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Abstract

This article studies the relationship between the business cycle and the dynamics of adjustment from a macroeconomic perspective, focusing on the aggregate responses of the Japanese economy with respect to the business cycle over time, rather than on the causes of business cycles. For empirical purposes, we estimate the rank of responsiveness in terms of price adjustment (real wage), quantity adjustment (employment) and utilization of employment (work-hour adjustment) toward economic fluctuation, based on the multivariate dynamic model with an error correction term. We find that the short-run adjustment over the full period has been done mainly through high flexibility of wages. However, in the long-run, employment adjustment plays more important role than adjustment via work-hour, while the flexible wage shows the most dominant role in the process of adjustment. Furthermore, when comparing two subsample periods, all the channels of adjustment become more flexible during 1990s than ones in the previous period. An implication from evidence is that Japanese economy responded to economic fluctuations not only through a high degree of wage adjustment but also through the long-run and permanent adjustment of employment, while maintaining the utilization of labor as a short-run response.

Ⅰ. Introduction

Dynamic adjustment of prices and wages in response to economic fluctuation and resulting unemployment has long been an important topic in macroeconomics. In general, the flexibility of wage or in broad sense, functional flexibility including employment adjustment has been playing an important role not only for supply and demand for labor force but also for stability of economy as a whole, especially through stabilizing real economic fluctuation by improving the efficient utilization of labor force and labor input as well as wage flexibility.

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Given variety of theories regarding dynamic adjustments and their inconclusive competing implications, we focus the following argument which seems to help explain Japanese adjustment mechanism in conjunction with business cycles including the prolonged slump after the boom period. The validity of the story and/or hypothesis would be tested, in an empirical way, by examining aggregate times series data in Japan. Under the high cost of adjustment on demand side, the adjustment process of employment become relatively sluggish, while flexibility and cyclicality of real wage turn out to be stronger than other adjustment process. In this context, the payment to labor in recession may fall short of the wage determined by firm's profit-maximizing conditions, whereas payments in booms rise above this level because employment does not adjust. The presence of adjustment costs for changes in the labor input could make the real wage more procyclical, although real wage sometimes might move in the same direction during both upturns and downturns. Under the situation where costs of adjustment are relevant, the *long-run* and *short-run* dynamic adjustments are needed to be considered in the empirical analysis.

This paper provides some empirical evidence on flexibility of real wage and the relative extent to which wage and labor inputs such as employment and work-hours adjust with respect to the economic fluctuation such business cycle as change in product demand, using aggregate data for Japanese economy including all the industry sectors. We draw empirical results from the multivariate dynamic model with a simultaneous specification of wage, employment and work-hours. The model allows us to consider appropriately time series properties of the data and the short-run structure specified in a way consistent with the long-run relation.

The organization of this paper is as follows. In the next section we briefly describe the development of business cycle after WW Ⅱ and the prolong slump during the post bubble period in Japan. Theoretical issues regarding wage flexibility, labor hoarding and economic fluctuation and Japanese experiences are discussed in the section Ⅲ. Empirical analysis in section Ⅳ starts with the introduction of dynamic model and the empirical specification for relationship among business cycles, wage flexibility and employment adjustment. The section reports estimates of the structural model and finally deals with economic interpretation and their implications for the dynamic responses from the empirical results. Some concluding remarks and the related discussion are outlined in the final section for the future research agenda.

Ⅱ. Business Cycles and the Prolonged Slump in Japan

A stylized fact from the Japanese postwar economic history is the extremely high economic growth in the pre 1974 era. In pre-1974 era, Japans economy expanded rapidly from the mid-1950s through the 1960s, which was well above Japan's average annual growth rate. The rapid expansion rate of economic activity in earlier period since the late 1950s was said to be attributed by an immense capital accumulation.

Japanese business cycles their components according to boom and contract periods since 1980s are summarized in Table 1. The Japanese economy in 1990s, however, experiences a

decade of economic stagnation, which is regarded as *A Lost Decade* due to slow economic growth and recession. After boom and high growth in the 1980s, Japan's economy faltered in the 1990s, starting after the asset price bubble of the late eighties burst. The average growth rate during 1990s was about 1% and the rate of many years during the decade was less than 1%, far below its previous year. It is the year of 1998 that performance of Japanese economy shows minus growth since 1974 that the first oil shock induced the economy to be negative growth[1]. The Japanese unemployment rate rose to 5% in 2001, its highest level since World War Ⅱ. Low growth and high unemployment led to a decline in inflation and ultimately deflation.

The fact that Japan has been in slump or recession for almost eight years during 1990s makes Japan's situation the most serious economic slowdown that was rarely experienced by major industrial developed country since early 1950s.

Various explanations, views and theories regarding business cycles allow us to combine those in order to form a story for understanding 'the 1990s in Japan: a lost decade'. It is well argued that Japan' slump seems to have been triggered by the collapse in Japanese asset prices such as stock prices and real estate prices. After a boom in the 1980s, stock price measured by Nikkei index decreased by more than half between 1989 and 1992. Prices of real assets such as land, house and buildings also has been dropped by more than half with some time lag. Soon after that, investment spending and growth fell drastically. Economic policy to be implemented for stimulating economy was monetary expansion. But it was too slow to avoid deflation and it is said Japan now is in a liquidity trap. The nominal interest rate was below 1% by 1996 and is close to zero in early 2002. In this circumstances, traditional monetary policy seems to be powerless to stimulate the economy. Fiscal policy through increasing government spending has been implemented since the slump, but it was mainly in form of public work projects (*Koukyou jigyou*). Though fiscal stimulus had some effect on output, but not enough to solve deflation problem, government deficit have increased the ratio of government debt to GDP, 130% in 2001. Given current low interest rate and the potential debt service burden in the future, it is not easy for policy makers to continue additional fiscal expansion. One important fact to remember is that the recession has occurred despite significant counter-cyclical policies, involving a considerable expansion in the fiscal deficit and reducing the overnight call rate to its effective floor in early 1999[2].

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1) On 1997, one year before 1998, there were major events in Japan such as increase in consumption tax, drastic decrease in budget spending (measured by contribution to GDP of −0.8%). Fall on the year, bank crisis, peaked by bankrupt of Yamaichi security company and Development Bank of Hokkaido, occurred just after the Asian currency crisis. Given financial turmoil since fall of 1997, export and investment of equipment had been rapidly decreased, causing Japanese economy to be minus growth of −1.1% in 1998.

2) Fiscal expansion policy had been done largely through packages aimed at fiscal expansion. Bayoumi (2001, 242).

Table 1. Japanese Business Cycles since 1980s

	Boom period					Recession period				
	Y	C	I	G	NX	GDP	C	I	G	NX
1980:1−1983:1						2.46	2.84	0.21	−0.53	15.66
1983:1−1985:2	3.61	3.02	8.48	−4.96	17.10					
1985:2−1986:4						3.44	3.07	8.47	3.65	−17.18
1986:4−1991:1	5.36	4.42	11.99	3.05	−8.05					
1991:1−1993:4						0.32	2.33	−10.38	11.75	4.49
1993:4−1997:1	2.95	2.83	6.20	−1.74	−5.13					
1997:1−1999:2						−0.67	−1.37	−2.35	3.94	1.36
1999:2−2000:4	2.78	1.34	12.48	−12.46	14.24					
2000:4−2002:1						−2.20	0.95	−10.65	0.21	−6.41
2002:1−2004:1	3.62	1.91	9.44	−10.75	35.86					

Source: ESI, Cabinet Office, *National Income Accounts*, Japan.
Note: Y denotes GDP growth rates, C indicates growth rate in private aggregate consumption, I represents the growth rate of private aggregate investment for equipment and machine, G denotes public capital formation government expenditure for public investment, NX indicates net trade measured by aggregate export minus import for goods and services.

What did cause Japan' slump and what were policy responses? Especially, the prolonged recession during 1990s in Japan induces researchers to explore reasons for what explains the Japanese economic stagnation of the 1990s. There are various views toward the Japanese recession in 1990s and thus the many possible explanations of Japanese prolonged recession in Japanese economic activity over 1990s has been emerged as a number of competing hypothesis theoretically and empirically challenged by economists.

Some categories among others include the passive and inconsistent fiscal stimulus, the limited room for expansionary monetary policy due to a liquidity trap, overinvestment and debt overhang, disruption of financial intermediation of largely through the impact of changes in domestic asset price on bank lending.

One view is that the prolonged slump reflects *inadequate policy responses*, particularly as the limited effect of fiscal policy. Though Japanese government conducted a number of fiscal packages aimed at reviving the economy over the 1990s, the fiscal policy has remained a small impact and has not been the source of unsustainable stimulus. Net contribution of fiscal policy (public consumption plus investment, excluding social security entitlements) has been negative in 15 of the last 18 quarters and all but one quarter since 2001[3].

Second view that focuses on monetary policy put emphasis on that Japan is stuck in *liquidity trap* where the Japanese monetary authorities are unable to reduce the real interest rate sufficiently far to bring the economy back to full employment, despite record low nominal short- and long-term interest rates[4]. The story starts from a fact that consumption is historically low

3) Posen (1998)
4) Kurugman (1998)

in Japan, resulting high structural saving rate. Though high saving rate had been balanced or offset during the high growth periods by high investment, a slowdown in anticipated growth had caused sufficiently so large imbalance between saving and investment that the equilibrium real interest rate becomes negative. Further, the anti-inflationary reputation of the central bank, the Bank of Japan, is sufficiently strong that expectations of future inflation are low. As Fisher equation, indicating relations among nominal interest rate, real interest rate and inflation rate, implies that despite low nominal interest rates, short and long-run rates, the monetary authorities face the limit to reduce the real interest rate sufficiently far to bring economy back to full employment. Thus there was the limited room for expansionary monetary policy under this liquidity trap situation.

A third view focuses on the depressed investment due to over-investment during the bubble period of the late 1980s and early 1990s. It holds that the prolonged slump reflects the *low rate of return to capital due to over investment*[5]. The past over investment in Japan causes the rate of return on capital to be low which, in turn, lowers current investment and spurs saving as consumers fail to achieve the desired level of asset accumulation. The inefficiency of the corporate sector due to significant corporate debt overhang also causes lower incentive to invest. Thus wealth effect in this case causes cyclical downturns. The economy with high portion of aging population faces demographic effect which depresses investment more than saving.

A fourth view holds that the prolonged slump reflects *problems with financial intermediation*. Literatures in the line of this view ask questions such as (i) whether the decline in bank loans was a "credit crunch", that is, a decline due to supply factors such as BIS capital ratio imposed on banks and (ii) if so, whether it depressed output by constraining investment. The *credit crunch hypothesis* holds that there is a limit on the amount a firm can borrow. If bank loans and other means of investment finance are not perfect substitutes, an exogenous decrease in the loan limit constraints investment and hence depresses output[6]. This explanation has an appeal because collapse of bank loans and the output slump occurred in the same period (the 1990s) and because the collapse of bank loans seems exogenous, taking place when the BIS capital ratio is said to be binding for many Japanese banks[7]

Banks play a much more important role in financial intermediation in Japan, relative to ones of USA and EU. During bubble period, the banks were lending a large amount of funds to firms using land as collateral. With the steady decrease in land prices since the collapse of the financial asset prices such as stock prices, many of these loans turn out to be non-performing or bad-performing debt and then reduce bank capital, causing *balance-sheet problem.* Bank capital is susceptible to changes in stock prices because banks typically hold large amount

5) Ando (1998), Bayoumi (2001, 243)

6) Kashyap and Stein (1994) for the detail statement of the hypothesis. Hayashi and Prescott (2003) confront the credit crunch hypothesis with data from various sources.

7) Hayashi and Prescott (2003, 13−14)

of stock in industrial companies[8].

Let us summarize various views in a simple way. Given the various different competing explanations and hypothesis, if we look at those from the empirical perspective, each explanation can be said to emphasis on behavior of different set of variables—fiscal policy, monetary policy, asset prices such as stock and land prices, and bank loans—as major factor explaining business cycle for a decade of stagnation or the prolonged recession and slump during 1990s. The views mentioned above mainly assume shocks from demand side which come from product market and financial markets. Thus focusing on causes for aggregate expenditure and its component of demand to explain macroeconomic fluctuation or business cycle, measured by change in GDP, will help understanding how demand side contributes macroeconomic fluctuation over time.

Taking the long-run development of expenditure side into account help to understand and identify the causes of the prolonged and persistent economic recession in Japan. The behavior of components of real demand aggregate in relation to the output produced could provide important facts to conjecture the possible causes of the business cycle, particularly the prolonged slump in 1990s. Table 2 shows the relative contribution of disaggregate demand and expenditure component to change in the aggregate behavior of overall economic activity measured by growth rate of real gross domestic product (GDP). The relative contribution is calculated by the product of the share of expenditure component out of real GDP and the rate of change (growth rate) in each demand component.

Private Business Investment: The largest fluctuation among the demand expenditure is for the private firm's investment in machinery and equipment and non-residential construction. The fact indicates that business investment was the main force behind aggregate fluctuation so that it contributed most to the decreases of GDP in early 1990s (1992−93, 1998) and to increase in mid-1990s (1996). Investment was reduced unusually severely in these phases of recession.

Private consumption and saving ratio: Two factors might affect the aggregate consumption and its relative contribution to the aggregate business cycle and growth: introduction of consumption and import. The behavior of aggregate consumption by private households showed a significant change in 1998, which can be explained in general terms by a significant increase in the consumption tax distorting private household's purchasing behavior in that period. The long stagnation of private consumption may be related to the increasing uncertainty with respect to job security and the system of public pensions that may have contributed to a higher savings ratio. The impact of consumption tax reminds us an important aspect of *shift in eco-*

8) Bayoumi (2001, 243) and see Kwon (1998) for the relationship between monetary policy, land prices, bank lending and output using a VAR. Ogawa et. al. (1996) and Ogawa and Suzuki (1998) for empirical evidence regarding how land collateral has affected investment by Japanese firms. Ogawa and Kitasawa (1998) for determinants of bank lending. Westcott (1996) for the role of small firms in the economy.

Table 2. Demand Side Contributions to Business Cycle and Growth in Japan

years	GDP	C	I (h)	I (e)	I (iv)	G (c)	G (pi)	NX	X	IM
1980−1984	3.1	1.5	−0.2	0.7	−0.06	0.32	−0.18	1.0	0.94	0.06
1985−1989	4.5	2.5	0.5	1.6	0.14	0.22	0.1	−0.5	0.7	−0.8
1990	5.1	2.6	0.3	2	−0.2	0.1	0.3	−0.1	0.7	−0.8
1991	3.8	1.5	−0.5	1.2	0.3	0.2	0.3	0.9	0.6	0.3
1992	1.0	1.4	−0.3	−1.4	−0.4	0.4	0.9	0.3	0.3	0
1993	0.3	0.7	0.1	−2	−0.1	0.5	1.1	0.1	0	0.1
1994	1.0	1.5	0.4	−1	−0.3	0.4	0.2	−0.2	0.3	−0.5
1995	1.9	1	−0.2	0.4	0.6	0.6	0.1	−0.5	0.4	−0.9
1996	3.4	1.4	0.6	0.7	0.3	0.4	0.5	−0.4	0.6	−1
1997	1.8	0.5	−0.6	1.7	0	0.1	−0.8	1	1.1	−0.1
1998	−1	−0.1	−0.6	−0.3	−0.6	0.3	−0.1	0.4	−0.2	0.6
1999	0.1	0.1	0	−0.6	−0.3	0.7	0.4	−0.1	0.1	−0.2
2000	2.8	0.5	0	1.5	0.3	0.8	−0.8	0.5	1.3	−0.8
2001	0.4	0.9	−0.2	0.2	0.1	0.4	−0.3	−0.7	−0.7	0
2002	0.3	0.8	−0.2	−0.7	−0.4	0.4	−0.3	0.7	0.9	−0.2

Source: Author's calculation based on National Income Accounts data.

Note: 1. GDP (Gross Domestic Products) is annual growth rates based on the previous year. GDP growth rate for 1980−84, 1985−1989 is calculated from average rate for five years. Other items are the contribution rates for GDP growth rate, which all growth rate of demand components are summed up to the GDP growth rate.

2. The contribution rate is the product of (i) share of each demand component out of the aggregate expenditure and (ii) growth rate of each component.

3. Component of aggregate demand and expenditure. C represents private final aggregate consumption expenditure; I (h) is construction investment, residential and housing investment by households; I (e) is investment for machinery equipment and non-residential; I (iv) is changes in inventory; G (c) is final consumption expenditure by government as a part of government expenditure; G (pi) is public capital accumulation or public investment by government; NX is the net export of goods and services that is sum of export and import; X is aggregate export of goods and services; IM is aggregate import for goods and services.

nomic environment and legal constraint: One important fact which have influenced behavior of variables is that changes in law played a role as a legal constraint and also affected the expectation so that caused behavior of variables which consist of aggregate economic activity in Japan.

Low Productivity Growth Rate Hypothesis

However, there are alternative views that look the problem for the prolonged economic stagnation as a *low productivity growth rate*, not a breakdown of the financial system, as corporations large and small were able to find financing for investments. Those with the view think hypotheses mentioned early part of this section may be relevant for business cycle but do not seem capable of accounting for the chronic prolong slump seen ever since the early 1990s. Among them, Hayashi and Prescott (2003) argue that there is no evidence of profitable investment opportunities not being exploited due to lack of access to capital markets. Low productivity growth is result of a policy that subsidizes inefficient firms and declining industries

because the inefficient producers produce a greater share of the output due to this policy[9]. Given this subsidizing hypothesis, they suggest, as a policy recommendation for the ongoing economic reform, that research effort should be focused on what policy change will allow productivity to again grow rapidly, assuming that growth theory with TFP as exogenous accounts well for the Japanese lost decade of growth. This view implies that the usual pick-up in economic activities, particularly investment such as over-investment, could be interpreted as due to an anticipation of higher productivity growth that never materialized during the bubble period in Japanese economy[10].

Ⅲ. Economic Fluctuation and Wage Flexibility: Theoretical Issues and Japanese Experiences

Business Cycles and Macroeconomic Adjustments

However, given the possible explanations and causes of business cycle and the prolonged slump summarized in the pervious section, it is more important to understand how Japanese economy does response, as a form of economic adjustment, especially through wage and labor input adjustment, with respect to changes in economic condition. *Persistent* aspect of Japan's slump seems to be better understood when we have improved the understanding about the adjustment mechanism in Japanese economy.

We need to have a distinction between the causes of business cycle (such as boom and recession) and the responses of economy (such as industry or firms responses through employment and wage adjustments). This implies that causality matters. In this study, after summarizing existing evidences regarding the former issues, we mainly focus on the latter topic of responses of economy toward business cycles, in particular, fluctuation of economic activities measured by aggregate demand in Japan. In theory, firms or industries respond to fluctuation of demand through labor adjustments which could be decomposed of in employment, work hours and wages. The extent to which component of adjustments has larger portion for the firms or industry may be influenced by structural and institutional factors as well as the labor market. This process could be interpreted as short-run and long-run dynamic adjustments of prices, wages, and labor quantity such as employment and work-hours.

In order to identify those responses of firms or industry as a whole or macroeconomic perspective, we use notion of cyclicality of aggregate adjustment variables in relation with economic fluctuation in aggregate demand. Given evidences from alternative theories, we consider intertemporal behaviors of employment and wages in Japanese economy as a whole as well as

9) Empirical evidences for this "subsidizing hypothesis" are supported by the experiences of Japanese economy in the 1978−83. Hayashi and Prescott (2003, 19).

10) Hayashi and Prescott (2003) point that accounting the bubble period in Japan need to have a model where productivity is stochastic and where agents receive an indicator of the future productivity.

the relative sensitivity to business cycle in terms of change in product demand over time.

Table 3. Dynamics of Output, Employment, Work-Hour and Wages in Japan

Adjustments / periods	Aggregate output	Employment	Hours	Nominal wage	Real wage
Entire period: 1970−2002	2.08 (1.58)	0.84 (0.64)	−0.29 (0.46)	2.86 (2.64)	1.13 (1.36)
Sub-periods					
1970−1980	2.17 (1.30)	0.71 (0.52)	−0.29 (0.63)	5.39 (2.56)	1.66 (1.57)
1981−1990	1.74 (0.55)	0.83 (0.38)	−0.12 (0.31)	1.54 (0.60)	0.66 (0.43)
1991−2002	0.54 (0.60)	0.37 (0.55)	−0.40 (0.51)	0.20 (0.99)	−0.33 (0.76)

Unit: Figures are growth rates of each variable and figures in ( ) indicates standard deviation of the corresponding variable. The standard deviations (S.D) measure the degree of variation of the variable. The S.D of employment, hour and wages provide the approximation for the relative degrees of flexibility for the labor adjustments over time.

Cyclical movement in employment (or unemployment rates), and total hours had been the central topics in understanding of overall activity of aggregate economy. Further, behaviors of employment, total hours of works and wages constitute issues to distinguish responses of the economy through responses of firms or industry as a whole, from demand-side causes of business cycles.

Business cycles and Real wages

There are many models that try to explain the cyclicality of the real wages which generate alternate and opposite theoretical predictions. One branch of alternative hypotheses concerning the cyclicality of real wages is to explain why one should expect real wages to be procyclical and the other branch is to explain why one should expect them to be counter-cyclcical[11]. It would be incorrect to associate the hypothesis of either real wage counter-cyclicality or real wage procyclicality with a particular approach to macroeconomics, as Abraham and Haltiwanger (1995) pointed out.

There had long been disagreements among macroeconomists regarding this issue. Macroeconomic research makes progress toward this fundamental controversy by developing economic theories and testing them empirically. The classical approach to macroeconomics is based on the assumptions that individuals and firms act in their own best interests and that price variables such as wages and prices adjust quickly to achieve equilibrium in all markets, while the Keynesian approach to macroeconomics assumes that wages and prices do not adjust rapidly.

Keynes (1936) wrote in *The General Theory* that "an increase in employment can only

11) See Abraham and Haltiwanger (September 1995) for the detail survey on this issue.

occur to the accompaniment of a decline in the rate of real wages," and conjectured that cyclical fluctuations in employment were associated with movements along a stable labor demand schedule, and thus that real wages should be *countercyclical*. Keynes' prediction that real wages should be countercyclical is consistent with the model with a stable labor demand curve such as sticky wage and worker-misperception models[12], yielding *countercyclical* behavior of real wages: employment rises when the real wage falls.

Given the earliest attacks on the General Theory regarding Keynes's prediction of a negative relationship between real wage and economic activity, empirical evidences showed the cyclical behavior of wages that as output fluctuate, the real wages typically moves in the same direction[13]. An alternative view of real wage procyclicality is consistent with a variety of alternative macroeconomic approaches. Many of models allow that the labor demand curve shifts over the business cycle. Views differ according to reasons for shifts of labor demand curve. Some shifts may arise because firms have sticky prices and cannot sell all they want at those prices. Alternatively, other reasons of shifts may be due to shock to technology, which alter labor productivity. *Real business cycle models* that emphasize a prominent role to technology shocks as a source of economic fluctuations[14] can accommodate pro-cyclical behavior of real wages, as can any other model that yields cyclical shifts in the labor demand schedule. *Contract and bargaining models* imply that by suggesting that there may not be a tight contemporaneous relationship even between desired employment and desired real wages. If workers have long-term attachments, the current wage may represent an installment payment on a long-term contract and thus little connection to current conditions[15]. *Efficiency wage models* provide reasons why the labor market may not behave like a simple spot market.

Given variety of models and theories regarding the cyclicality of real wages, identifying the contribution and the degree of cyclicality depends on empirical evidences and their specification and interpretations. Generally perceived views are as follows. While real wage in U. S. is generally neither pro-cyclical nor counter-cyclical, the real wage rate in Japan has been said to be grown less rapidly during recessions and more rapidly during expansions. This indicates that Japan exhibited greater flexibility and had a generally smaller influence on employment and output, though the conjecture remains tentative and induces empirical matter to

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12) The standard textbook in 1960s and 1970s includes models with sticky wages or sticky expectations. These expectations augmented Phillips curve style models exhibit countercyclical real wages because nominal wages are slow to adjust during recession to the decrease in aggregate demand and the associated slowdown in price growth.

13) For evidences from a scatterplot of the percentage change in real compensation per hour and the percentage change in real GDP using annual data for United States, Gregory Mankiw, Macroeconmics, 2nd ed. Worth Publishing, 1994, Ch. 11, pp 289−320.

14) For some of the early work on this topic, see John Long and Charles Plossor (1983), Finn Kydland and Prescott (1982), Julio Rotemberg and Michael Woodford (1991).

15) Paul Beaudry and JohonDiNardo (1991) assume a relationship between the terms of the contract and the current and expected future demand conditions at the time of the start of the contract. Abraham and Haltiwanger (1995, 1217)

identify conclusive behavior of Japanese firms and industry as a whole.

There are some reasons why the inflexible or sticky wage argument might be less applicable to Japan relative to US or other countries. Further in addition to *market factors*, there are also some *institutional* features of Japanese markets support the difference. Those factors, among others, include ①bonus, ②wage negotiation, ③long-term trading arrangement among firms, ④life-time employment practice.

A form of compensation: the practice of awarding a substantial portion of compensation in form of bonus which is widespread in Japan. A way of wage negotiation: besides bonus as form of compensation, the fact that wage negotiations in Japan are synchronous has played a role to impart a degree of flexibility to wage contracts that would not be present if the contract periods were staggered, as is typical of the USA. Business to Business trading arrangements: the ubiquity of long-term trading arrangements in Japanese economy probably weakens the influence of prices and output[16]. Life-time employment practice: the behavior of employment over the business cycle in Japan must also reflect the practice known as lifetime employment.

In Japan, firms tend to be particularly reluctant to dismiss workers during a temporary business downturn because the employees have acquired firm-specific skills, and it would be more costly to train new replacements after the inevitable next business downturn than to hoard the trained workers during downturns. This argument is based on labor-hoarding theory which we will discuss.

Labor Hoarding , Wage Flexibility and Cyclical Labor Productivity

The major economic rationale for the phenomenon of excess labor or labor hoarding and the sequential wage flexibility, derives from the theory of firm or industry specific human capital. Firm-specific investments give rise to a stream of rent shared by the firms and its workforce. Given the fact that returns are uncertain and that relevant information may well be asymmetric, it is argued that it may be the mutual interest to maintain a long-term employment relationship as long as joint rents remain positive or even if they turn negative in the short run.

For unexpected short-term fluctuation, say, downturns in economic activity, firms must weight the cost of holding employment that is surplus to current requirements against those of lay-off, and subsequently potentially needing to replace, specific human capital investment. As a rationale for different responses, human capital argument indicates differences in firm or industry-specific human capital investment across countries and across industries or firms[17]. Given this, the sensitivity of labor inputs or the degree of labor adjustments to changes in demand should differ systematically cross countries and across industries.

Given this *quantity-side* argument of relatively high degree of hoarding or the long-term

16) Falth (2003) pointed examples of long-term arrangements such as the business group

17) Evidences, based on the estimated wage-tenure profiles, support strongly the proposition that firm-specific human capital investments are significantly higher Japan than the United Sates Hashimoto and Raisian (1985), Mincer and Higuchi (1988) and than in United Kingdon Koike (1988).

employment, there are the *price-side* arguments, linked the significance of human capital investment, that Japanese firms use internal buffers against aggregate demand changes; in particular, wages are relatively flexible. The buffer to fluctuations in product demand, given flexible agreements over optimal rent shares in Japan, is said to be prices (wages) rather than quantities. The internal mechanism of wage adjustment consists of frequent recontractings or regular arrangement (usual biannual) over regular wages and bonus.

In addition to this internal adjustment mechanism of wage, the other is change in labor utilization rates. This includes the use of hours, or change in the rate of labor utilization, as another buffer against demand fluctuation. Firms can response to downward business cycle by reallocating employment or by recourse to work-sharing rather than layoffs. This issue is related with the excess labor and the limit of overtime hour of work. It is important to understand adjustment mechanism in that it allows us to examine both stock and utilization dimensions of the labor input[18]. This seems similar to portfolio adjustment in financial asset investment in which change in ratio of asset among total amount of funds to maximize the return from the portfolio. In response to change in demand, firms and industry as a whole have to adjust ratios of wage and inputs (utilization rate and employment) in order to minimize the total cost over time.

IV. Empirical Analysis: Business Cycle, Wage Flexibility and Employment Adjustment

In this chapter, estimates of dynamic relationship among business cycle, the degree of wage flexibility, utilization of labor, and employment adjustment are reported from time series data of Japanese aggregate variables. For the empirical specification, we use vector autoregressive model as a statistical model for relationship between product demand, wages and work-hours. We interpret estimates of the model to draw implications for responses of corresponding variables to measure the degree of the flexibility of wages, employment adjustment and labor utilization in terms of not only short-run but also long-run perspectives. Evidences form estimates allow us to know changes and their characteristics of the dynamic behaviors among wages, employment and work-hours in response to business cycle, via change in product demand in Japan.

1. Model and Empirical Specification

The goal of empirical analysis is to estimate the relative responses of labor adjustment to change in product demand and to identify channels through which effects of adjustment are propagated over time. The main focus thus will be on estimating the relative responses of labor adjustments, that is, changes in wage, employment and work-hour in response to change in demand.

One contribution of this study is to us the model with simultaneous consideration of real

18) Orazem and Park (2003, 6−7)

wage, employment, work-hours and aggregate demand. We treat real wage as endogenous as well as employment and work-hours. The other contribution of our study is to provide the dynamic statistical model and empirical evidences regarding not only short-run responses but also the speed of adjustment by adding long-run relationship among labor adjusting variables. This allows us to decompose the gross response into short-run (size response) and long-run (speed) responses. This means that we can draw implications for cyclical and permanent behaviors of adjustment variables used in our empirical study.

By transforming the p-dimensional VAR model of vector Z_t into VAR model with long-run relationship, the general form of dynamic model based on VAR with long-run relationship can be written as

$$\Delta Z_t = \Pi Z_{t-1} + \Pi_1 \Delta Z_{t-1} + \mu + \varepsilon_t$$

The specification represents model of a vector error-correction (VECM). We estimate the relative importance of each labor adjustment channels in question: price channel (wage adjustment), quantity channel (employment adjustment) and utilization channel (work-hour adjustment). For this empirical analysis, let $\Delta Z_t = (\Delta w_t,\ \Delta n_t,\ \Delta H_t,\ \Delta y_t)$, then the equations that we seek to estimate is as follows:

$$\Delta Z_t = a_{i0} + a_{i1} ECM_{it-1} + \sum_0^T a_{i2}(j)\Delta w_{t-j} + \sum_0^T a_{i3}(j)\Delta n_{t-j} + \sum_0^T a_{i4}(j)\Delta H_{t-j} + \sum_0^T a_{i5}(j)\Delta y_{t-j} + \varepsilon_{it}$$

where $\Delta Z_t = \{\Delta y_t,\ \Delta w_t,\ \Delta n_t,\ \Delta H_t\}$. The possible channels are represented by variables Δw_t Δn_t ΔH_t which are changes in wage, employment and work-hours respectively. Δy_t is change in real demand or real output. ECM represents the long-run relationship among the labor adjustment variables such as wages, employment and work-hours. We estimate system of equation in form of VAR with long-run equilibrium.

It is worth noting macroeconomic relation between aggregate earning and then its possible disaggregate channels of aggregate earnings. The variation in aggregate earning, by definition, can be represented by the sum of changes in wage, employment and work-hour:
$dE_t = \mathrm{a1}^* dw_t + \mathrm{a2}^* dH_t + \mathrm{a3}^* dn_t$. Note that aggregate labor cost can be measured by E=w*L where w is real wage, L is total labor inputs: L=H*n, where n=employees, H=work-hours or utilization of labor.

2. Data

The basic variables used for the empirical analysis in this chapter are real wage (w) constructed by nominal wage divided by the price level, employment (n) measured by the number of employees, hours of work (h), product demand (y) measured by real GDP. The sample period in the study covers the time series observation in Japanese economy between 1970 and 2002. Time series data are quarterly index values, seasonally adjusted with base year of 2002 are collected and take logarithm of those variables to get coefficients in elasticity terms from empirical analysis.

Table 4. Descriptive Statistics

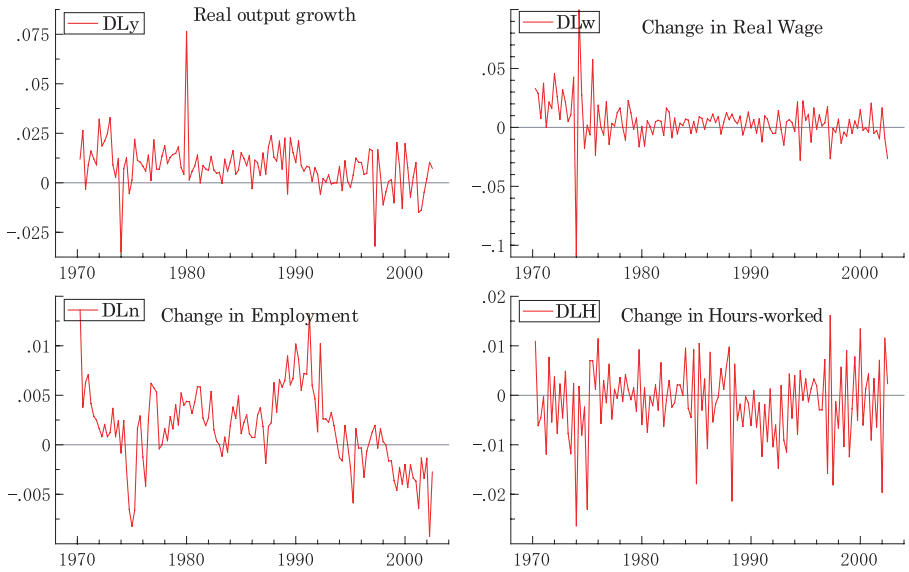
Variables / Statistics	Labor adjustment and Real output			
	Lw	Ln	LH	Ly
Mean	4.461435	4.507056	4.686822	12.792454
Std. Deviationn.	0.148977	0.094086	0.055697	0.335251
Skewness	−1.163219	0.080500	−0.369543	−0.415130
Excess Kurtosis	0.957849	−1.558149	−1.117541	−1.209388
Minimum	3.986518	4.352855	4.582925	12.123732
Maximum	4.640856	4.636669	4.787492	13.198812
Normality Chi^2 (2)	53.306 [0.00]**	33.613 [0.00]**	23.626 [0.00]**	32.893 [0.00]**

Series on employment, hours and wages are from the same sources as aggregate level data. Series on employment, employees are from *Labor Force Survey (Roudouryoku chousa toukei)*, Ministry of Public Management, Home Affairs, Posts and telecommunication. Series on wages (total earnings), hours of work are from *Monthly labor Survey (Maigetsu roudou toukei)* and *Wage Census (Basic Survey on Wage Structure)*, Ministry of health, labor and welfare. Series on price are from *Consumer price Index*, Ministry of Public Management, Home affairs, Post and telecommunications. For measuring changes in aggregate demand, we use data of aggregate demand or output series. Series on output change of each are from "Gross Domestic Product by kind of Economic Activity", in *Annual Report on National Accounts*, Office of Cabinet (Economic Planning Agency). Time Series on output are from SNA Time series for Japanese real GDP for the period of the post WWII: Annual real GDP 1955−2001, where series 1955−1979 is from former SNA68 series and series 1980−2001 is from New SNA95 (H 7) series.

The time series properties of output, employment, real wage and work-hours in both level and the first difference over the sample period of 1970−2002 have differing characteristics of time series data. Wage and employment seem to be dominated by strong trends. Work-hours with a secular decline growth of variables measured by differences of log variables show quiet different behavior from levels.

Our informal assessment is that all variables of interest may reasonably be considered to be I (0). Formal tests for times series properties such as or integration or stationarity of series and relationship among integrated series help us specify the model for the analysis. Regarding stationarity, evidences from the tests based on ADF statistics reveal that all the variables are indeed unambiguously I (1). For long-run relationship for the bivariate case, the estimation of integrated process allows for the possibility of cointegration among variables. However, it needs to determine the number of contegrating relationships that four variables are estimated to produce. The choice is important in that incorporating true number of long-run relationships prevent omitting relevant error correction information or distorting the distribution of the statistics in question. For that purpose, Π is estimated by the maximum likelihood method, proposed by Johansen (1988), that allow us to have formal test for the number

Figure 1. Change in Output, Wages and Labor Adjustment Variables in Japan



of cointegration relationships among sequences of variables[19]. We focus the case that there may be long-run relationship among variables in labor adjustment. That is, we assume that there is at least r relations which are less than m＝4 in our study: rank (Π)＝r＜m. In this case, the small system we consider is non-stationary but there are r cointegrating relationships among the considered variables. The results indicate that we reject the hypothesis of rank＝0, 1, but can not reject hypothesis that rank is 2 or 3, suggesting that there exist two or three long-run relationship among four variables considered in the model. The rank test allows us to use three relationships in the process of the model specification.

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19) It is the properties of the matrix Π that the long-run properties of the system (labor market and the economy) are described. The rank of Π matters. When rank (Π)＝0, the system is non-stationary with no cointegration between the variables. In this case, since Π is the null matrix, the level terms have no effect and a model in first differences is appropriate. This is the only case in which non-stationarity is correctly removed simply by taking the first differences of the variables. If the rank of Π is between zero and m, then there are m*r matrices α and β such that $\Pi = \alpha\beta'$, where α is an (m*r) matrix of ***weights*** and β is an (m*r) matrix of ***parameters*** determining the cointegrating relationships. This means there are r cointegrating vectors et＝β'*Zt, and the system can be written in terms of the errors:

△Zt＝ΣΠi*△Zt-i＋α*et＋ut (**) with feedback or loadings α, which is weights of parameters β. Here, r cointegrating vectors et＝β'*Zt. There could be several possible interpretations regarding this term. one is error correction.

In the absence of any priori theory, there is clearly a problem of identifying the structural relationships from ΠZt－1＝$\alpha\beta$Zt－1, where weights, α＝feedback or loadings. Thus an infinite number of vectors satisfy the cointegrating (reduced rank) restriction. The theory of employment and labor utilization we consider, fortunately, offers identifying restrictions.

3. Estimation and Results

To quantify responeces and their qualitative aspect of economic adjustment with respect to channels of labor adjustment, we estimate the dynamic adjustment model based on VAR specification which allows interaction among adjustment variables we use in the study. Given the estimated values of relative adjustment coefficients, we can measure and identify the rank of responsiveness in terms of *price adjustment* (wage adjustment), *quantity adjustment* (employment adjustment) and *utilization of employment* (work-hour adjustment) toward change in business cycle such as change in product demand.

The structural model formulated was estimated using method developed in conintegartion and dynamic econometrics. The equations below show the model estimated with full information maximum likelihood (FIML) by Johansen (1988). Our model is similar to variation of a multivariate cointegartion model for labor demand but differs in treating real wage as endogenous to identify the flexibility of real wage in the process of labor adjustment.

Table 5 presents estimates of a dynamic relationship among real wages, employment, and work-hours which is consistent with the long-run structure equilibrium in terms of error correction in a cointegrated VAR model. The first and second relations can be interpreted as production and wage relations. The third and fourth relations can represent labor demand relations in dynamic sense, respectively for employment and work-hours.

Table 5. Estimates of the Multivariate Dynamic Adjustment Model by FIML:
Sample period: 1971 (2) to 2002 (3) T = 126

DLy = +0.03006 DLy_1 −0.0792 DLw_1 +0.2923 DLn_1 −0.07363 DLH_1 +
(SE) (0.09935) (0.06639) (0.2924) (0.1489)
0.1113 ECMw_1 −0.1802 ECMn_1 +0.3074 ECMh_1 +0.007365
(0.08587) (0.1313) (0.1761) (0.001346)
sigma = 0.0115788

DLw = +**0.1225** DLy_1 −0.3773 DLw_1 −0.09864 DLn_1 +0.02928 DLH_1
(SE) (0.1477) (0.0987) (0.4346) (0.2213)
−**0.3116** ECMw_1 +0.3708 ECMn_1 +0.1541 ECMh_1 +0.005342
(0.1277) (0.1952) (0.2618) (0.002001)
sigma = 0.0172133

DLn = +**0.05279** DLy_1 −0.03026 DLw_1 +0.6644 DLn_1 −0.03652 DLH_1
(SE) (0.02225) (0.01487) (0.06547) (0.03334)
−0.006836 ECMw_1 −**0.042** ECMn_1 +0.0534 ECMh_1 +0.0001331
(0.01923) (0.0294) (0.03944) (0.0003014)
sigma = 0.00259312

DLH = +**0.06353** DLy_1 +0.04654 DLw_1 −0.3598 DLn_1 −0.4553 DLH_1
(SE) (0.05433) (0.03631) (0.1599) (0.08142)
+0.05097 ECMw_1 −0.2126 ECMn_1 −**0.01085** ECMh_1 −0.002239
(0.04696) (0.0718) (0.09631) (0.000736)
sigma = 0.00633218

Optimization result: Strong convergence (eps1=0.0001, eps2=0.005)
loglik = 2499.9169 log|Omega| = −39.6812 |Omega| = 5.84339e−018

We summarize the estimated responses of wage and labor input adjustment channels by reorganizing estimated coefficients in Table 6 thus to decompose the gross adjustment into both short-run response and long-run of adjustment. Short-run response can be interpreted as temporary or cyclical (or size) response, while long-run response implies permanent adjustment or speed to return to long-run level of the variable. It allows us to measure the extent to which each adjustment variable responds through possible channels. Estimates of relative responses provide us information for explicit comparison among labor adjustment variables with respect to short-run and long-run adjustment, that is, cyclical and permanent adjustment.

Short-run adjustment or size response of each labor adjustment channel is measured by coefficients in the model as $\xi_{iSR} = a_{i5}(1)$, where i=wages(w), employment(n), work-hours(H.). Long-run adjustment or speed response of each channel is measured by coefficients in the model as $\xi_{iLR} = a_{i1}$, i = w, n, H. In order to measure the total responses including cyclical and permanent adjustment, we define 'gross response' as which includes the sum of the absolute value of $\xi_{SR} = \sum_{0}^{i} \xi_{iSR}$ and $\xi_{LR} = \sum_{0}^{i} \xi_{iLR}$. This measure or statistics allows us to distinguish between short-run and long-run adjustments in each adjustment channel. It also gives us implications for both cyclical and permanent responses of each labor adjustment channel in response to change in business cycle.

The larger the value of ξ_{iSR}, the larger the cyclical response, suggesting the relatively larger portion of short-run adjustment in response to change in business cycle measured by real aggregate demand. The larger the value ξ_{iLR}, the higher the speed of adjustment toward the

Table 6. Responses Channels of Japanese Labor Adjustment: Wages, Employment and Work-hours. 1971 (2)−2002 (3)

Responses / Channels	Short-run adjustment [*Size Response*] $\xi_{iSR} = a_{i5}(1)$ (SE)	Long-run adjustment [*Speed Response*] $\xi_{iLR} = \lvert a_{i1} \rvert$ (SE)	Total Adjustment [*Gross Response*] ξ_{iG}
Wages	0.123 (0.148)	0.312 (0.128)	0.435
Employment	0.053 (0.022)	0.042 (0.029)	0.095
Work-Hours	0.064 (0.054)	0.011 (0.096)	0.075
Output	0.03 (0.099)	—	
Aggregate Adjustment	$\sum_{0}^{i} \xi_{iSR} = 0.27$	$\sum_{0}^{i} \xi_{iLR} = 0.365$	$\xi_G = 0.635$

Note (1) Short-run adjustment or size response of each labor adjustment channel is measured by coefficients: $\xi_{iSR} = a_{i5}(1)$, where i = wages(w), employment(n), work-hours(H);
(2) $\xi_{iLR} = a_{i1}$, i=w, n, H is long-run adjustment or speed response of each channel.
(3) Gross response is the sum of the short-run and long-run adjustment. For individual channel, $\xi_{iG} = \xi_{iSR} + \xi_{iLR}$. For the aggregate responses, $\xi_G = \xi_{SR} + \xi_{LR}$, where $\xi_G = \sum_{0}^{i} \xi_{iG}$, $\xi_{SR} = \sum_{0}^{i} \xi_{iSR}$ and $\xi_{LR} = \sum_{0}^{i} \xi_{iLR}$, i=w, n, H.

long-run value of the adjustment variable, implying the relatively larger portion of permanent adjustment in response to business cycle.

4. Dynamic Adjustment between the bubble and the post-bubble periods

Given the prolonged slump in 1990s, it is important to address question whether the flexibility or cyclical behavior of real wage change over time, that is, between the slump period and the previous period. The similar question about whether the degree of employment adjustment change over time is also important to understand the macroeconomic adjustment in Japan.

We empirically examine whether the relative responsiveness of wage and labor inputs (employment and work-hours) has been changed over time between sub-periods of the full period in the study. One sub-period covers the post-bubble and prolonged recession period of

Table 7. Estimates of the Model with sub-sample periods: Dynamic Adjustments

Periods / Dynamic Adjustments	The bubble period (1970s and 1980s)	The Post-Bubble period (1990s and 2000s)
Short-run adjustment [*Size Response*]	$\xi_{iSR} = a_{i5}(1)$ (SE)	
Wage	0.049 (0.20)	0.116 (0.166)
Employment	0.041 (0.02)	0.065 (0.046)
Hour worked	0.073 (0.07)	0.053 (0.086)
Long-run adjustment [*Speed Response*]	$\xi_{iLR} = \lvert a_{i1} \rvert$ (SE)	
Wage	−0.534 (0.16)	−0.802 (0.586)
Employment	−0.098 (0.043)	0.283 (0.174)
Hour worked	0.119 (0.148)	−0.291 (0.14)
Total Adjustment [*Gross Response*]	$\xi_{iG} = \xi_{iSR} + \xi_{iLR}$	
Wage	0.538	0.918
Employment	0.139	0.348
Hour worked	0.192	0.344
Chow Test Statistics	R2 = 0.84 T=75	
LR multiplier		
Wage	−0.383	−0.463
Employment	−0.262	0.629
Hours-worked	0.042	−0.888

Note (1) The high growth period of 1980s covers the period of 1971(2)−1989(4) and the prolonged slump period of 1990s approximately covers 1990(1)−2002(3). (2) Short-run adjustment or size response of each labor adjustment channel is measured by coefficients: $\xi_{iSR} = a_{i5}(1)$, where i= wages(w), employment(n), work-hours(H.); (3) $\xi_{iLR} = a_{i1}$, i=w, n, H. measure the long-run adjustment or speed response of each channel. (4) Gross response is represented by the sum of the short-run and long-run adjustment. For individual channel, $\xi_{iG} = \xi_{iSR} + \xi_{iLR} = a_{i5}(1) + \lvert a_{i1} \rvert$. For the aggregate responses, $\xi_G = \xi_{SR} + \xi_{LR}$, where $\xi_G = \sum_0^i \xi_{iG}$, $\xi_{SR} = \sum_0^i \xi_{iSR}$ and $\xi_{LR} = \sum_0^i \xi_{iLR}$, i=w, n, H.

mainly 1990s while other sub-period covers the high growth and bubble period of 1970s and 1980s.

5. Findings and Interpretations

Some findings from empirical evidences based on estimates of the dynamic model of economic responses with respect to change in business cycles measured by change in product demand could be summarized as follows.

(1) In *short-run* response to business cycles in form of change in product demand, the adjustment has been done mainly via high flexibility of wages. That is, wages are more flexible than input adjustments such as employment and work-hours. The first column in Table 5 shows the estimates of *short-run* elasticity of wage and labor input adjustment. The values of elasticity of wages (0.12) are greater than ones of employment and hours (0.05, 0.06). However, the estimate of elasticity of work-hours shows higher value than one of employment in the short-run adjustment. This implies that adjustment of work-hours play an important role as short-run labor input adjustment through the change in utilization ratio such as reduction of over-time hours and work-sharing. These evidences are consistent with the argument that flexible wages and changes in work-hours are dominant short-run responses with respect to change in product demand in Japan.

(2) In the *long-run* adjustment process, the degree of wage flexibility shows the most dominant role in responses to change in demand, relative to labor input adjustments. An interesting finding is that in the long-run, employment adjustment plays more important role than adjustment via work-hours in Japan. The second column in Table 6 shows estimate of the long-run adjustment of wage, employment and hours. The long-run value of wage elasticity (0.31) is greater than ones of employment and hours (0.04, 0.01). The long-run elasticity value of wage flexibility is greater than the short-run elasticity of wage adjustment (0.31, 0.13).

(3) According to estimates from short- and long-run adjustment, the flexible wages play more important role than employment and hours both in short-run and long-run. This means that price adjustment (wage) is more dominant than quantity adjustment (employment and work-hours) in Japan. However, when we look at labor input adjustment via employment and adjustment through change in work-hours plays relatively more important role in short-run, while adjustment through change in employment is more dominant than work-hours in the long-run adjustment process. This reflects that firms or industry as a whole respond economic fluctuation through long-run and permanent adjustment of employment, while utilization of labor by change in work-hours is used as a short-run response to change in product demand.

(4) *Accumulated dynamic adjustment* can be estimated by *gross* responses which are the sum of short- and long-run elasticity. The third column in Table 6 shows estimated values of gross elasticity. The elasticity of wage is the highest while one of employment is greater than work-hour elasticity. Evidences in accumulated responses indicate that wage is most flexible among

other adjustment variables. Among labor inputs adjustment, employment is more flexible than work-hours in terms gross and accumulated adjustment.

(5) The *gross* labor adjustment responds sensitively to change in aggregate demand. The unit changes in aggregate demand cause 0.64 percentage change over time. The dynamic gross labor adjustment which is defined as sum of wage, employment and hours. The estimated elasticity value of aggregate adjustment shown in lower bottom, the third column at Table 6 is 0.635. This empirical behavior is consistent with dynamic behavior of aggregate earnings in Japan, which is equivalent to behavior of aggregate labor compensation over time.

(6) Empirical evidences regarding labor adjustments of wage, employment and work-hours are consistent with evidences from aggregate earning data by Orazem and Park (2003). The aggregate earning, defined by the sum of wage and labor input adjustments, is changing by 0.64 percentage change in response to the one percentage change in the real shock measured by change in real output.

(7) In order to express the relative contribution in adjustment as ratio, Orazem and Park (2003) suggest a notion of Relative Responses Ratio (RRR). We rearrange estimates of elasticity characterizing the adjustment in terms of wage and labor inputs (employment and work-hours). We decompose the gross response into two responses of adjustment channels: (i) wage adjustment of 68.5, (ii) labor input adjustment of 26.9. The labor input adjustment, defined by the sum of employment and work-hour, can be further decomposed into (iii) employment adjustment of 14.96 and (iv) work-hour adjustment of 11.91.

(8) Gross responses or total adjustment is dominated largely by wage adjustment channel (about 70%) rather than labor input adjustment (about 30%).

(9) One of striking finding is utilization of employment or work-hour is playing a dominant role in labor input adjustment in the short-run which is consistent with the conventional wisdom regarding Japan's labor adjustment. However, evidences about the long-run response, we find that employment adjustment (6.61) is greater than work-hour adjustment (1.73).

(10) The evidences suggest that for input labor adjustment, cyclical adjustment is contributed by work-hour response and permanent or long-run response is realized by adjustment of employment. This implies that, although the adjustment in employment is slow relative to utilization of labor (or work-hour) in the short-run, there is higher degree of the long-run adjustment employment relative to labor utilization (work-hour).

(11) The higher speed of employment adjustment means that there is change in excess labor holding toward the equilibrium or desired level employment. This is related with the notion labor hoarding in Japan. Evidence of higher speed response in employment adjustment implies that there seems some change in labor hoarding by adjusting the excess labor input by changing employment level.

(12) Trend of work-hours seems to show a structural shift over time. This may reflect the fact that the reduction of the work-hour length (average hours worked per week) from 44 hours to 40 hours between 1988 and 1993 has been brought about by the 1988 revision of the Labor Standard Law.

(13) Gross adjustment or total response was done by both short-run response (size response) and long-run adjustment (speed response), but latter response of long-run or speed response (60.3%) was greater than one of size response or short-run adjustment (40.2%). Evidence from aggregate data is supportive to the argument of flexible wage, which implies existence of adjustment cost.

Next question to address is whether adjustment process through flexible wage and rigid employment response has been changed over time. By examining the sub-periods of the full sample in our study, we focus change in dynamic responses between the recession period during 1990s and 2000s and the previous slump period before 1990s in Japan. We draw some empirical findings from estimates of the model with sub-sample period, shown at Table 7.

First, when we compare the short-run adjustments between two periods, the behavior of wage become more flexible in slump period of 1990s than one in the pervious period. The estimate of wage flexibility in the post-bubble period is 0.116, while one in the pervious period is 0.049. This indicates that adjustment through flexible wage also plays a dominant role in adjustment process relative to employment and work-hours adjustments in both sub-periods.

Second, however, during 1990s, the value of the *short-run* elasticity in employment adjustment has been increased from 0.041 to 0.065, while the elasticity value of work-hours decreased from 0.073 to 0.053. This provides an important implication for a significant shift in adjustment response. Rigid adjustment employment during boom period become less rigid and show relatively flexible long-run adjustment of employment. Thus evidence indicates that, during 1990s, as for input adjustments between employment and work-hour, employment adjustment become more dominant than adjustment work-hours in 1990s compared to the previous period.

Third, the *long-run and permanent* responses of all form of adjustment become flexible than in the pervious slump period. The long-run responses of each adjustment variables means adjustment to deviations from disequilibria. Wage adjustment also show higher priority which means adjustment mechanism of flexible wages work well in both short run and long-run.

Fourth, the long-run coefficient value of employment has almost tripled between two period, from 0.098 to 0.283. This indicates that there is the permanent change in employment adjustment during 1990s. The adjustment of employment to deviation from disequilibria is rather sluggish during boom period. However, the estimated values pf employment adjustment during the slump period indicates higher speed to correct disequilibria so that employment adjustment become less sluggish and even more flexible in the long-run perspective. This may reflect structural changes in employment system in Japan after the boom and bubble

period. The relative value of coefficient can be interpreted as the speed of adjustment in terms of error correction which allows over-employment to return to the normal or equilibrium level over time.

Fifth, when we compare the accumulated responses as a gross response as, all forms of adjustment in the slump period have become more flexible than ones in the previous period. Wage adjustment shows highest value of 0.92, labor inputs of employment and work-hours have a similar value of responses, 0.34. Estimates of gross responses indicate that wage and employment in 1990s become more flexible than the pervious period.

In summary, we confirm that not only wage but also employment have become more responsive to economic fluctuation during the lost decade in Japan. When comparing two subsample period, all the channels of adjustment become more flexible during 1990s than ones in the pervious period. However, the coefficient value of employment's adjustment become more flexible in 1990s than rigid one in during the previous period. The large coefficient values of long-run adjustment for all the three adjustments implies that there might be permanent change in channels, due to structural change in wage, employment and work-hours as well as larger cyclical responses during the slump period than during the previous period.

V. Discussion and Research Agenda

Empirical evidences from Japanese aggregate times series in the previous section reflect recent development in Japanese economy and labor section, particularly change in dynamic behaviors of employment and wages. Shift in aggregate adjustments through wage and employment has important implications for macroeconomic stability because the movement of aggregate earnings consists of their composition: wages, employment and work-hours. Evidences from changes in *long-run* responses estimated by error correction coefficients may reflect *structural changes* in Japanese economy, for example, employment system and wage structure since the higher values of error correction term represent the higher speed of adjustment and change in permanent responses. Several facts and features from the recent development in the behavior of Japan's employments and wages in the 1990s can be summarized as follows[20].

First, (*Non-regular employment*) Japanese firms try to achieve their flexibility with regard to employment and wages through the increased use of non-regular employees such as , in particular, part-timers. The portion of non-regular employees has been raised rapidly since the mid 1990s and reached nearly about 30 percent out of Japan's total employees.. See Appendix for Table A.4.

Second, (*Composition of non-regular employment*) In order to seek higher flexibility in labor costs, Japanese firms have become more dependent on non-regular employees. Major portion of non-regular employees come from part-time workers, but the portion of contract workers and temporary workers has increased the larger portion of contract worker-type-non

20) Orazem and Park (2003, p4−5)

regular employees consist of professional and technical workers. This may reflect the effect of the information and communication advances. The high availability of non-regular employment in the external market allowed firms or industry to have the high internal flexibility of employment. Female employment serves as a buffer workforce that provided external flexibility. Japanese women's employment and labor force participation is much more pro-cyclical than Japanese men's, with women typically withdrawing from labor force in recession rather than being counted as unemployed[21].

Third, (*Internal labor market*) it is worth noting one of characteristics of Japanese firm and labor market. Japanese firms had been preferred internal work forces rather than external labor forces when they adjust labor input. In other word, when Japanese firms make decision on adjustments in response to fluctuating demand conditions, firms had heavily relied on internal labor markets. With stable and sizable internal labor market in the firms or in the group of firms, keiretsu, Japanese firms frequently used reallocation or transfer of employees within a firms in the process of employment adjustment. Employment adjustment had mainly done internally through intra- and inter firms transfer or retaining program, often with government financial assistance. This way of adjusting employment allowed Japanese firms to avoid employment adjustment through layoff. Labor hoarding is common and consistent with function of internal labor market in Japan. In this sense, it had been said that the internal labor market dominates the external labor market[22]. Evidences from our finddings for a structural change in employment adjustment during 1990s, implied by higher values of long-run response in employment variable, show that there is high pressure for reliance on internal adjustment that is reflected in comparatively high employment stability in the face of demand fluctuations.

Fourth, (*Wage flexibility and composition of wage: Bonus*) The high flexibility of wages has been largely attributed to the fact that bonus, which is a significant portion of total earnings, are highly flexible. Note that this case seems sustainable the higher degree of flexibility in regular wages. Precisely speaking, it is thus important to *see whether the process of regular wage determination for regular employees has been changed to a more flexible structure than before.* In the 1990s, Japanese firms reduced bonus payments almost constantly. See Appendix Table A.1 and A.2.

However, regular wages during 1990s which is the largest component of total wages have recently become flexible compared to the previous period when there was little flexibility in regular wages. The higher flexibility of regular wages may reflect the fact that the increase in wage flexibility for overall employees is mainly due to the higher portion of non-regular employees because cost for them can be easily adjusted by changing the number of days or hours. See Table A.1., Table A.3., Table A.5. and others if needed

Finally, to improve understanding *structural* adjustment of employment and wages, observation of employment and wages by industry provide how the structural adjustment has been

21) Hamada and Kurosaka (1986, 285−286)
22) Tachibanaki (1987, 652)

influenced in the Japanese economy. This allows us to know behavior of disaggregate economic activities in terms of wage and employment adjustment over time.

References

Abraham and Haltiwanger, "Real Wages and the Business Cycle," *Journal of Economic Literature*, Vol. XXXIII, p. 1215−1264. September 1995.

Abrham, Katharine G. "Job Security and Work Force Adjustment: How Different Are U.S. and Japanese Practices" *Journal of The Japanese and Economies* 3, 1989, 500−521

Ando, A., Demographic Dynamics and the Causes of the Japanese Recession, unpublished mimeo, University of Pennsylvania, 1998.

Bayoumi, T., "The Morning After: Explaining the Slowdown in Japanes Growth in the 1990s," *Journal of International Economics*; 53, April 2001, 241−59.

Hamada, K. and Kurosaka, "Trends in Unemployment, Wages and Productivity: The Case of Japan," *Economica*, 53 (210) 272−296, 1986.

Hashimoto, Masanori "Aspects of Labor Market Adjustments in Japan", *Journal of Labor Economics*, Vol. 11, Issue 1, Part 1, p 139−156.

————, *The Japanese Labor Market in a Comparative Perspective with the United States*, W.E. UPJOHN INSTITUTE for Employment Research Klamazoo, Michigan, 1990

————, "Investments in Employer-Employee Attachments by Japanese and U.S. Workers in Firm of Varying Size" *Journal of the Japanese and International Economies* 3, 1989

Hausman, Susan and Abraham, Katharine, "Female Workers as a Buffer in the Japanese Economy," *American Economic Review*, Vol. 83. No. 2; 45−51

Hamermesh, Daniel S. "Econometric Studies of Demand and Their Application to Policy Analysis", *Human Resources,* Vol 11, No. 4, Fall 1976

Hayashi, F. *Understanding savings: Evidences from the United and Japan*, Cambridge: MIT Press 1997.

Hayashi, F. and Edward Prescott, "The 1990s in Japan: A Lost Decade,"

Johansen, S. "Statistical analysis of cointegrating vectors," *Journal of Economic and Dynamics and Control*. Vol. 12 231−54, 1988.

Flath, D. *The Japanese Economy*, Oxford University Press, 2000.

Kashyap, A and J. Stein, "Monetary Policy and Bank Lending," in G. Mankiw, ed., *Monetary Policy*, University of Chicago Press, 1994, 221−56.

Kiyotaki, N. and West K, "Business Fixed Investment and the Recent Business Cycle in Japan," NBER wp 5546, April 1996.

Krugrman, P., "Its Baaak: Japan's Slump and the Return of the Liquidity Trap, *Brookings Paper* No. 2, 137−205.

Mankiw, Gregory, *Macroeconomics*, 2nd ed. Worth Publishing, 1994, Ch. 11, pp 289−320.

Mincer, Jacob and Yoshio Higuchi, "Wage Structures and Labor Turnover in the United States and Japan" *Journal of the Japanese and international economies* 2, 1988

Motonishi, T. and H. Yoshikawa, "causes of the Long Stagnation of Japan during the 1990s," *Journal of Japanese and International Economics*, 181−200, 1999.

Nakanishi, Yasuo "Dynamic Labor Demand using Error Correction Model" *Applied Economics,* 2001, 33, 783−790

Orazem, Peter and Park, Cheol S. "Labor Adjustments and Wages Flexibility in Japan: Evidences from Macro and Industry Data". Mimeo Working Paper, Department of Economics, Iowa State University, 2003.

Ogawa, Kazuo, "Financial Distress and Employment: The Japanese Case in The 90s", Working Paper, April 2003 http://www.nber.org/paper/w9646

Ogawa, K. and S. Kitasaka, *Asset Markets and Business Cycles* (in Japanese), Nihon Keizai Shinbunsha, 1998.

Ogawa, K. and Kitasaka, S. Bank Lending in Japan: its determinants and Macroeconomic Implications, Mimeo, Osaka University 1998.

Posen, *A Restoring Japan's Economic Growth*. Institute of International Economics, Washington, D. C. 1998.

Prasad, Eswar "Sectoral Shifts and Structural Change in the Japanese Economy: Evidence and Interpretation" *Japan and the World Economy*, 9, 1997, 293−313

Gordon, Robert, "Productivity, Wage, and Prices Inside and Outside of Manufacturing in The US, Japan, and Europe," *European Economic Review* 31, 1987, 685−739

Tachibanaki, Tosiaki "Labor Market Flexibility in Japan in Comparison with Europe and The U. S." *European Economics Review*, Vol 31, No. 3, April 1987

Topel, Robert H "Inventories Layoffs, and the Short-Run Demand for Labor," *American Economic Review* 72 September 1982, p769−787

Rotemberg, Julio and Lawrence Summers, "Labor Hoarding, Inflexible Prices and Procyclical Productivity," NBER WP 2591, May 1988.

Yoshikawa, Hiroshi, *Macroeconomics and Japanese Economy*, Oxford University Press, 1995.

West, K. D., "Sources of Cycles in Japan, 1975 − 1987," *Journal of the Japanese and International Economies*, 6 (1) : 71−98, 1992.

Wescott, R. Assessing the Risks of a Credit Squeeze Among Samll- and Medium-Sized Enterprises in Japan, IMF Staff Country Report, 1992, 96−114.

Appendix

Table A.1. Trends of Employees and Wages by Industry in Japan

(1) Employees—*Labor Force Survey*

annualized % chg.

	81−90	91−95	96−01	98−01
Total	2.0	1.7	0.3	−0.1
Manufacturing	1.4	0.0	−1.6	−2.4
Non-manufacturing	2.2	2.3	0.9	0.6
Construction	0.8	3.3	−0.8	−2.0
Finance, Insurance and Real estate	3.1	0.2	−1.7	−1.6
Transport and communications	0.6	1.5	0.3	−0.2
Wholesale and retail trade	2.4	1.7	0.9	0.6
Services	3.8	3.1	2.5	2.2

(2) Employees—*Monthly Labor Survey*

annualized % chg.

	81−90	91−95	96−01	98−01
Total	3.6	1.8	−0.1	−0.8
Manufacturing	3.9	2.0	0.6	−0.3
Non-manufacturing	3.4	1.8	−0.3	−0.9
Construction	4.7	2.3	−0.9	−1.9
Finance, Insurance and Real estate	4.0	1.8	0.1	−0.8
Transport and communications	3.8	1.5	−0.7	−0.8
Wholesale and retail trade	2.9	1.6	−0.7	−1.6
Services	3.0	1.6	0.2	−0.6

Sources: Ministry of Health, Labor and Welfare, "*Monthly Labor Survey*"; Ministry of Public Management, Home Affairs, Posts and Telecommunications, "*Labor Force Survey*."

Note: 1981−1990 figures are the data for establishments with at least 30 employees, and those after 1990 are for establishments with at least 5 employees.

Table A.2. Trends of Wage Growth Determined by Spring Offensive and Bonus Payments (Summer and Year-end)

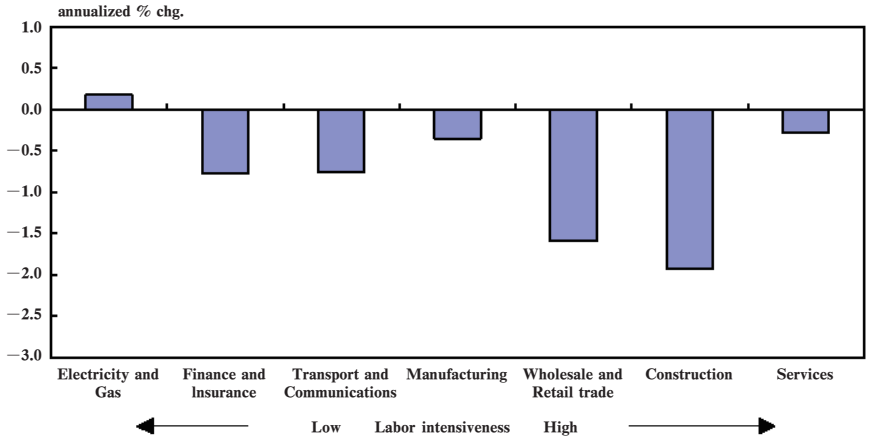
		1970	1980	1997	1998	1999	2000
Wage Increase at Spring Labor Offensive	Major Firms Amount (yen) Ratio (%)	 9,166 18.5	 11,679 6.74	 8,927 2.90	 8,323 2.66	 7,005 2.21	 6,499 2.06
	Small & Medium Firms Amount (yen) Ratio (%)	 7,390 19.9	 10,069 7.38	 6,213 2.63	 5,381 2.24	 4,042 1.67	 3,789 1.56
Bonus Payment (Major firms)	Summer Agreed amt (yen) Increase rate (%)	 138,892 **22.2**	 447,985 **10.3**	 798,340 **2.9**	 810,685 **1.1**	 768,230 **−5.65**	 758,804 **−0.54**
	Year-end Agreed amt (yen) Increase rate (%)	 160,202 **19.2**	 482,672 **8.7**	 848,575 **2.8**	 — —	 801,235 **−4.40**	 799,232 **0.76**

Source: Studies by Labor Relation Bureau, Ministry of Labor.

Notes: (1) Major firms surveyed are, as a rule, those listed in the First Section of the Tokyo Stock Exchange or Osaka Stock Exchange that are capitalized at 2 billion yen or more, have 1,000 or more employees, and have labor unions. The small and medium firms surveyed are approximately 8,000 firms that have fewer than 300 employees and have labor unions. (2) Annual increase rates in lump-sum payments over the previous year were calculated from the increase rates for firms for which the figures from the previous year for the same firm could be compared. Increase rates are not determined by comparison of the agreed increase for the current year with that of the previous year. (3) Complications include NTT and Japan Tabaco incorporated, construction and services from 1987, and the seven JR corporations from 1988.

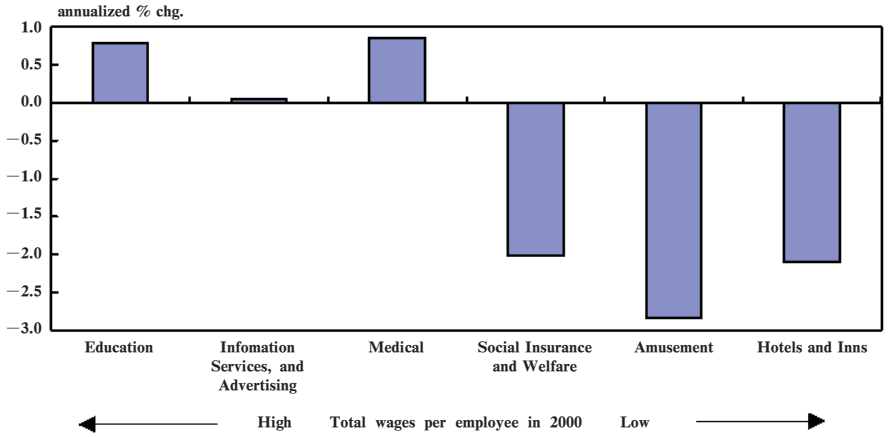
Table A.3. Total Wages and Labor Intensity in Non-Manufacturing

(1) Wages and labor intensiveness (CY98−01 average)



Note: Labor intensiveness = Employed people (SNA basis) by industry/Real GDP by industry
〈Data for CY 1995〉

(2) Wages in the services industry (CY98−01 average)



Sources: Cabinet Office, "*National Accounts*"; Ministry of Health, Labor and Welfare, "Monthly Labor Survey."
Notes: 1. Figures for total wages are data for establishments with at least 5 employees.
2. Figures for total wages per employee are data for CY2000.

Table A.4. Proportion of Non-Regular to Total Employees by Industry

level; mil. persons, ratio: %

	1991		1996		1999		2002	
	Level	Ratio	Level	Ratio	Level	Ratio	Level	Ratio
Total	9.0	19.8	10.4	21.5	12.3	24.9	14.1	28.7
Manufacturing	n.a.	n.a.	2.0	16.4	1.9	16.9	2.1	20.1
Construction	n.a.	n.a.	0.6	13.4	0.7	14.8	0.7	15.9
Transport and Communications	n.a.	n.a.	0.5	13.9	0.6	16.5	0.6	19.5
Wholesale and Retail Trade, Restaurants	n.a.	n.a.	3.7	37.3	4.7	43.2	4.9	45.5
Services	n.a.	n.a.	2.9	22.8	3.6	26.9	4.7	31.2

Sources: Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Special Survey of the Labor Force Survey," "Labor Force Survey."

Notes: 1. Non-regular employees are part-time workers, "*arubaito*," temporary workers, contracted or entrusted workers.

2. Ratio of non-regular employees = non-regular employees/total employees, excluding executives of corporations, in non-agricultural industries *100

3. Figures from 1991 to 1999 are data as of the February of each year and those in 2002 are the averages of the first quarter.

Table A.5. Mobility Across Industry

		Previous industry								
		Agriculture, Forestry and Fisheries	Mining	Construct-ion	Manufact-uring	Transport and Communi-cations	Wholesale and Retail Trade, Restaurants	Finance, Insurance and Real estate	Services	Others
Current industry	Mining	0.0	5.9	0.1	0.1	0.3	0.0	0.1	0.0	0.1
	Construction	11.1	2.9	64.0	5.5	6.1	1.4	3.5	2.8	4.4
	Manufacturing	12.8	38.2	8.0	51.3	9.4	12.3	10.0	9.6	12.2
	Transport and Communications	1.7	14.7	4.6	5.0	52.3	5.0	3.5	4.8	6.6
	Wholesale and Retail Trade, Restaurants	17.2	2.9	9.6	19.2	9.9	57.3	20.6	27.3	21.7
	Finance, Insurance and Real estate	1.7	0.0	2.5	1.7	1.9	2.9	35.4	3.5	5.1
	Services	55.6	32.4	11.2	17.1	20.1	21.0	26.5	51.9	48.7
	Electricity, Gas, Heat Supply and Water	0.0	2.9	0.1	0.1	0.1	0.1	0.1	0.1	1.1
	Total (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note: "Others" is composed of Electricity, Gas, Heat Supply, Water, and Govemment Affairs.
Source: *Survey on Employment Trends*, 1999, Ministry of Health, Labor and Welfare.