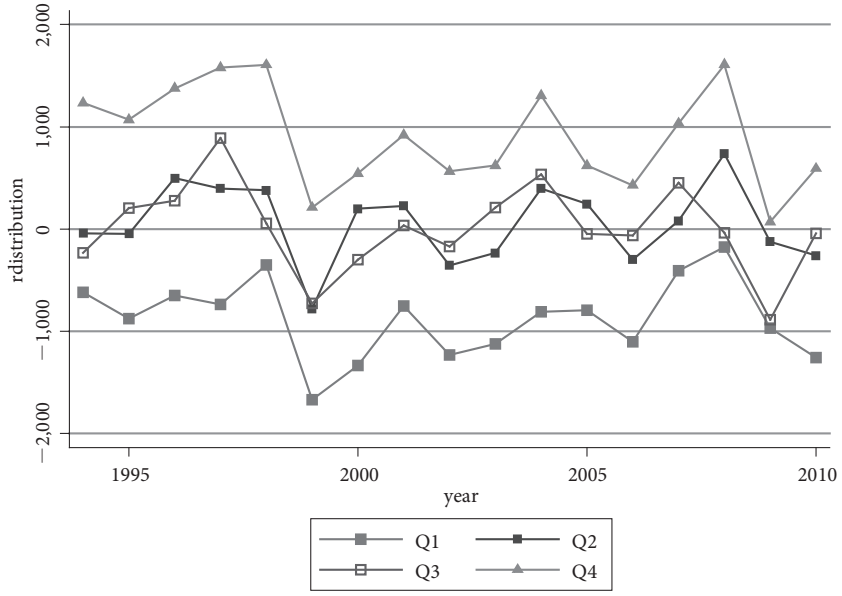


Figure 15d Movement by quarter of all industries rraw

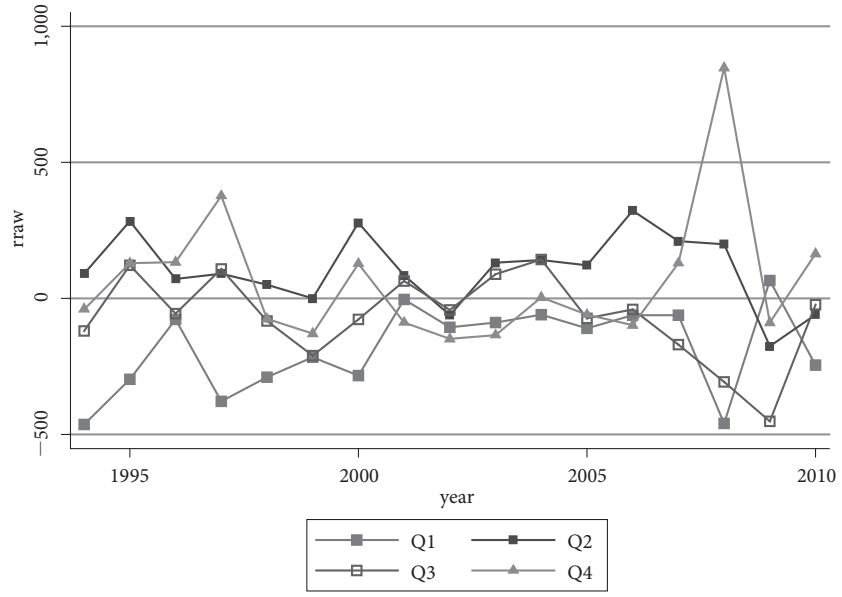


table (Table 4) in this section, with this method, the sd of Rrtotal, revised rtotal, over the whole period dramatically decreased to less than 30 percent of that of the original rtotal.

Here I show four figures, two for 2003~2010 studied in [4-2] Rrfinal and Rrprocess in the first and Rrdistribution and Rrraw in the second, both with Rrtotal, and two for 1994~2002 including the Finan-

cial Crisis period of 1997~1999 in a parallel manner with the first two. Readers confirm three points: first, regular seasonal fluctuations disappear almost completely; second, variations dramatically decrease; and third, distribution stock rather than goods-in-process stock becomes the dominant factor of quarterly total inventory investment fluctuations.

First come the two figures for 2003~2010.

Figure 16a Rrtotal, Rrfinal, and Rrprocess: all industries, 2003~2010, quarterly

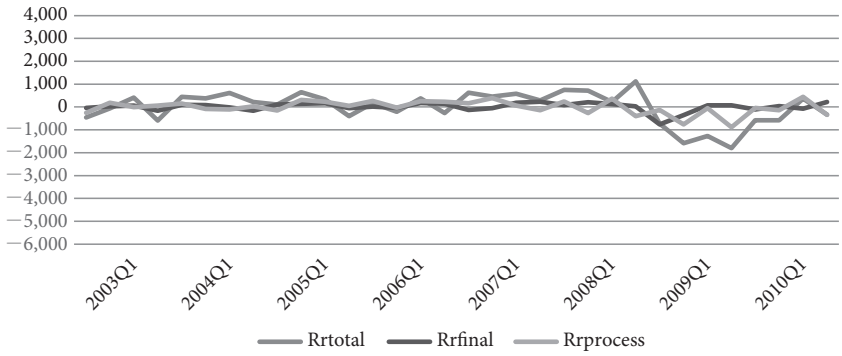


Figure 16b Rrtotal, Rrdistribution, and Rrraw: all industries, 2003~2010, quarterly

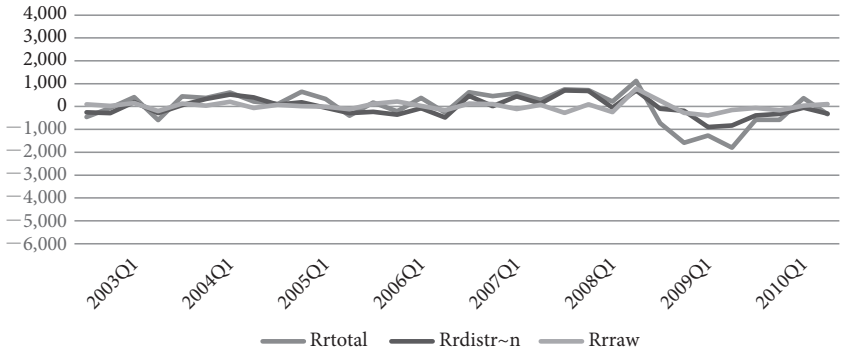


Figure 16c Rrtotal, Rrfinal, and Rrprocess: all industries, 1994~2002, quarterly

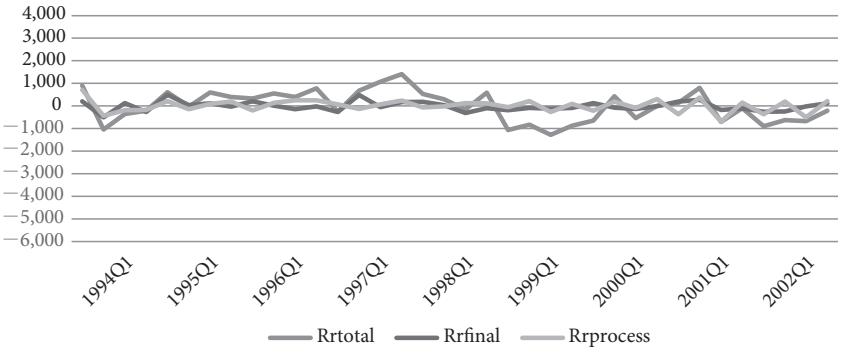


Figure 16d Rrtotal, Rrdistribution, and Rrraw: all industries, 1994~2002, quarterly

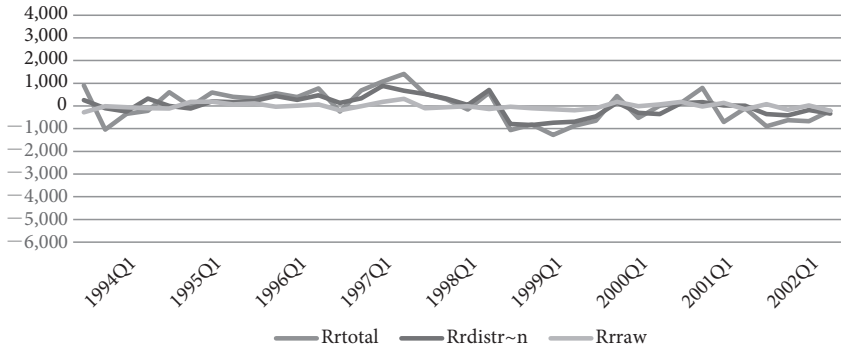
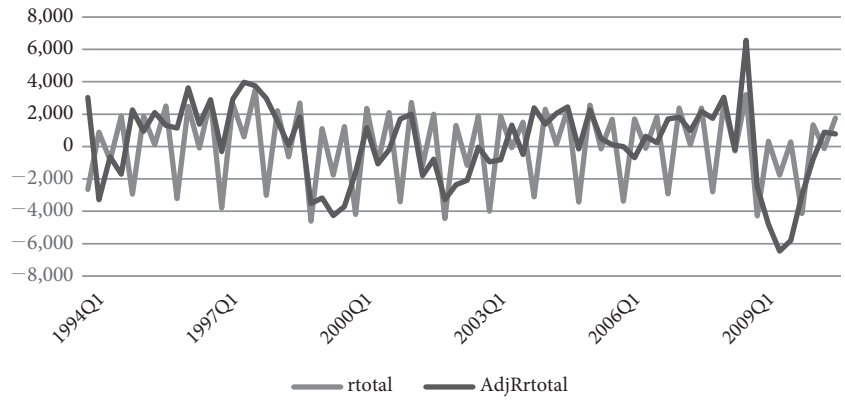


Figure 17 Qarterly Real Inventory Investment: original vs. seasonally adjusted, 1994~2010



Next come figures for 1994~2002.

This study primarily uses the original series of the final estimates (*kakuho*) of quarterly GDP inventory investment statistics. As reference for comparison, the next Figure 17 shows both the original series and the seasonally adjusted series published by the Japanese government, both of which are of the quarterly GDP inventory investment statistics. rtotal stands for the original series, and AdjRrtotal the seasonally adjusted series.[35)]

[6]. Sources of Wild Fluctuations in Quarterly GDP Inventory Investment Statistics

Wild seasonal fluctuations in quarterly GDP inventory investment statistics arise primarily from its estimation process, that is, estimation methods and source statistics. It is especially prominent in goods-in-process inventory investment that is dominant in total inventory investment fluctuations. By eliminating the influence of regular seasonal fluctuations, wild quarterly fluctuations decrease dramatically. Moreover, fluctuations in goods-in-process inventory investment, the dominant source of fluctuations in quarterly total inventory investment, disappear in annual statistics (or in annual averages of four

quarterly statistics) almost entirely.

Upon all these observations, in Section [5] I drew two conclusions. It will be an important research issue in the future to investigate the sources and generating mechanisms of the M-shaped wild inventory investment fluctuations and adopt appropriate countermeasures.

(1) Wild fluctuations in quarterly inventory investment statistics do not accurately and appropriately reflect the economic reality of inventory investment and its fluctuations, the dominant portion of which arises on the estimation process of the quarterly GDP statistics.

(2) Aside from annual SNA accounts for accuracy demand for reporting accurately the economic reality, quarterly GDP accounts is published in response to promptness demand for diagnosing the state of the economy. Wild quarterly inventory investment fluctuations are observed in quarterly GDP accounts published for promptness demand, and inventory investment fluctuations radically decreased in annual SNA accounts for accuracy demand. Therefore, in investigating the reality of inventory investment and the fluctuation generating mechanisms where promptness is inessential, we should switch focus from the quarterly GDP estimates to the annual SNA estimates, and make active use of micro-based source statistics like IIP and *Corporate Enterprise Statistics.* In using the quarterly GDP inventory investment statistics, we should take account of wild and spectacular regular seasonal fluctuations.

As information for "an important research issue in the future", in [6] with background materials I suggest my basic view on a major source of wild regular seasonal fluctuations in quarterly GDP statistics.

As the third point I emphasized at the end of [3] that the inventory investment was the change in inventory stock value. Available inventory data are inventory stock values in corporate accounting, which are obtained upon inventory valuation standards. Hence, the change in inventory stock value, obtained by deducting the opening inventory value from the final inventory value, includes the changes due to the ones in valuation price. With fair-value adjustments at the end of accounting period, for example, without any change in inventory stock volumes, the inventory stock values may decrease dramatically, reporting a huge negative value in inventory investment.

In my view, a large portion of wild regular seasonal fluctuations in quarterly GDP inventory investment statistics is most likely to be due to regularly conducted fair-value adjustments. In addition, a vast majority of Japanese firms, choosing a year from April to next March as accounting period, end the accounting year at the end of March which is also the end of GDP quarterly acconts' first quarter. For those firms, the end of September is the end both of midterm period and of second quarter. As a consequence, every year inventory investment starts with a big negative value in Q1 valued at the end of March, jumps up to the a big positive value in Q2, jumps down halfway in Q3, jumps up again to the top in Q4, and then return to the level around the starting point in the next Q1, thus forming a M-shaped annual fluctuation.

Explanation[36)]

At the end of accounting year a firm is forced to comply with a set of accounting regulations. For example, at the end of accounting year it has to re-evaluate the current value of inventory assets when its current value falls below the fixed ratio of acquisition cost. The ratio was raised higher recently, which makes this regulation have a much higher impact. Under this regulation, a firm has to re-evaluate

the value even when it strongly expects soon a sharp rise in market value. For instance, in industrial machinery manufacturing sector where made-to-order is dominant, some products, remain as inventory stock, goods-in-process stock in particular, due to cancellation or postponing delivery. In such cases, the current value often drastically decreases, falling below the fixed ratio of acquisition cost.

In addition to mandated regulations, as an in-house rule or custom or as a business strategy, a firm re-evaluates inventory stocks particularly at the end of accounting year, and at the end of midterm accounting year, which also have big impact. The executive branch, accounting department in particular, are not able to accurately understand the status of profits and finance by just accepting the reported figures from manufacturing and marketing divisions. For decreasing the risk of management control problems over the corporate organization and alleviating bloated inefficiency, the accounting department often appraises and evaluates the financial status of individual divisions, part of which are stock value re-adjustments at the end of accounting term. Stock value re-adjustments, reducing pre-tax profits, often reduce (or roll over) the amount of corporate income tax payment.

Inventory stock evaluation costs money. At what timing, in what rigor and coverage, and who design and implement the stock value re-evaluation differs between firms. Furthermore, when and what part of re-evaluation results obtained by accounting department is open to other in-house divisions, and further to the public also differs by firm and by information. For example, the division that reports to government statistical survey does not always possess all the re-evaluation results available to the accounting department. Relevant information the reporting division possesses may not always be reflected accurately in the report to the statistical office. Particularly, the responses to the questionnaires about quarters other than the end of accounting period and midterm period, Q2 and Q4 in the present study, may not be of the same character and quality as that of the end of the period, which is obtained primarily to make public.

The effects of the aforementioned factors greatly differ between firms making replies, however. The accounting periods may affect the firm's choices about which a firm would record existing stocks as inventory. Firms may take positive (or negative) actions for settling the enterprise's accounts. Firms often expedite or delay delivery to distributors either materially or on paper.

At the end of accounting period a firm may take other actions than fair-value adjustments. Some promote sales, often at a substantial discount, and others demand distributors to accept more as stocks (channel stuffing).[37)]

The effects of those corporate accounting institutions and customs, and in-house decisions substantially differ both between firms and industries, which also depend on time. Moreover, both the type of its effects and its importance differ between Japan and the US, for instance. To my knowledge, there is little research on those points, and no relevant information is available.

Seasonal Fluctuations of Inventory Investment in *Corporate Enterprise Quarterly Statistics*

Quarterly SNA (GDP) accounts estimates inventory investment (change in private inventory stock) by category, in four categories of product-, goods-in-process-, raw material-, and distribution stock, and sums up. On estimating the quarterly inventory investment values, *Corporate Enterprise Quarterly Statistics* (CEQS) is of critical importance, which is directly used as source statistics for goods-in-process- and material stock.[38)] Change in inventory stock values is estimated by commodity from the inventory stock value in corporate accounting data, typically surveyed in CEQS. As I show below soon, evident

regular seasonal fluctuations are observed also in the estimates of inventory stock values and changes in their values in CEQS surveyed by firm and published by industry. This suggests that regular seasonal fluctuations in quarterly GDP inventory investment statistics do not emerge primarily on the process of conversion and estimation from the source statistics. As reference material for the former, I present relevant results of my CEQS study.[39)]

Inventory stock values (not inventory investment values) in CEQS are respectively aggregates of inventory stock values by category reported by firms, and therefore respective aggregates of raw material, goods-in-stock, and product firms possess as inventory stock both at the start and the end of the period. Thus, in industries like the automobile industry where industry classification corresponds to commodity classification, goods-in-process- and product stock data in CEQS basically corresponds to those in GDP statistics, in coverage of survey objects and stock values. As for material stock, coverage of survey objects is completely different. Distribution stock is not directly surveyed in CEQS. In CEQS distribution sector is classified and surveyed in two industries, wholesaling and retailing. Any estimate corresponding to automobile distribution stock, for example, is unavailable.[40)]

In Section [6] I show the results in the order corresponding to the manufacturing sector in total, wholesaling, and retailing. I show the results of CEQS study by industry in [9], following the examination of quarterly GDP inventory investment estimates by commodity in [7] and [8].

First comes the movement of inventory investment values (=change in stock values during the quarter) in the manufacturing sector as a whole. Two figures show the movement for 2006~2012Q3 and 1997~2002, respectively, of inventory investment values in three categories, product (final), goods-in-process (process), and material, and also inventory investment in total (total), (unit=¥million).

Of the total inventory stock in the manufacturing sector, product inventory occupies approximately 40 percent, and goods-in-process inventory and material inventory 35 percent and 25 percent, respectively. The ratio of total inventory to total assets is approximately 10 percent.

The total inventory stock value in the manufacturing sector is ¥40 trillion, which is 30 percent larger than the value in the construction industry, ¥30 trillion, in the first half of the 1990s, and also exceeds the sum of wholesaling sector's ¥20 trillion and retailing sector's ¥10 trillion.

The maximum ratio (in absolute value) of total inventory investment value to inventory stock value, ¥4 billion/ ¥40 billion, is 10 percent.

Both every inventory investment by category and in total shows M-shaped regular seasonal fluctuations.

During the period around Lehman Shock neither a notable increase in inventory stock nor a long-run stock adjustment process is found anywhere. Actually, over two years after the Shock, the inventory investment continuously fell below the previous level, deforming temporarily the regular seasonal fluctuations.

Including the case of 2011Q2 after the Great East Japan Earthquake, in no shock periods I find a notable increase in inventory stock. The inventory investment value in 2011Q2 is rather lower than the previous Q2 values.

In order to confirm the existence of regular seasonal fluctuations I show the figures on movement of estimates by quarter that I used in [5], in the order corresponding to inventory investment in total, product inventory investment, and goods-in-process inventory investment. Only to the first figure I add the movement of annual average inventory investment.

Regular seasonal fluctuation is especially prominent on goods-in-process inventory investment value. As was the case in [5], the annual average inventory investment is the least volatile.

Because distribution stock is not rich in information, I show figures on inventory investment in wholesaling and retailing industries from CEQS. In both most is goods-in-process inventory stock, approximately 90% in the former and 97~98% in the latter. Naturally most variations in inventory investment value arise from goods-in-process inventory investment. In both, the ratio of total inventory stock to total assets is 10%. I show figures in the same way as the case of the manufacturing sector in Figures 18a and 18b.

First comes the wholesale industry.

On average the total stock value is ¥20 trillion, and the maximum absolute value of inventory investment, ¥2 trillion, is equivalent to 10% of the total stock value.

No notable increase in inventory stock is found either in the 2008Q4 just after the Lehman Shock or in 2008Q3, and inventory investment decreased radically in the next 2009Q1. It seems that there was little increase in purchased goods that remained unsold and that due to fair-value adjustment at the end of March 2009 inventory stock value drastically decreasedin 2009Q1. I find little influence of the Earthquake in March 2011, either. The seasonal variation may offset the stock increase in 2009Q1, however.

Wholesalers' inventory investment in CEQS corresponds to part of quarterly GDP distribution stock investment. It fluctuates wildly, but like the quarterly GDP distribution stock investment, it does

Figure 18a Inventory Investment: manufacturing, all size, quarterly, 2006Q1~2012Q3, CEQS

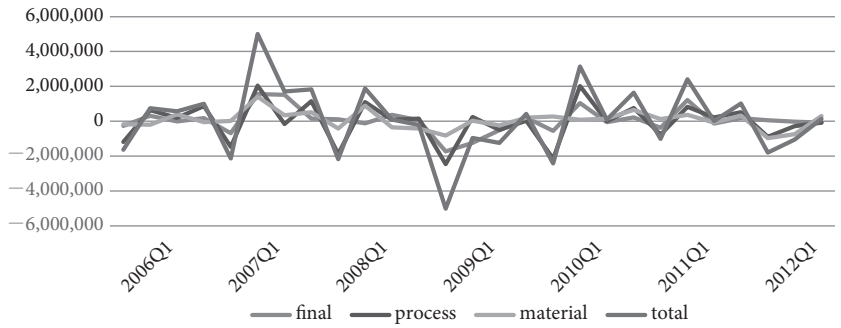


Figure 18b Inventory Investment: manufacturing, all size, quarterly, 1997Q1~2002Q4, CEQS

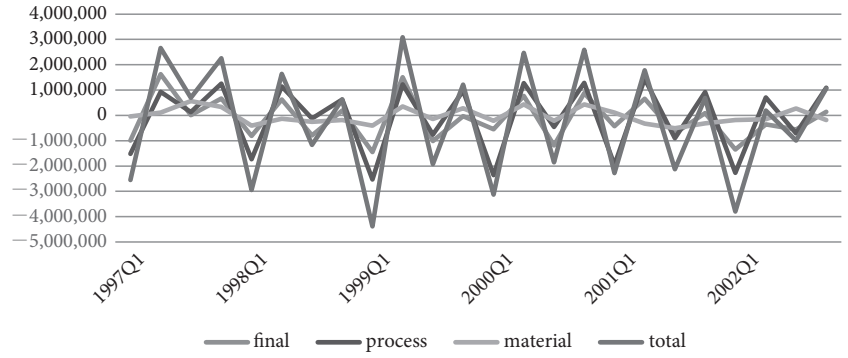


Figure 19a Movement by quarter of all industries diffTinv, CEQS

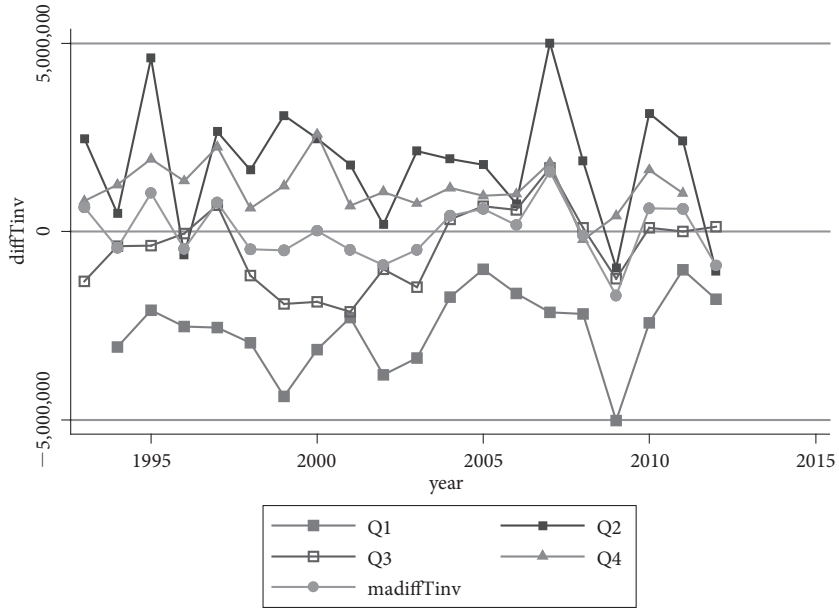


Figure 19b Movement by quarter of all industries diffproduct, CEQS

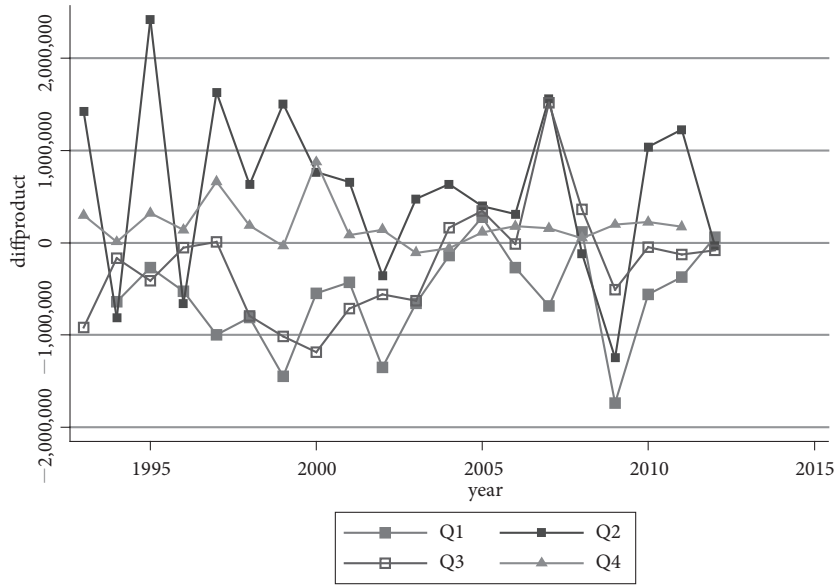


Figure 19c Movement by quarter of all industries diffprocess, CEQS

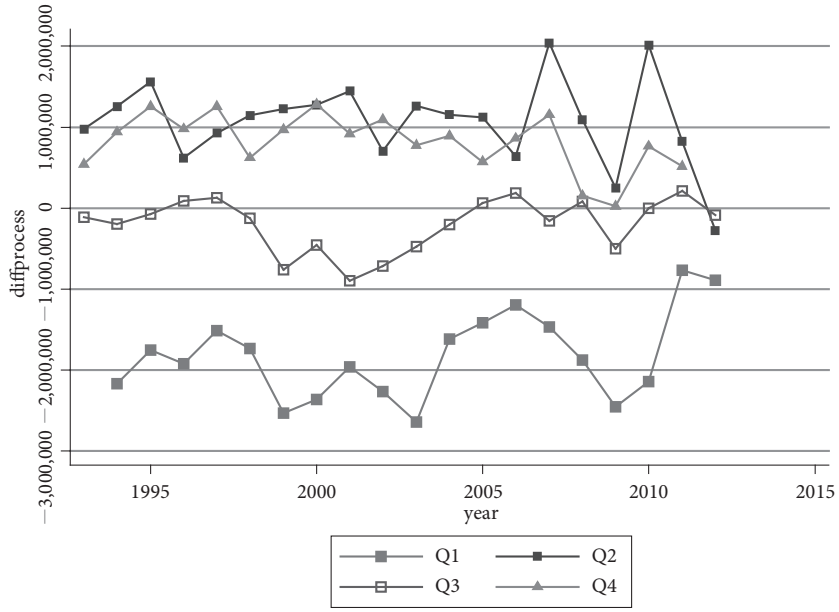
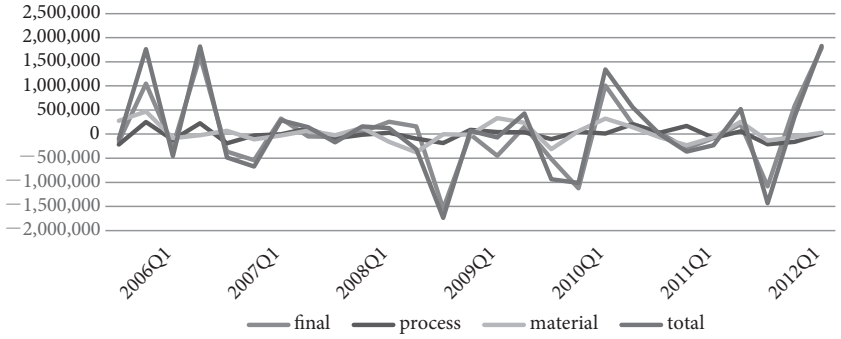


Figure 20a Inventory Investment: wholesale, all size, quarterly, 2006Q1~2012Q3, CEQS



not show regular seasonal fluctuations.

Next comes the retail industry.

The maximum absolute value of inventory investment, ¥2 trillion, is equivalent to 20% of the total stock value of the retailing sector, ¥10 trillion.

Either after the Lehman Shock or after the Earthquake, no notable increase in inventory stock is observed.

Retailers' inventory investment in CEQS corresponds to part of quarterly GDP distribution stock investment. It fluctuates wildly, but like in the wholesale industry, it does not show regular seasonal fluctuations.

Unlike in the case of inventory investment estimates in quarterly GDP statistics, we can obtain from CEQS the estimates of inventory stock value.

The ratio of maximum absolute value of quarterly inventory investment to total stock value is, 10%

Figure 20b Inventory Investment: wholesale, all size, quarterly, 1997Q1~2002Q4, CEQS

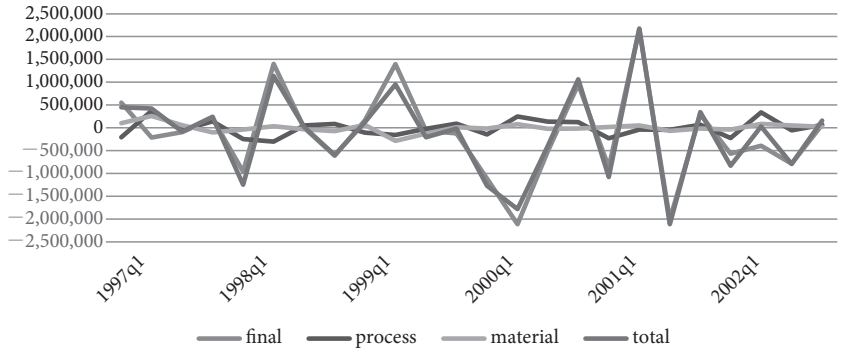


Figure 21a Inventory Investment: retail, all size, quarterly, 2006Q1~2012Q3, CEQS

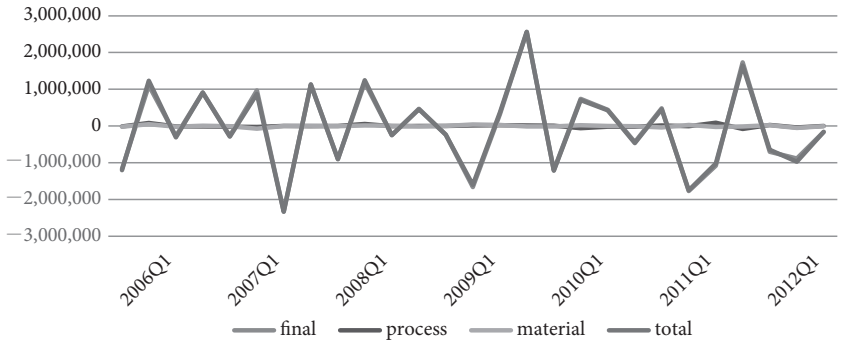
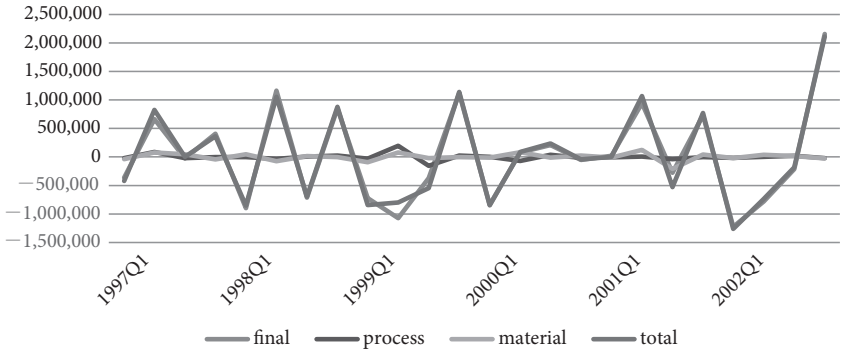


Figure 21b Inventory Investment: retail, all size, quarterly, 1997Q1~2002Q4, CEQS



both in the manufacturing- and wholesaling industry, and 20% in the retailing. For example, assuming the inventory investment is all due to fair value adjustments at the end of accounting period, the maximum adjustment ratio is 10% or 20%.

1) Professor, Faculty of Economics, Osaka Gakuin University, and Professor Emeritus of the University of Tokyo. Email: miwa@e.u-tokyo.ac.jp. This is a revised version of the discussion paper with the same title (CIRJE-F-903, CARF-F-327, September 2013). The Japanese version is available as a discussion paper with the same title (CIRJE-J-249, CARF-J-098, September 2013). In those discussion papers reader finds Figures and Tables in color. I gratefully acknowledge the helpful comments and suggestions of Mototsugu Fukushige, Takashi Kano, Tatsuya Kubokawa, Naoto Kunitomo, Tadashi Morita, Hiroshi Ohashi, Wataru Ohta, Yasuhiro Omori, J. Mark Ramseyer, Kaoru Sano, Sim Seung-Gyu (Andrew), Hajime Wago, Yoshihiro Yajima, and participants of workshops at Osaka University and the University of Tokyo. Also I acknowledge the helpful cooperation in providing detailed information and suggestions from Kengo Moro (Director, National Expenditure Division, Department of National Accounts, Economic and Social Research Institute, Cabinet Office) and Kazuhiko Manaka (Deputy Director, Statistics Planning Office, Research and Statistics Department, Minister's Secretariat, METI). This research was supported by MEXT Kakenhi, Grant-in-Aid for Scientific Research (C) 23530271.

2) Also see his survey article, Wen [2011], in *American Economic Journal: Macroeconomics.*

3) Referring to Table 5.2 Behavior of the components of output in recessions (p.191), the only place he focuses on inventory, Romer (2012) writes: "even though inventory investment on average accounts for only a trivial fraction (0.6%) of GDP, its fluctuations accounts for close to half of the shortfall in growth relative to normal in recessions: inventory accumulation is on average large and positive at peaks, and large and negative at troughs." The average share in GDP was 0.6%, and the average share in fall in GDP in recessions relative to normal growth was 44.8%.

4) See Bernanke *et al.* [1999]. I will discuss the "financial accelerator" theory in Section [10].

5) In fact, most those studies focus on finished goods inventory of the manufacturing industry. Feldstein and Auerbach [1976], however, using *Survey of Current Business*, focus on the finished goods, raw material, and work-in-process inventories in durable-goods manufacturing industries. The corresponding value of inventories of materials and goods in process is obtained by subtracting real finished-goods inventories from the value of total durable-goods manufacturing inventories reported in the national income accounts (p.353). Blinder and Maccini [1991, p.76] points, "retail inventories and materials and supplies held by manufacturers are by far the most volatile components of inventory investment." However, the data availability has severely constrained research.

6) Even in the year of the deepest drop in stocks, "[T]he entire year's fall in the stock of finished-goods inventories was thus equal to less than one day's production! The largest one-year increase in finished-goods inventories was a $2.0 billion rise from the end of 1966:2 to the end of 1967:2" (Feldstein and Auerbach, 1976, p.356). Nonetheless, facing with the wild fluctuations in quarterly data available for a long term (and probably because no other reliable and effective data is viable), they shift the focus to the target-adjustment model.

7) Wen [2005] uses the OECD database.

8) The same holds also for many macroeconomists who have little interest in short-run macroeconomic fluctuations, recognizing that it is hard to explain it or that economics have achieved little success in it.

9) OECD [2012] reports that, in addition to its availability, the estimation method of quarterly SNA (GDP) inventory investment data differs greatly across countries. Basically it is because of the content and accuracy of the basic information available like the source statistics and the timing of their availability. At least at the *kakuho* stage (detailed below in [3]), the accuracy of Japanese inventory investment estimates, upon wide range of rich data, is not lower than many other OECD countries.

10) On the *sokuho* and *kakuho* stages of quick estimates, we see in [3].

11) It is based on the international standard recommended by the UN in 1993 (93SNA). For the details, see Cabinet Office (CAO), Economic and Social Research Institute (ESRI), Department of National Accounts ed.,

"Transition to 93SNA in Japan" and "Technical Manuals for 93SNA Estimation" (both in Japanese) (http://www.esri.cao.go.jp/jp/sna/menu.html).

12) "[S]ince the publication of Metzler's theoretical study of the inventory cycle", the size of sales-forecasts error has been a big concern of economists. Upon an estimate that the average absolute error of $2.01 billion per quarter is equal to about one day's production, Feldstein and Auerbach [1976, p.363] concludes, "Forecast errors should not be a source of any substantial undesired quarterly changes in inventories". My conclusion is consistent with this view, and mutually complementary.

13) See Kunitomo [2006]. Referring to X-12-ARIMA, Kunotomo comments: "Most economists using seasonally adjusted figures in their empirical studies rarely understand how those statistics are seasonally adjusted. Yet, both in the US and Japan persons in the government statistical offices provide and use fairly complicated seasonal adjustment methods for their practical needs of estimation and publication of public time-series statistics, but often they lack professional expertise in statistical time-series analysis like those summarized in RegARIMA Model" (p.464).

14) For the Japanese economy of the time, see *The Annual Report of the Japanese Economy and Public Finance* (CAO), and *White Paper on International Economy and Trade* (METI), each year, particularly 2009.

15) As in *The Annual Report of the Japanese Economy and Public Finance* and *White Paper on International Economy and Trade*, it is standard in Japan to focus on IIP for studying the state of industrial production. Including METI's *Analysis of All Industrial Activities*, it is customary to show and emphasize the inventory ratio (=inventory/shipment) as in the next figure. As shown in the Figure 4 on the Lehman Shock, however, although inventory remains stationary, the ratio moves wildly primarily because of wild variation in shipment. This ratio backs up and amplifies the conventional wisdom. So I show the inventory ratio only in the Figure 4.

16) In [10-2] I discuss briefly the process of firm's prompt response and adjustment.

17) Reader interested in other commodity sectors should see *Analysis of Industrial Activities*, quarterly, by METI. Like the SNA (GDP) statistics I mainly use in what follows, IIP and *Current Survey of Production* on which IIP depends, and therefore those estimates are all commodity-based. In contrast, *Corporate Enterprise Statistics*, quarterly and annual, is firm and industry based. I will discuss the details and its importance of this difference in Section [3].

18) Surveyed "commodity" is not necessarily the same in production survey and shipment survey. As a result, even when production index moves in perfect harmony with shipment index, the inventory index could move remarkably. It may be important to note that in some commodities survey item is the value rather than quantity. Also readers should note that indices define the base year level as 100 and similar movements in indices do not imply their similar movements in size.

19) Assuming comments that distribution stock must have accumulated, *Analysis of All Industrial Activities* (the Review of the Year 2009) concludes with evidence that it did not occur. As I show below, my conclusion upon quarterly SNA statistics is consistent with this one.

20) As the IIP figures shown above illustrate, decrease in shipment, both for export and domestic markets, had begun before the Lehman Shock. Drastic shipment decline in 2008Q4 and 2009Q1 began slightly earlier in export than in domestic market, and also its size a bit bigger in the former. Nonetheless, fall in domestic shipment was also dramatic during this period. The same applies also to the rapid recovery of shipment since the 2009Q2. The view is unpersuasive that dramatic decline in export shipment, by way of decrease in national income, is the primary cause of the drastic fall in domestic shipment.

21) *The Census of Manufacturers* surveys once a year the activities of manufacturers during the reference year and their state at the end of the year.

22) In Japan QE stands for either "quarterly estimate" or "quick estimate", and here the latter.

23) Using as the benchmark the realized values of the previous year estimated by commodity-flow method adopted for the Final estimates, it conducts extrapolation estimation upon the period-to-period rates of increase both in demand-side statistics like *Household Expenditure Survey* and *Corporate Enterprise Quarterly Statistics* and in supply-side statistics like *Current Survey of Production* and *Survey of Selected Service Industries*. Upon integrating thus estimates both from demand-side and supply-side, it applies price- and seasonal adjustment. See CAO, "System of SNA Estimation" available on its HomePage.

24) See Sakuramoto [2010], p.53 for instance.

25) OECD [2012] points that not many OECD countries estimate quarterly inventory investment statistics from detailed supply-side information like Japan. Not a few countries make estimates as the difference between shipment and production.

26) For example, when the annual Final 2008 is published (December 2009), every 2008 quarter is in "the period the Final already exists", and 2009 quarters belong to "the periods the Final do not exist". The 2010 Final was published in December 2011. It is November 2012 that this research began the use of the quarterly Final inventory investment estimates for 1994~2010, and all the periods under study belong to the "the periods the Final already exists".

27) For the details of source statistics and estimation methods that differ across inventory categories, see CAO [2012, pp. 27~29].

28) The purposes of revision of this time were, (1) for better understanding of economic trends, in response to the environmental changes surrounding statistics, by greatly expanding the source information primarily on the supply side, (2) improving the contribution to prompter business outlook, by speeding the publication timing in no way inferior to other major developed countries, and (3) improving the consistency with the estimation method of the annual Final (p.1).

29) Although IIP and *Current Survey of Production* I used in [2] are commodity-based, the survey object is producer and the "inventory" is producer's product inventory. In *The Corporation Enterprise Quarterly Statistics* I use later, the survey object is corporation and the statistics is published on industry-base, inventory stock values by industry in three categories, raw material-, goods-in-process-, and product stock. Nonetheless, for example, some automobiles in distribution stock are included in distributors'' inventory, but none appears in inventory in the automobile industry.

30) "The SNA is in principle based on an accrual basis, and change in inventory values is evaluated at the price of the time it occurs. Notwithstanding, available inventory related information is firm's accounting data on inventory stock, which is evaluated by various inventory valuation standards allowed as standard business accounting practices such as last-in first-out system and first-in last-out system. Hence, the change in inventory stock value, obtained by deducting the opening inventory value from the final inventory value, includes the changes due to the change in valuation prices." Following this commentary, CAO [2012, p. 27] states, "In estimating the changes in inventory stock values upon the inventory stock information obtained from firm's accounting data, it is necessary to adjust the valuation difference between the SNA and business accounting, which we call the inventory valuation adjustment," and explains their methods. As shown below, however, the results of this research pose grave doubts on the effectiveness and validity of this "adjustment". For more details, see the opening paragraphs of Section [6].

31) I use here nominal sales as real sales estimates are unavailable, and correspondingly nominal inventory investment estimates rather than real values.

32) Notwithstanding, inventory investment estimates is a part of quarterly GDP accounts, and it may not be easy to take measures to inventory investment estimates separately.

33) On this point, see [6].

34) Here I use 'by category' on three dimensions, that is, quarter, commodity, and inventory category, therefore for 1,840 categories (=4*92*5) I deduct average values for the original.

35) No information on the objective and the method of seasonal adjustment is available. Recall the above footnote 13.

36) No reference with clear statements is available, however. This explanation is based on my interviews from several persons including academic experts in accounting.

37) Experts may illustrate this group of observations as "end-of-accounting-period adjustments". Relevant information is decisively missing, however, and no effective measure is available for identifying them and evaluating their importance.

38) CAO [2012, pp. 27–29].

39) Here I present figures on all size categories. Although I studied also two size categories, from ¥100 million~ ¥1 billion and more than ¥1 billion in paid-in capital, I found no noteworthy difference to report.

40) Kunitomo [2001] discusses the application of seasonal adjustment methods, particularly the X-12-ARIMA method, to main items of CEQS, such as sales, profits, fixed investment, and inventory (investment), suggesting great difficulties particularly in application to inventory (investment) estimates.

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(to be continued)

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