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Abstract

In this paper, we survey the theoretical and empirical literature to investigate why nominal wages can be downwardly rigid. Looking back from the 19th century until recently, we first examine the existence and extent of downward nominal wage rigidity (DNWR) for several countries. We find that (1) nominal wages were flexible in the 19th century and first half of the 20th century, but (2) nominal wages were downwardly rigid in almost all industrialized countries in the second half of the 20th century, although (3) the extent of DNWR varied from country to country. Next, we use a behavioral economics framework to explain the reasons for DNWR. We also explain why the existence and extent of DNWR varied between time periods and/or from country to country, focusing on differences in the labor market characteristics (such as labor mobility and employment protection legislation) and in the macroeconomic environment (such as economic growth and inflation), which can alter employees' and firms' perceptions toward nominal wage cuts.

Keywords: Downward nominal wage rigidity; Behavioral economics; Labor mobility; Employment protection legislation; Inflation rate; Indexation
JEL classification: E50, J30, N30, Z13

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I. Introduction

In this paper, we survey the theoretical and empirical literature to investigate why nominal wages can be downwardly rigid even when wage cuts are needed.

Using longitudinal data on individual employees, Kuroda and Yamamoto (2003a, b) show that nominal wages for full-time employees in Japan were downwardly rigid over the period from 1993 to 1998. Kuroda and Yamamoto (2003b), however, also show that Japan's nominal wages have had a small extent of downward rigidity relative to other countries. Furthermore, based on the aggregated data on establishments, Kuroda and Yamamoto (2005) show that downward rigidity in nominal wages for full-time employees was observed until 1997 in Japan, but seemed to disappear after that. What factors can account for these differences in the extent of downward nominal wage rigidity (hereafter, DNWR) between different time periods and/or from country to country?

This paper is organized as follows. In Section II, we first observe a long-term time series data on prices and nominal wages and overview the previous literature on DNWR. We show that the existence and extent of DNWR vary with the era or time period analyzed as well as with the country. Specifically, we show that from the 19th-century to the first half of the 20th century nominal wages were flexible in Japan, the US, and the UK, while in the second half of the 20th century, they were downwardly rigid in many industrialized countries, including the three named above. We also show that the extent of DNWR differed from country to country and that Japan's nominal wages were considerably less rigid than those of other countries. In section III, we consider the reasons why nominal wages can be downwardly rigid. We briefly survey the theoretical research since Keynes (1936), and then apply a behavioral economics framework, which has received considerable attention in recent years, to consider the reasons for DNWR. Lastly, in section IV, we posit a possibility that differences in the existence and extent of DNWR, between time periods and/or from country to country, can be attributed to differences in the labor market characteristics (such as labor mobility and employment protection legislation) and in the macroeconomic environment (such economic growth and inflation), which can alter employees' and firms' perceptions (social norms) toward nominal wage cuts.

II. Times Series and Country Comparison of DNWR

A. Long-term Time Series Data Observations

Were nominal wages downwardly rigid during the past periods of low inflation or deflation? To find out, we look at long-term time series data on the inflation rate and rate of nominal wage change in three countries: Japan, the US, and the UK. [1]

Figure 1 plots the inflation rate and rate of nominal wage change from 1850 until 2003 for those three countries.[2] Several trends common to all three countries are evident from the figure. The first is the movement of the inflation rate and rate of nominal wage change until the mid 20th century. That is, prior to the mid 20th century in the US and the UK, the probabilities for a positive and negative inflation rate seem to be even, and when the inflation rate was negative, so was the rate of nominal wage change. The same trend was also evident in Japan, although somewhat more volatile, and there were several periods prior to the mid 20th century during which the nominal wage change was negative. The second is the disappearance of this trend from the mid 20th century. From the 1960s, in particular, inflation became the normal state in all three countries, and there were virtually no periods in which the nominal wage change was negative.

In sum, as far as can be seen from the long-term time series data, prior to the mid 20th century the inflation rate and rate of nominal wage change fluctuated both above and below zero.[3] These observations suggest that during past periods of low inflation or deflation, there have been periods when nominal wages have been relatively flexible, with no indication of downward rigidity, in Japan, the US, and the UK.

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[1] Because of aggregation bias, it is impossible to accurately gauge whether DNWR exists by observing only changes in the average value of aggregated data on nominal wages. As will be explained later, DNWR is often studied by using data at a lower aggregation level for this reason.

[2] We combine several available statistical series in order to show the long-term time series for each country. One should note that some of the older statistical series may not be as accurate as they are now.

[3] The same observation has been made concerning fluctuations in the inflation rate by De Long and Summers (1986), Nishimura and Teruyama (1990), Bootle (1997), Yoshikawa (2000), and Kitamura (2002).

B. Literature Using Data from the mid-20th-century and Before

The possibility that nominal wages were relatively flexible prior to the mid 20th century was also pointed out by Gordon (1982) and Sachs (1980). Gordon (1982) uses aggregate data from the three countries (Japan, the US, and the UK). He divides the data into two periods, the 19th to the mid 20th century (1873-1940) and the second half of the 20th century (1962-82), and compares the volatility in nominal wage change. He shows that in all three countries, nominal wages were more flexible in the 19th to mid 20th century than they were in the second half of the 20th century. Using long-term time series data from the US, Sachs (1980) compares the flexibility of nominal wages for each business cycle and finds that nominal wages were more flexible in the 19th century to mid 20th century (1890-1930) than they were in the second half of the 20th century (1947-76).

Meanwhile, the literature on nominal wage changes prior to the Second World War includes analysis using nominal wage data disaggregated by occupation and business establishment.[4] For example, using the UK historical nominal wage data of building craftsman, compiled by Brown and Hopkins (1956), Yates (1998) concludes that there was no DNWR in the 19th century since frequent nominal wage cuts were observed.[5]

In the US, there are several papers analyzing establishment data. Hanes and James (2003) use the US nominal wage data disaggregated by business establishment and occupation, and investigate DNWR in the 19th century (1840-91), when there were several periods of low inflation. They statistically test the shape of the nominal wage change distribution using the method proposed by Kahn (1997)[6] and found no DNWR in the 19th century.

There is also research that points to the possibility that nominal wages have gradually lost flexibility over time. Hanes (1993), for example, uses the average daily

[4] One of the reasons for using such data may be that nominal wage data aggregated at the macro level harbors a statistical bias associated with changes in employee attributes.

[5] Yates (1998) notes that his results were consistent with Adam Smith's statement that "the money price of labor rises in the one [year] and sinks in the other."

[6] Kahn's (1997) method is to test significant differences in shape between the nominal wage change distribution during periods of low inflation and the notional distribution estimated based on the data from periods during which the DNWR constraint was not binding.

wage and hourly wage in the US manufacturing industry during the period 1865-1907. He finds that nominal wages were relatively flexible in the 19th century but the flexibility gradually weakened toward the end of that century. Additionally, using data on manufacturing establishments in the US state of Ohio covering 1892-93 and 1901-10, Sundstrom (1990) observes some extent of DNWR in 1893 and that rigidity became even more pronounced after the turn of the century.

Mitchell (1985) examines DNWR in the US from 1929 to 1930, when the great Depression occurred. Using establishment data compiled by the Bureau of Labor Statistics, he finds that a certain percentage of establishments left nominal wages unchanged,[7] but that there was also a fairly high percentage of establishments that cut wages by at least 10 percent. Based on this, he argues that nominal wages in the 1920s and 1930s were fairly flexible compared with the period of low inflation around 1960.

For Japan, Hashimoto (1984) notes that during the recession of the 1920s, when consumer prices declined persistently, changes in nominal wages varied considerably by industry: nominal wages increased consistently in the heavy equipment industry, but fell sharply in other industries, as seen in the wages of female spinning and weaving operators in the cotton industry.[8] He also notes that nominal wages were adjusted downward relatively flexibly in Japan from the start of the Great Depression in 1929 until 1931. More specifically, nominal wages were cut primarily in such light industries as the cotton industry, just as in the 1920s. But, there were also quite a few heavy industry firms that cut nominal wages during this period.[9,10] Furthermore, both

[7] To explain why some business establishments left nominal wages unchanged for the first few years of the Great Depression, O'Brien (1989) cites passages in the memoirs of the US president at that time, Herbert Hoover, that indicates the government had policies regulating wage cuts. A press release dated November 21, 1929 contained the following passage. "The President was authorized by the employers who were present at this morning's conference to state on their individual behalf that they will not initiate any movement for wage reduction, and it was their strong recommendation that this attitude should be pursued by the country as a whole."

[8] Hashimoto's (1984) observations are mostly based on wage data (C-series) from Ohkawa et al (1966), which indicate that wages paid to skilled female spinners and weavers declined by almost 20 percent from their peak in 1922 until 1929. There was also a persistent downward trend in wages paid for skilled labor in other sectors, including lumber/wood products and printing. Some research (Takeda [2002] for example) claims, however, that DNWR was one cause of the recession in the 1920s.

[9] For example, Sumitomo Steel Works stopped giving out special allowances and supplemental pay in 1931, and in the first half of 1931 cut wages by an average of 23 percent year on year. Yokohama Dock cut nominal wages by 10 percent by changing working hours from 1929 to 1932, while Mitsubishi Shipbuilding and Engineering had implemented double-digit reductions in the nominal wages of its

Hashimoto (1984) and Takeda (2002) note that many industries in Japan continued to experience moderate declines in nominal wages from 1932, when employment began to recover following the Great Depression.[11]

The literature on nominal wage changes in Japan during the 1940s is scarce, due in part to the lack of data. Among the few, Odaka (1993) finds that the government intervened aggressively in Japan's nominal wage setting process at the end of the 1930s and in the early 1940s, which laid the foundations for today's annual wage increments system (*teisho*).[12] Considering that customary annual wage increments make nominal wages more prone toward downward rigidity, it is conceivable that Japan's nominal wages may have become less flexible around the end of the 1930s and beginning of the 1940s, when *teisho* was introduced.

In sum, the studies based on the data from the mid 20th century and before show that (1) when comparing the periods before and after the mid 20th century, nominal wages were more flexible and exhibited less downward rigidity before the mid 20th century in Japan, the US, and the UK; (2) nominal wages have become gradually less flexible and become downwardly rigid over time. Care must be taken when

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factory and group heads by 1930. Shibaura Engineering Works implemented measures to cut nominal wages for piece workers by 30 percent in 1930 (Hashimoto, 1984).

[10] Both Nakamura (1971) and Takeda (2002) also find that in Japan in the early 1930s there were many occupations that were subject to nominal wage cuts. The size of these cuts differed based on the employee's gender; Nakamura (1971), for example, finds that the size of the nominal wage cut for female industrial workers was considerably larger than that for male workers. This can be attributed to several factors. Turnover of the female industrial workforce was high and many came from farming backgrounds, and thus their wages were very sensitive to changes in the farming sectors' wages, which were being affected severely by the depression at the time. On the other hand, the average years of service of the male industrial workforce had become fairly stable and quite long at the time, which served to dilute the link between agriculture and the industrial sectors.

[11] According to both Hashimoto (1984) and Takeda (2002), the primary causes of the decline in nominal wages from 1932 may have been that (1) job growth was primarily in the younger age groups, and the resulting change in the age composition of workers pulled the average wage lower, and (2) there was growing use of low-wage production schemes, including hiring temporary workers and outsourcing.

[12] Odaka (1999) notes that the Japanese government issued a directive to freeze nominal wages from September 1939. Subsequently in 1942, however, the Labor Management in Major Enterprises Directive *(Jyuyo Jigyosho Roumu Kanrirei*) mandated a pay raise for all employees once a year and required firms to stipulate three standardized amounts for these raises: maximum, standard, and a minimum. Odaka (1999) states that this was the impetus for establishing the age-based institution of pay raises (*teisho*) that Japan has become known for.

interpreting these results, however, since these prior studies are based on historical data which may have problems in accuracy.

C. The 1970s and Later

Next, we survey the literature that examines the existence of downward nominal wage rigidity using data from the 1970s. The issues over DNWR, along with those over the optimal inflation rate, have been discussed extensively since the 1990s, when many of the industrialized countries experienced low inflation. The pioneering paper on the subject was McLaughlin (1994). Then, a series of papers followed in the US to deal with the problems inherent in the data and testing methods used by McLaughlin (1994). These papers use longitudinal data tracking the same business establishments or individuals with various methods. These were also followed by studies using data from other industrialized countries, such as Canada, European countries, and Japan. Table 1 provides a summary of some of this literature.

As is clear from Table 1, most of the literature using data from the 1970s finds the existence of DNWR. That is, the downward rigidity of nominal wages was a common thread among industrialized countries from the 1970s, regardless of differences in the data, the period or the testing methods.

We also find two important points from Table 1. One is that the extent of downward rigidity varies depending on country analyzed. For example, Altonji and Devereux (2000), Fehr and Götte (2005), and Kuroda and Yamamoto (2003b) use similar methods to examine the extent of DNWR in the US, Switzerland, and Japan, respectively. Comparing the results, nominal wages in Japan exhibited considerably less downward rigidity than those in the US or Switzerland. The data on Switzerland used by Fehr and Götte (2005) include periods of extremely low inflation, just as the data on Japan in Kuroda and Yamamoto (2003b). Thus, it is unlikely that the observed differences in the extent of DNWR were affected by the level of inflation. Furthermore, Knoppik and Beissinger (2004), who applied Kahn's (1997) method to nominal wage data of the 12 euro-zone countries compiled by the same methods for the same period, find considerable differences in the extent of DNWR among countries. What explains these cross-country differences in DNWR?

The other is that the existence of DNWR varies depending on the time period analyzed. Looking at Japan, for example, Kuroda and Yamamoto (2003a, b) observe the existence of DNWR using longitudinal data on individuals from 1993-98, whereas Kuroda and Yamamoto (2005) show its disappearance from 1998 using aggregate data on establishments from 1985-2001.[13]

Why do the existence and extent of DNWR vary depending on the country and time period? In section III, we look to the theoretical literature following Keynes (1936) as well as behavioral economics, which has attracted growing interest recently, in order to discern why nominal wages can become downwardly rigid. Then, in section IV, we give some consideration as to what causes the extent of DNWR to differ between time periods and/or from country to country.

III. Reasons why Nominal Wages can be Downwardly Rigid: A Survey of the Theoretical Literature with a Focus on Prospect Theory

A. Relative Wage Theory

The issue over downward nominal wage rigidity dates back to Keynes (1936). Lord Keynes' point, known as relative wage theory, can be summarized as follows. First, it is relative wages that employees are concerned with, so that during economic downturns their resistance to nominal wage cuts is not really that strong. They do become concerned, however, when they perceive that it is only their wages that are reduced and that their (real) wage are lowered relative to others. This makes it difficult to adjust nominal wages downward over the short run. On the other hand, people should not resist an across-the-board decline in real wages resulting from a rise in the general price level, which affects everyone. Keynes pointed to this in making the argument that the

[13] Kimura and Ueda (2001) find that Japan's nominal wages were downwardly rigid when using data through 1998 from the Ministry of Health, Labor and Welfare's *Basic Survey on Wage Structure*. However, they also find that this DNWR was nowhere to be found when using another data source through the first quarter of 2000 from the *Monthly Labor Survey*, which is published by the same Ministry.

wise policy was to maintain stability in the average level of nominal wages, while adjusting real wages through a rise in prices over the short run.[14]

There is a considerable body of economic theory explaining wage rigidity written in the 1970s and 1980s. These include the *long-term contract theories* found in Fischer (1977a) and Taylor (1979). Both Fischer and Taylor showed that nominal wages become sticky since wage contracts are set for multiple years and those contracts are mostly staggered.[15] *Long-term contract theory* does not explain why nominal wages are rigid only in the downward direction, however. Furthermore, almost every other economic theory explaining wage rigidity addresses the (downward) rigidity of real wages, rather than nominal wages, and thus does not explain why nominal wages are downwardly rigid.[16]

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[14] See Chapter 2, page 14, of Keynes (1936), which says the following. "Since there is imperfect mobility of labour, and wages do not tend to an exact equality of net advantage in different occupations, any individual or group of individuals, who consent to a reduction of money-wages relatively to others, will suffer a relative reduction in real wages, which is a sufficient justification for them to resist it. On the other hand it would be impracticable to resist every reduction of real wages, due to a change in the purchasing-power of money which affects all workers alike; and in fact reductions of real wages arising in this way are not, as a rule, resisted unless they proceed to an extreme degree."

[15] Such a long-term contracts system is said to have been established in the US in the late 1940s. Gordon (1982) notes that because of the frequent strikes that occurred in the US in the 1940s, multi-year contracts became more common as firms attempted to hold down the cost of negotiating wages. He also notes that many of these long-term contracts wound up being indexed to inflation, so that wages were increased when prices increased. For example, in 1948 the UAW (United Auto Workers) and GM (General Motors) agreed on a long-term contract that required a portion of price increases to be passed on to nominal wages as a cost of living adjustment, known as a COLA clause. This was described by GM's president at the time as "buying a long-term contract by offering unions cost-of-living protection." One may anticipate that if this type of wage contract, in which price changes lead directly to nominal wages changes, become widely used, nominal wages would become flexible. In the appendix to this paper, however, we point out the possibility that nominal wages would not become flexible under low inflation or deflation, even if there were an agreement on this type of wage contract.

[16] For example, under the *implicit contract theory* of Azariadis (1975), Stiglitz (1986), and others, real wages stabilize at low levels as a consequence of the transfer of risk from risk-averse employees to risk-neutral firms, thereby creating rigidity of real wages. Akerlof (1980) and Solow (1980) focus on the fairness that people would think about and argue that real wages could be rigid since a reduction of real wages considered unfair by people would harm worker's morale and productivity. Furthermore, Solow (1979) and Yellen (1984) adhere to the *efficiency wage theory* in which real wages become downwardly rigid because of the positive correlation between employee productivity and real wages. The *efficiency wage theory* is justified by the *shirking model* (low wages harm employee morale) of Shapiro and Stiglitz (1984), the *gift-exchange model* (firms offer employees the gift of high wages, in exchange for the gift of high morale and productivity from their employees) of Akerlof (1982, 1984), the *adverse selection model* (low wages will induce skilled employees to quit and make it difficult to hire

As pointed out by Yates (1998), very little theoretical research on DNWR was done, compared with the large body of empirical research. In this regard, the behavioral economics developed by Kahneman and others since the 1980s has received wide attention. It is said that behavioral economics provides a framework whereby DNWR and other seemingly irrational behavior can be rationally explained. Below, we will shed light on how DNWR can be explained using a behavioral economics framework.[17]

Although behavioral economics has garnered considerable attention since Kahneman won the Nobel prize for economics in 2002, it is still at the developmental stage, and thus subject to substantial criticism, particularly on its methodology. For example, surveys are often used in behavioral economics to investigate people's behavioral nature, but these surveys are based on hypothetical events and not necessarily indicative of the behavior that people would follow if that event were actually to occur (Yates [1998] and Howitt [2002]). Another problem that has been pointed out is that it is difficult to generalize the results of a survey targeted at a limited sample, and that the survey results would differ between, for example, a sample of students in the economics department and another sample (see Rubin [2004]). Although this paper explores the reasons for DNWR based on the principles of behavioral economics, one should be aware of the criticisms of, and problems in, this field of economic research.

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new skilled employees) of Weiss (1980), and the *job separation model* (high wages lower the job separation rate and help evade the sunk costs of hiring and job training) of Stiglitz (1974) and Hashimoto and Yu (1980). Summers (1987) marries the *efficiency wage theory* with Keynes' relative wage theory to explain the mechanism by which real wages resist declines and unemployment increases even when there is a negative demand shock, since firms are concerned over a decline in employee morale and therefore tend to emulate wage trends at other firms. As an explanation of why the extent of real wage rigidity varies among countries, Bruno and Sachs (1985) point out institutional differences in the length of wage contracts and the extent to which contract renewal is staggered, as well as differences in the level at which wage bargaining between employees and firms are carried out (at the national, firm, or individual level).

[17] The efficiency wage hypothesis introduced in the previous footnote appears to be similar to the behavioral economics approach to the extent that wages are not lowered because the wage cuts would harm employee morale. However, one major difference is that the efficiency wage hypothesis argues that the *level* of real wages affects employee morale and productivity whereas it is *changes* in (nominal) wages that affect them in the behavioral economics approach.

B. Behavioral Economics and Prospect Theory

1. A brief summary of behavioral economics

Following is a review of the essence of behavioral economics. Behavioral economics, a field studied by Kahneman and others, is mainly represented by two broad frameworks; "heuristics" and "prospect theory." Both are derived from the large number of experiments that have tested the various hypothesis of human behavior. They suggest that in general, people's judgment and decision making under uncertainty may differ from those of the rational agents assumed in neoclassical economics. However, they also find that people's behavior is not totally irrational in the sense that the judgmental biases of people are not completely random, but rather systematic.

"Heuristics" describes how there are certain systematic patterns in people's decision making when they face a problem under uncertainty. Kahneman and others suggest that people do not make perfectly rational judgments based on all of the information that is available, but rather make simpler judgments based on a more confined information set. They note that although this behavioral characteristic may lead to "judgmental biases," those biases are systematic and predictable. In addition, considering the cost of assessing broad classes of information, this behavior can be regarded as bounded-rational. There are several types of heuristics, such as "representativness heuristics (people tend to exaggerate how often a small sample closely resembles the population or underlying probability distribution that generates the sample)" or "availability heuristics (people tend to overuse salient and memorable information from their daily life and rely less on more statistical information)".

"Prospect theory" provides a systematic description of people's tastes, choices or prospects under uncertainty. As explained in more detail below, the essence of prospect theory lies in the properties assumed for the value function of economic agents under uncertainty. In general, neoclassical economics assumes that economic agents have a concave and risk-averse utility function. In prospect theory, people's utility does not depend on the absolute level of the outcome, but rather on the magnitude of change from a certain "reference point." Furthermore, the value function is concave (risk averse) for gains as neoclassical economics assumes, but it is convex for losses (risk seeking). Prospect theory therefore makes it possible to provide a coherent explanation for "anomalies" that are regarded as irrational and difficult to explain with neoclassical economics.

2. Prospect theory (loss aversion, endowment effect, and framing effect)

We briefly explain why nominal wages become downwardly rigid by providing an overview of several survey examples conducted in previous literature. Before moving to specifics, we first explain three key notions of the theory: *loss aversion*, *endowment effect*, and *framing effect*.

a. Loss aversion

Based on numerous experiments, Kahneman and Tversky (1979) propose the notion of *loss aversion*. Loss aversion can be described in the value function $v(x)$ shown in Figure 2. In the figure, the horizontal axis is the outcome x, the vertical axis is the value v, and the point o is the reference point subjectively determined by the economic agent. Under this value function, an economic agent values the outcome x according to what magnitude the outcome deviates from the reference point o. When outcome x is above the reference point and she obtains gains, the value function becomes concave (risk averse), whereas when outcome x is below the reference point and she incurs losses, the value function becomes convex (risk seeking).

Furthermore, as shown in Figure 2, the value of a loss is larger in absolute terms than that of a gain that is of equal distance from the reference point ($v(x_0) < -v(-x_0)$). This reflects the behavioral characteristic of an economic agent[18] in which a marginal loss is felt more deeply than a marginal gain of the same dimension. In prospect theory, this characteristic is called *loss aversion*. In addition, people tend to value the outcome x less as it deviates more from the reference point. This property of a diminishing increase in both gains and losses is called *diminishing sensitivity*.

This value function differs from the traditional expected utility hypotheses of von Neumann and Morgenstern (1944) and Savage (1954) in two respects. First, the economic agent values outcome x based not on an absolute level but rather on distance from the reference point o. Second, the assessment of value based on the reference point differs between gain and loss, and the response to a loss is larger.

[18] For a specific example, the increase in value when gaining $100 is not as great as the decrease in value resulting from losing $100.

b. Endowment effect

Regarding the choice of a reference point, Kahneman and others introduced the concept of *endowment effect* (see Kahneman, Knetsch, and Thaler [1990] for details): once a person comes to possess a good, she immediately values it more than she did before she possessed it.[19] Kahneman and others use this *endowment effect* to explain how an economic agent tends to place her reference point to the level she currently possesses (or the status quo she faces), and to be more averse to losses relative to the reference point.

c. Framing effect

Kahneman and others also found that two logically equivalent statements of a problem could lead an economic agent to choose different options, a concept called the *framing effect*. An example of the framing effect is shown below. As described in the example, people tend to assign different values to two logically equivalent phenomena when the two phenomena are described differently. This is closely related to the idea of *loss aversion* explained above.

d. Example

Below is an example of a survey conducted on about 150 individuals by Tversky and Kahneman (1986).

Survey example 1 (Tversky and Kahneman [1986])

- *Question A*

  Imagine that the U.S. is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the

[19] Kahneman, Knetsch, and Thaler (1990) conducted an experiment with university students. In the experiment, some of the students were given campus mugs (worth about a few dollars) and told to trade the mugs with the other students, including those who did not possess any mugs. The experiment showed that (1) the average price at which the students were willing to sell their mugs was much higher than the average price that other students were willing to pay to receive the mug, and (2) the trading volume was much smaller than the amount that would be expected under neoclassical economics. Based on their result, Kahneman *et al* suggested that economic agents have a tendency to hold onto goods once they possess them.

disease have been proposed. Assume that the exact scientific estimates of the consequences of the programs are as follows:

- *If Program A is adopted, 400 people will die.*
- *If Program B is adopted, there is one-third probability that nobody will die, and two-thirds probability that 600 people will die.*

→ *Answer: Program A=22 percent; Program B= 78 percent.*

In this case, although the survival rate is equivalent in both programs, many people choose the one-third chance of saving all lives in Program B over Program A, which was certain to lose 400 lives. This can be interpreted as showing how people place their reference point at the status quo, where everyone is alive (*endowment effect*), and try to avoid the certain loss of 400 people's lives from that reference point (*loss aversion*).[20]

Meanwhile, a second group of respondents was given the same initial scenario with the following descriptions of their program alternatives.

- *Question A (same as before)*
  - *If Program C is adopted, 200 people will be saved.*
  - *If Program D is adopted, there is a one-third probability that 600 people will be saved and a two-thirds probability that no people will be saved.*

→ *Answer: Program C=72 percent; Program D=28 percent.*

Programs A and C are identical, as are Programs B and D, but more people chose the first alternative, Program C, in the second group, the opposite of what occurred in the first group. The only difference that can explain the different results is that Programs C and D are described in positive terms – "the number of lives saved," whereas Programs A and B are described in negative terms – "the number of lives lost." Since the outcomes were framed in positive terms (gain) in Program C and D, people's

[20] As is shown in Figure 2, the value function is convex (risk seeking) when incurring losses, which is consistent with the result that many people chose Program B.

decisions may not have been affected by their loss aversion behavior. This is a typical example of the *framing effect*.[21]

C. An explanation of downward nominal wage rigidities using the Prospect Theory

Using the prospect theory framework explained above, a consistent explanation of why nominal wages become downwardly rigid becomes possible. Below, we show the behavioral features of both employees and firms by introducing some examples of surveys conducted previously.

1. Why do nominal wages become downwardly rigid?

a. Behavioral features of employees toward changes in nominal wages

Kahneman and others conducted a survey combining the concept of *fairness* with prospect theory to find out why nominal wages become downwardly rigid during a recession. The following survey is from Kahneman, Knetsch, and Thaler (1986).

Survey example 2 (conducted on about 100 individuals)

- *Question B*

  A company is making a small profit. It is located in a community experiencing a recession with substantial unemployment but no inflation. There are many workers anxious to work at the company. The company decides to decrease wages and salaries seven percent this year.

  → *Answer B: Acceptable=38 percent; Unfair=62 percent.*

- *Question C*

  A company is making a small profit. It is located in a community experiencing a recession with substantial unemployment and inflation of 12 percent. There are many workers anxious to work at the company. The company decides to increase salaries only five percent this year.

[21] When pricing goods for sale, a seller finds it better to offer a "cash discount" for not using a credit card rather than charging a credit card surcharge for using one. This can also be regarded as a *framing effect*.

→ *Answer C: Acceptable=78 percent; Unfair=22 percent.*

In both questions, B and C, the firm has decided to lower real wages, after accounting for inflation, by seven percent. The percentage of those responding "acceptable," however, differed greatly. For Question B, only 38 percent of those surveyed thought the wage-setting decision was acceptable, thus showing a strong tendency to resist nominal wage cuts. One interpretation of the result of Question B is that people placed the nominal wage of the preceding year as their reference point (*endowment effect*), considered the nominal wage cut as a loss, and thus felt the firm's wage-setting decision unfair (loss aversion).[22]

In Question C, however, 78 percent thought the decision "acceptable." This is a classic example of the *framing effect*. People viewed the five percent nominal wage increase as a gain from the reference point of the preceding year's nominal wage, even though it was actually a seven percent cut in real wages. In other words, an environment of 12 percent inflation framed a seven percent loss (in real terms) as a five percent gain (in nominal terms) and made many people view the nominal wage cut as acceptable.

This phenomenon in which people tend to think of nominal wages rather than real wages has long been referred to as *money illusion* in neoclassical economics.[23] *Money illusion*, considered an irrational behavior in neoclassical economics, can be explained rationally using prospect theory and its concepts of *loss aversion*, *endowment effect* and *framing effect*.

[22] Shafir, Diamond, and Tversky (1997) state that people tend to use nominal value from the preceding year as a reference point despite understanding the difference between real and nominal values because nominal values provide a more easily understood yardstick over the short run. In addition, the existence of nominal debt may provide one intuitive reason why employees exhibit such behavior. Postlewaite, Samuelson and Silverman (2004) show theoretically that when people commit to consumption at a certain point in the future, such as purchasing a home, they tend to become more risk averse following this "consumption commitment," and this in turn makes them more likely to oppose nominal wage cuts.

[23] On page 271 of Chapter 19 in Keynes (1936), Keynes refers to "…the psychological encouragement likely to be felt from a moderate tendency for money-wages to increase." Tobin (1972), on the other hand, disagrees, stating "An economic theorist can, of course, commit no greater crime than to assume money-illusion."

b. Behavioral features of firms

When employees follow a value function that is loss averse and use the preceding year's nominal wage as a reference point, it is probable that firms also tend to avoid reducing nominal wages.[24] This is because nominal wage cuts lower employee morale and thus cause a decrease in the firm's productivity, both directly and indirectly. If the losses stemming from this productivity decline outweigh the benefits from reducing nominal wages, a firm would hesitate to cut wages.

This was shown through research in Europe and the US based on interviews and surveys of corporate executives and human resource professionals. This research includes surveys of 19 large US firms by Blinder and Choi (1990), 186 US firms by Campbell and Kamlani (1997), over 300 US firms by Bewley (1999), 26 UK firms by Kaufman (1984), and 179 Swiss firms by Agell and Lundborg (1995). Most of this literature, including Blinder and Choi (1990)'s example below, show that firms exhibit an aversion to nominal wage cuts.

Survey example 3 (from Blinder and Choi [1990])

- *Question D*

  Let's say that unemployment in your area rises by 2 percent. One possibility is that you could reduce wages to take advantage of a larger labor supply. For this question, assume that there is no inflation. Do you (as a manager) perceive this as acceptable or unfair?

  → Answer D: Acceptable=5 percent; Unfair =79 percent, Irrelevant=16 percent.

- *Question E*

  The actual inflation rate is currently 4.4 percent, and let's assume that your employees are receiving yearly wage increases of 4.4 percent to keep up with inflation. If unemployment rises by 2 percent, one possibility is that you could reduce the wage increase to take advantage of a larger labor pool. Do you (as a manager) perceive this as acceptable or unfair?

  → Answer E: Acceptable=47 percent; Unfair = 53 percent.

[24] The argument here assumes an imperfect labor market in which nominal wages are set by a bargaining process between firms and employees.

According to Blinder and Choi (1990), many of the interviewed managers perceive a psychological difference between "taking away (the nominal wage cut under zero inflation)" and "not giving (a cut in real wages but an increase in nominal terms under positive inflation)," and thus employers view the former as having a more adverse psychological effect. These results can be also interpreted as demonstrating the framing *effect*.

Bewley (1999)'s interviews are also instructive as to the reasons for this behavior. Roughly 70 percent of the firms surveyed by Bewley (1999) were seriously concerned over a decline in employee morale caused by nominal wage cuts. When asked why this decline in morale was a concern, many of the firms responded that they believed lower morale led to lower productivity. Specifically, they noted that lower morale would not only reduce employee effort and create a moral hazard, but would also raise monitoring costs.

In addition, the decline in employee morale due to nominal wage cuts may also induce competent employees to quit.[25] This could be viewed as an adverse selection problem. Campbell and Kamlani (1997) argue that the most important reason why firms avoid nominal wage cuts is the adverse selection problem. Another result, shown in Blinder and Choi (1990), is that many firms are concerned that nominal wage cuts would not only result in adverse selection as to the employees who quit, but also lead to adverse selection in hiring, in the sense that they would be unable to hire capable workers.

It should be possible to keep competent employees from quitting by only reducing the wages of certain employees rather than implementing across-the-board nominal wage cuts. When Bewley (1999) asked this question, however, many firms indicated a negative attitude toward wage reductions for certain employees, since the feeling of unfairness for these reductions would engender would wind up leading to lower productivity on average.

[25] Blinder and Choi (1990) also note another loss from nominal wage cuts – the sunk costs associated with hiring and training the employees who wind up quitting because of lower morale.

2. Are nominal wage cuts ever accepted?

Are nominal wage cuts always regarded as unfair and never accepted by people? The following survey provides a clue in regards this question. Kahneman, Knetsch, and Thaler (1986) conducted a survey similar to Questions B and C, but positing a change in the firm's profitability in their question:

Survey example 4 (from Kahneman, Knetsch, and Thaler [1986])

- *Question F*

  A small company employs several workers and has been paying them average wages. There is severe unemployment in the area and the company could easily replace its current employees with good workers at a lower wage. The company has been making money. The owners reduce the current workers' wages by five percent.

  → *Answer F: Acceptable=23 percent; Unfair=77 percent.*

- *Question G*

  A small company employs several workers and has been paying them average wages. There is severe unemployment in the area and the company could easily replace its current employees with good workers at a lower wage. The company has been losing money. The owners reduce the current workers' wages by five percent.

  → *Answer G: Acceptable=68 percent; Unfair=32 percent.*

In Question F, a number of people regard a five percent nominal wage cut "unfair." Even in an environment of high unemployment rate, people set their reference point to the current wage level (*endowment effect*) and find it unfair if wages are reduced from that reference level (*loss aversion*).

On the other hand, in Question G, one can see that downward nominal wage rigidity is not a phenomenon that is seen in every situation. Note that the only difference between Question F and G is the firm's profitability. However, this difference leads people to think a five percent nominal wage cut "acceptable." This implies that people have a tendency of *loss aversion*, but they are also capable of

finding a nominal wage cut “fair” and accept it, when their firm experiences a loss and needs to cut costs.

IV. Reasons why the extent of DNWR varies across countries and across time

In section III, we surveyed prospect theory in behavioral economics and examined the reasons why nominal wages could be downwardly rigid. Using prospect theory, one can then explain consistently why nominal wages in Japan were downwardly rigid during 1990s. That is, under near zero inflation, firms were reluctant to cut nominal wages because of concerns over violating workers’ fairness. We assume this happened because it took a certain amount of time for both firms and employees to recognize the deepness of recession. This was partially due to delays in the banks’ disposal of non-performing loans, and thus bankruptcies were uncommon for the first several years after the bubble economy burst in the early 1990s. Furthermore, it was not until the 1990s that the unemployment rate climbed to an unprecedented level and persisted.

As shown in section II, however, DNWR seemed to disappear around the end of the 1990s in Japan. The *extent* of DNWR found in Japan during the 1990s was small compared to that of Switzerland, which experienced a similar period of extremely low inflation and prolonged recession. In addition, a comparison of time series data shows that there was greater downward rigidity after the mid 20th century than before among the industrialized countries. Why does the extent of DNWR vary across countries and across time?

In this section, we discuss the reasons why these differences across countries and across time occur. In Section 4.A., we begin with a look at the reasons why Japan had less DNWR than other countries in the 1990s, primarily by focusing on differences between Japan and the US in labor market characteristics and institutions. In Section 4.B., we consider why there would be variations in DNWR across time within the same country, and also examine why Japan’s nominal wages exhibited no downward rigidity at the end of the 1990s. Our application of the prospect theory framework below is aimed in part at seeking the reasons for these differences.

A. Differences across countries

1. Employee reaction to nominal wage cuts

a. Firm-specific human capital and labor mobility

It is conceivable that differences in the extent of DNWR across countries reflect differences in labor market characteristics. Japan's labor market, in particular, is characterized by such "Japanese employment practices" as seniority-based wages and long-term employment, which might have made Japan's nominal wages in the 1990s less rigid than those of the US or Switzerland.

It is said that since firm-specific human capital through on-the-job training (OJT) is important, seniority-based wages and long-term employment contracts tend to be prevalent in Japan. Under such conditions, it may be hard for an employee who has accumulated firm-specific human capital to find another firm that assigns a high value to that human capital. Thus, if he were to switch jobs he would be forced to accept a large cut in his wages. In other words, a high share of firm-specific human capital leads to a large gap between the nominal wages paid by the current firm and the expected market wage of a job search. In this case, it would be reasonable for this employee not to quit but rather to accept the nominal wage cut to minimize the expected loss, as long as his nominal wage level after the nominal wage cut remains higher than the expected market wage.

The high share of firm-specific human capital in the Japanese labor market has a dampening effect on labor mobility and makes it difficult for job seekers to find a new job. In fact, as shown in Tables 2 and 3, which exhibit labor turnover and the share of long-term unemployed (the greater the incidence of long-term unemployed, the lower the probability of being rehired) for different countries, Japan has less labor mobility and longer periods of unemployment.[26]

This can be also explained within a prospect theory framework. As explained in Figure 2, prospect theory says that people will set their reference point to the previous year's nominal wage and value the current year's wage in terms of the deviation from

[26] The proportion of long-term unemployed is high not only in Japan but also in European countries. Another possible reason for this, in addition to a high share of firm specific human capital, is the presence of generous unemployment insurance in European countries.

that point. In this context, suppose two workers, A and B, who each received the same nominal wage last year, are offered nominal wage cuts as a result of a negative shock that occurred this year. Depending on the share of firm-specific human capital, worker A's expected market wage is assumed to be equivalent to last year's wage, whereas worker B's expected market wage is much lower than his wage last year. Figure 3 illustrates the hypothetical value function of worker A (the solid line; $v_A(x)$) and B (the dashed line; $v_B(x)$), and shows how each worker values the loss that would occur if the nominal wage cuts were accepted.

In this figure, worker B's aversion to nominal wage cuts is relatively less than that of worker A, which means a lower extent of DNWR for worker B. It can be concluded that this difference arises because the disutility of worker B caused by the nominal wage cuts is relatively less than that of worker A. Worker A may be able to maintain his wages at the previous year's level even after switching jobs, whereas worker B's expected market wage may be far below his previous year's wage (or the current year's wage level after the nominal wage cut). Therefore, even when they use the same reference point (the previous year's wage) in the *endowment effect*, the value functions of worker A and B may differ in a way that makes worker B less loss-averse than worker A.

To further support this point, we introduce the results of a survey[27] taken in Japan by Ohtake (2002) to gauge how people choose between accepting a nominal wage cut or possible dismissal. The survey and its results are as follows.

Survey example 5 (from Ohtake [2002])

- *Question H*

  Assume that you are currently employed in a certain firm. The firm's business conditions have worsened, and management is considering two different ways to cope with the situation. Which of the two approaches would you prefer? Please select one of the two choices for each of the following three scenarios, I, II, and III.

  Scenario I) 1. A 5 percent cut in wages for all employees lasting two years.

[27] The survey was conducted in February 2002 on 6000 people, males and females, between 20 and 65 years of age, and had a response rate of 32 percent.

2. A 5 percent reduction in the number of employees through layoffs.

→ *Answers: 1. Wage cut=86.7 percent; 2. Layoffs=13.3 percent.*

Scenario II) 1. A 10 percent cut in wages for all employees lasting two years.

2. A 10 percent reduction in the number of employees through layoffs.

→ *Answers: 1. Wage cut=81.9 percent; 2. Layoffs=18.1 percent.*

Scenario III) 1. A 30 percent cut in wages for all employees lasting two years.

2. A 30 percent reduction in the number of employees through layoffs.

→ *Answers: 1. Wage cut=58.9 percent; 2. Layoffs=41.1 percent.*

These results are consistent with peoples' behavioral characteristics of *loss aversion* explained in Section III, in the sense that a certain number of respondents chose to maintain their wage levels by risking layoff instead of accepting a nominal wage cut. What should be emphasized, however, is that the majority of respondents chose across-the-board nominal wage cuts over layoffs in all three scenarios. This result is consistent with the fourth survey example explained in Section III, as well as with the results of Kuroda and Yamamoto (2003b), which suggest that large nominal wage cuts are possible in Japan when business conditions are serious enough to necessitate layoffs.[28]

Another point worth noting from this survey example is that the proportion of respondents choosing the nominal wage cut becomes smaller as the size of the nominal wage cut increases. The choice between nominal wage cut and layoff is made based on the level of nominal wages after the cut and the expected market wage (which depends on the probability of layoff, the probability of finding a new job, and the nominal wage of the new job) if layoff is chosen. We interpret the relatively larger number of respondents who preferred a 30 percent probability of layoff over a 30

[28] Since no equivalent surveys have been analyzed for other countries, it cannot strictly be shown based on the results of Ohtake's (2002) survey that employees in Japan react differently to wage cuts than do employees in other countries. Furthermore, if the same survey were to be taken under conditions when it is predetermined which employees will be laid off, as under seniority rules in the US, it is possible that the results would be different.

percent nominal wage cut under scenario C as an indication that many people believe the expected market wage would be higher than the wage at the current job after accepting a 30 percent cut.[29]

b. Form of nominal wage payments

The proportion of bonuses to total nominal wages is higher in Japan than in other countries, and this is one possible factor contributing to the smaller extent of DNWR. This can be also explained using *loss aversion*, the *endowment effect*, and the *framing effect* as described in section III. To see this, we look at another result reported by Kahneman, Knetsch, and Thaler (1986).

Survey example 6 (Kahneman, Knetsch, and Thaler [1986])

- *Question I*

  A small company employs several people. The workers' incomes have been about average for the community. In recent months, business for the company has not increased as it had before. The owners reduce the workers' wages by 10 percent for the next year.

  → Answer I: Acceptable=39 percent; Unfair=61 percent.

- *Question J*

  A small company employs several people. The workers have been receiving a 10 percent annual bonus each year and their total incomes have been about average for the community. In recent months, business for the company has not increased as it had before. The owners eliminate the workers' bonus for the year.

  → Answer J: Acceptable=80 percent; Unfair=20 percent.

[29] According to the *Surveys on Working Life (Kinrou Seikatsu ni kansuru Chusa)*, taken in 2001 by The Japan Institute for Labor Policy and Training, approximately 30 percent of respondents in their 20s answered that a wage cut was acceptable to avoid becoming unemployed, whereas about 60 percent of respondents in their 40s and 50s gave that answer. This result suggests that the tendency to tolerate wage cuts to avoid unemployment becomes stronger with age. This tendency may indicate that the value function of people in their 20s is less risk averse, as $v_A(x)$ in Figure 3, than that of people in their 40s and 50s as $v_B(x)$. That is, the younger people accumulate less human capital and have a smaller gap between the expected market wage and the actual wages than the older people, and therefore resist wage cuts more strongly.

Although both questions describe the same situation, that is, a 10 percent reduction in total nominal wages, the difference in how these total nominal wages were framed produced different results. That is, in Question I the previous year's total nominal wages were set as the reference point, and a majority of respondents answered that a 10 percent reduction in total nominal wages from that level was unfair. In contrast, Question J describes the same phenomenon as "a reduction in the bonus that is added to the base salary." Since many people set their reference point to the base salary (excluding bonus) , a majority of people perceived the change not as a loss but as a decrease in gain, and accepted the firm's decision. When such a *framing effect* is made effective by the fact that a bonus is an irregular additional payment, it becomes easier to reduce total nominal wages by cutting the bonus in a country, like Japan, where bonuses account for a relatively high proportion of total wages.[30, 31]

2. Institutionally Driven Firm Behavior

As pointed out by Keynes, Kahneman and others, employees do not continue to stubbornly resist nominal wage cuts when business conditions become very weak. Bewley (1999), based on worker and firm interviews, reports that workers found the cost of gathering information on the deterioration of firm profits small, and that firms found it less likely that employees' morale would decline as a result of nominal wage cuts if they were implemented when the firm was losing money.

Why, then, do US firms prefer layoffs to nominal wage cuts?[32] Bewley (1999) answers the question using the following results. First, because firms can choose to a certain extent which employees to lay off, an adverse selection problem is unlikely to

[30] Another possible interpretation of this survey is that employees were likely to view the decision of no bonus (Question I) as a temporary measure, but view the reduction in total nominal wages (Question J) as permanent, and therefore possibly also affecting the basis for retirement pay.

[31] The interpretation provided here is consistent with the results by Kuroda and Yamamoto (2003a, b), which show empirically that it is relatively easy to adjust labor costs in Japan through bonuses, and that annual earnings including bonuses was less downwardly rigid than regular monthly wages.

[32] Under recessionary conditions, firms have a tendency to reduce overtime working hours before cutting nominal wages or reducing employment (this is also shown by Kuroda and Yamamoto [2005] using Japanese data). Accordingly, we will limit our discussion in this paper to the question of whether adjustments are made to wages or employment once a firm has run out of room to adjust overtime hours worked.

occur. Furthermore, because the relatively more competent employees survive the layoff and the morale of these survivors does not decline, layoffs have the effect of raising the average productivity of employees. Additionally, because layoffs also reduce such fixed costs as fringe benefits, they have a fairly substantial downward effect on labor costs.

A major reason that the morale of remaining employees after the layoff does not decline in the US may be that the order in which employees are laid off is predetermined based on seniority, and thus many employees are not unnecessarily exposed to the job insecurity. In contrast, such US layoff practices do not exist in Japan, and a series of case law accumulated since the end of the Second World War has established a legal regime that places strict limits on the dismissal of employees. It is conceivable that strict employment protection legislation (EPL) provides one possible explanation for Japan's low labor mobility. The greater the firing costs, the more hesitant firms will be in hiring and thus the less mobile the workforce.

Table 4 summarizes the results in OECD (2004), a paper that ranks countries based on the strictness of their EPL. Under this ranking system, the lower the ranking, the more difficult that country makes it for firms to dismiss employees. Japan, which has a small extent of DNWR, ranks number 22 out of the 28 OECD countries in difficulty of dismissal, whereas the US and Switzerland, both of which have a relatively large extent of DNWR, rank at the top. That is, one can interpret the results in OECD (2004) as showing that Japanese firms have limited discretionary ability to dismiss employees and therefore need to cut wages in order to reduce labor costs. In fact, looking back at Japan's experience in the 1990s, there were numerous examples of workers and firms coordinating and implementing nominal wage cuts in exchange for maintaining job security.

This is also consistent with Kuroda and Yamamoto (2003a, b), which showed that in contrast with the partial downward rigidity of nominal wages for Japan's full-time employees, the hourly wages of part-time employees were almost perfectly rigid downward. In Japan, the jobs of full-time employees are generously protected by EPL, but part-time employees can have their employment contracts terminated once the

contractual period expires.[33] This makes it easy for firms to cut surplus part-time employees, and may bring nearly perfect downward rigidity to the hourly wages of part-time employees who have effectively been continuously employed.[34, 35]

As assumed in the *insider-outsider theory*, however, when employment is strictly protected by legislation, workers' bargaining power is increased and wages are raised above the level that clears the labor market (see Holden [1994, 2004], for example). As stated in Holden (1994), this phenomenon may be related to the tendency among those countries who adopt strict EPL to also prohibit by law unilateral nominal wage cuts by firms. One of the reasons why many European countries adopt strict EPL and at the same time prohibit unilateral nominal wage cuts is that if the law allowed firms to cut nominal wages without the employee's consent, the firm could encourage an employee to quit by implementing a huge nominal wage cut. This could be interpreted as an indirect dismissal, which goes against the spirit of job security.[36]

[33] This can be also seen from the fact that Japan's ranking rises up to number 12 if we focus on overall EPL strictness, which is based on a weighted average of EPL for regular employees and for part-time employees, as shown in Table 4.

[34] As also pointed out by Gordon (1982), another reason that Japan has less wage rigidity is the fact that in general the term of wage contracts for full-time employees is one year, which is shorter than many other countries. As noted earlier, wage contracts in the US often cover multiple years, making it impossible for firms to cut wages even if they suffer a negative shock during the contract period. This is in contrast to Japan, where the annual "*Shunto* (spring offensive)" presents an opportunity for wage negotiations between workers and firms every year. We believe this greater frequency of opportunity to renew wages contributes to nominal wage flexibility in Japan. It is important to keep in mind, however, that differences in the wage contract period explain nominal wage rigidity in not only the downward direction but in the upward direction, as well.

[35] Another possible reason for the downward rigidity of wages is the existence of labor unions. Nevertheless, although Japan's labor unionization rate has been in a declining trend over the years, it is still not low when compared to the US or Switzerland, and this suggests that the extent of DNWR cannot be explained by the unionization rate.

[36] In principle, the worsening of working conditions without the consent of workers is prohibited by law in Japan as well. However, a number of case laws have approved of firms' unilateral deterioration of working condition including wage cuts, for the purpose of protecting the employment, when courts find the situation necessary and reasonable, even after taking account of the deterioration of working conditions.

B. Differences across time

We described above the possibility of explaining the extent of DNWR with labor market characteristics and other institutional differences. We turn now to the reasons why DNWR appears and disappears within the same country depending on the time period of observation.

As explained in Section III.C., employees are capable of accepting a nominal wage cut when their firm experiences a loss and needs to cut labor costs. Is it possible to interpret the disappearance of DNWR in Japan from the end of the 1990s as the result of macroeconomic conditions such as recession, low inflation, and deflation altering how both employees and firms view nominal wage cuts? Or was this only a large, one-time adjustment in response to a huge negative shock, with no real change in peoples' loss aversion in respect to nominal wage cuts?

Hanes and James (2003) state that the DNWR observed in most industrialized countries later in the 20th century "reflects employers' fear of damaging employee 'morale' by violating social norms and concepts of fairness" and does not reflect "a fundamental preference on the part of workers" as argued by Shafir, Diamond and Tversky (1997) and Akerlof, Dickens, and Perry (1996).[37]

In other words, there is a possibility that the social norm that "nominal wage cuts should be rare" had been established in the latter half of the 20th century as a result of a persistent positive inflation under which there was no need to cut nominal wages. Under such an environment, a nominal wage cut can be regarded as "unfair" by workers and thus firms, who fear damaging employees' morale, would not immediately cut nominal wages, resulting in nominal wages becoming downwardly rigid.

Social norms can change over time, however. Thus, it may be possible that a social norm that is tolerant of nominal wage cuts could be established, depending on the economic environment. As we saw in section II, Figure 1 shows the high volatility of prices observed prior to the mid 20th century in comparison with later, as well as the

[37] As explained in section II using Figure 1, judging from the long-term time series data on Japan, the US, and the UK, nominal wages appear to have been flexible from the 19th-century until the mid-20th-century. This observation is contrary to Shafir, Diamond, and Tversky (1997) and Akerlof, Dickens and Perry (1996), both of which argued that DNWR is permanent phenomenon reflecting fundamental preferences of workers.

frequent reductions in nominal wages that accompanied these swings in prices. Under such conditions, employees' resistance to nominal wage cuts and the extent of DNWR may have been weak. To put this in the framework of prospect theory, the increase in people's disutility associated with the nominal wage cut might be relatively small because the social norm that "nominal wage cuts should be rare" was not formed prior to the mid 20th century. And the shape of the value function at that time might have followed the $v_B(x)$ rather than the $v_A(x)$ in Figure 3.[38]

How, then, should one interpret the disappearance of DNWR in Japan at the end of the 1990s? One possibility is that, because of prolonged recession, people's aversion to nominal wage cuts gradually weakened along with steady erosion of the social norm that "nominal wage cuts should be rare." Using a prospect-theory framework, the prolonged recession following the bursting of the bubble changed the shape of people's values function from $v_A(x)$ to $v_B(x)$ and gradually diluted their resistance to nominal wage cuts around the end of the 1990s.

There is a possibility that, as deflation became more entrenched and nominal wage cuts started to occur, people's perceptions changed gradually to accommodate nominal wage cuts. The survey taken by Ohtake (2002) noted above may not have produced the same results if it had been taken immediately following the bursting of the bubble rather than in 2002, by which time the recession had deepened considerably. In fact, looking back at the period from the bursting of the bubble until the late 1990s in Japan, employees tended to think of nominal wage cuts as out of the question, and would not even have approved of a freeze in base pay.[39] Since 2000, however, some unions actually proposed lower wages than the previous year in the opening round of bonus negotiations, according to data compiled by the Japanese Trade Union Confederation (*Rengo*). This suggests the possibility that with the recession becoming

[38] In addition, when prices and nominal wages are volatile, there is a possibility that the reference point becomes the real wage or the average value of nominal wage over the past several years, rather than the nominal wage of the previous year.

[39] In August 1998, the Secretary General of the Japanese Trade Union Confederation commented that labor unions shall think about a freeze of base pay, but many industry-specific labor unions were strongly opposed to the idea. Until the bubble burst in the early 1990s, base pay increases were a common practice in Japan for decades.

even more serious, employees changed their attitudes to recognize the inevitability of nominal wage cuts.[40]

Furthermore, Japan's unemployment rate rose persistently in the late 1990s to reach historic highs, while the mass media reported frequently on corporate restructuring. Under this environment, there is a possibility that employees began to consider unemployment as more imminent and overestimated the risk of losing their job. In other words, even if the risk of dismissal was actually small, employees may have become more amenable to nominal wage cuts so as to avoid dismissal. Considering that Japan's unemployment rate had remained low and that employment adjustments were normally small up until the late 1990s, there is also a possibility that people became overly sensitive to the rapid increase in unemployment and became more risk averse, thereby further weakening their resistance to nominal wage cuts in the late 1990s.[41]

On the other hand, there is another way to view the disappearance of DNWR in Japan from the end of the 1990s, suggested by Kuroda and Yamamoto (2005), which is as a large, one-time adjustment in response to a huge negative shock. In other words, the social norm that "nominal wage cuts should be rare" remained in place and the shape of value functions was unchanged, but the nominal wage reductions at the end of

[40] Until recently, many firms have taken the approach of adjusting bonuses or reducing wages for a limited period of time without actually changing wage schedules. In 2002, however, changes in management's stance seemed to occur. For example, Nippon Keidanren issued this statement in 2002: "Maintaining and strengthening competitiveness precludes any further rise in nominal wage levels, and increasing base wage levels is out of the question. Freezing or reviewing the annual wage increment in line with reforming wage systems is another issue that could come up for discussion." Therefore, there is a possibility in the future that drastic reform of the wage system, agreed upon by both labor and management, would occur which imparts flexibility to nominal wages.

[41] Prospect theory suggests that economic agents use their own subjective probability $\pi(p)$ for the outcome with probability p, when they are forced to render a judgment. Specifically, the theory says that when probability p is low but not negligible, $\pi(p)$ is overestimated, and that the risk is more likely to be taken if it is for a gain, but more likely to be avoided if it is for a loss. This type of behavior is frequently seen when taking out insurance. For example, the probability of having an automobile accident is low but not negligible, and thus there is a tendency to overestimate this probability. In such case, many people will exhibit the risk-averse behavior of taking out automobile insurance in order to prepare for the unlikely event of an accident. This can be restated in terms of the risk of job loss: if a company's earnings deteriorate to the point where either dismissal or a wage cut is unavoidable and a person feels exposed to the risk of job loss at more than a negligible probability, then many people will bear the small price of an insurance premium (wage cut) in order to avoid a major loss (unemployment).

the 1990s were implemented as exceptional measures to avoid crisis in the face of sustained recession.

Accordingly, the reason for the nominal wage cuts at the end of the 1990s differs depending on whether the social norm that "nominal wage cuts should be rare" is thought to have disappeared at the end of the 1990s or to have remained in place. A closer examination of this question has important implications for monetary policy. That is, the assumption that the social norm has disappeared implies that the Japanese economy has been freed from the DNWR constraint, whereas if the social norm is assumed to remain in place, the implication is that nominal wages cannot always be flexibly adjusted downward every time there is a recession in Japan.

In order to evaluate the nominal wage cuts observed at the end of the 1990s, however, there is a need to wait for further data to accumulate. It is also important to be aware that, given the difficulty of using data to answer whether the social norm that "nominal wage cuts should be rare" does or does not remain in place, a statistical test of the two alternatives would also be difficult. For this reason, we do not seek here to judge which is correct, but rather to merely state that there are two viewpoints on this issue.

V. Conclusion

Why do nominal wages become downwardly rigid? We proposed an answer to this question based on a survey of the theoretical and empirical research.

This paper can be summarized as follows. First, in section II, we looked at long-term time series data on prices and nominal wages to examine the downward rigidity of nominal wages from the 19th-century until recently in several different countries, and found the following three results. (1) There is a possibility that in three countries, Japan, the US, and the UK, nominal wages from the 19th century until the mid 20th century were more flexible than they were in the late 20th century and exhibited no downward rigidity. (2) In the late 20th century, nominal wages in general were downwardly rigid in all of the industrialized countries. (3) In the late 20th

century, the extent of DNWR varied across countries, and Japan had less downward rigidity than other countries.

Second, we addressed in section III the question of why nominal wages were downwardly rigid by summarizing the theoretical literature and by presenting specific examples from behavioral economics, a field that has attracted considerable attention in recent years. The behavioral economics literature has shown that (1) people value outcomes based on their distance from a reference point rather than on an absolute measure, and (2) gains and losses from this reference point are valued differently, with losses evoking a stronger reaction (an indication of loss-averse behavior). This framework makes it possible to provide a rational explanation for why nominal wages exhibit downward rigidity: people use their most recently received nominal wage as a reference point and strongly resist any declines below that nominal wage level. We also noted, however, that people are also capable of finding a nominal wage cut "fair" and accepting it, under a situation in which their firm experiences a loss and needs to cut costs.

Finally, in section IV, given the explanation of these characteristics based on behavioral economics, we considered the reasons why there are differences in both the existence and extent of DNWR between time periods and/or from country to country. We showed that differences in labor market characteristics (including level of labor mobility and employment protection legislation) and in macroeconomic variables (such as economic growth and inflation rates) could lead to differences in how employees and firms perceive nominal wage cuts (social norms), which may alter the existence and extent of DNWR.

Appendix: The Relationship between DNWR and Indexation

As explained in the main text, one reason for DNWR is people's behavioral tendency to value the current year's nominal wage using the previous year's nominal wage as a reference point. If wage contracts are price indexed, however, nominal wages could be more flexible even when employees exhibit such a behavioral tendency. Why is indexation not widely used in wage contracts nowadays? In this appendix, we survey the history and the basic scheme of indexation, and consider why indexation has not become more widespread.

A. The History of Indexation

Indexation is a way to link the amount of future nominal payments to the price level when forming a wage or loan contract, thereby maintaining the real purchasing power of the nominal amounts to be paid. As shown theoretically by Gray (1976) and Fischer (1977b), indexation has the advantage of minimizing fluctuations in output when nominal shocks occur.[42] Accordingly, the indexation of nominal contracts has been recommended by many economists for more than a century, including Lowe (1822) and Jevons (1875), and more recently Tobin (1971), Friedman (1974), Fischer (1986), Bodie (1990), and Shiller (1997).

As far as the industrialized countries are concerned, however, the indexation of nominal contracts has not been used as widely as recommended by economists.[43] For example, the use of indexation in nominal contracts in Japan is limited to public pensions, where indexation was introduced in 1973, and to the inflation-linked Japanese government bonds (JGBs), which were first issued in March 2004.[44] In the US, as well, there are some examples of nominal contracts tied to price indices, including

[42] As will be explained later, it is important to keep in mind that one disadvantage of indexation is that it makes adjustments to real shocks more difficult and thereby lowers economic welfare.

[43] An exception to this is the inflation-linked bonds that have become prevalent in the UK. According to the *Debt and Reserves Management Report 2005-06*, inflation-linked bonds (index-linked gilts) accounted for approximately 23 percent of the total government bond issuance as of the end of December 2004. For research on indexation in the UK, see Liesner and King (1975).

[44] The total issuance of inflation-linked JGBs as of the end of fiscal year 2004 was 900 billion yen, less than 1 percent of the total amount of JGBs outstanding.

social security pensions from 1975, Treasury Inflation-Protected Securities (TIPS), which were first issued in 1997, and a portion of wage contracts. TIPS, however, only accounted for about four percent of the total US treasury bonds outstanding at the end of June 2005, and the percentage of wage contracts indexed to prices has declined in recent years to about 20 percent.

Although the prevalence of indexation in nominal wage contracts has declined in recent years in the US, over 60 percent of wage contracts were indexed between the mid 1970s and the mid 1980s.[45] Below, we review the US experience with nominal wage indexation to consider the extent to which such indexation can contribute to increasing the flexibility of nominal wages.

B. Indexation of Nominal Wages: Examples of Wage Contracts in the US

1. Indexation Schemes and the Downward Rigidity of Nominal Wages

In the US, nominal wages are indexed by adding a COLA (cost-of-living allowance or cost-of-living adjustment) clause to the wage contract. When the wage contract has a COLA clause, an allowance equivalent to the increase in the CPI is added to the amount of wages paid in order to compensate for the decline in real wages caused by inflation. Consequently, if the COLA fully compensates for the inflation rate, the real wages of employees become independent of inflation.

Nevertheless, even if nominal wages are indexed to prices through COLA, a wage increase is not always 100-percent indexed to inflation. For example, Vroman (1985) uses US data covering 1968-80 to compare the COLA actually paid to the inflation rate, and found that the COLA corresponded to only about 60 percent of the inflation rate. Bauman (1991) also showed that the COLA amounted to slightly under 50 percent of the inflation rate in the US in 1990.[46] Thus, the data from the US appears to indicate

[45] Shiller (1997) noted that in the US, the indexing of nominal wages to prices was widespread during the First World War, declined during the period of stable prices in the 1920s, and then became more common again during the period of high inflation in the 1970s.

[46] In other research, COLA as a fraction of the inflation rate was shown to be 0.49 by Douty (1975) and 0.48 by Sheifer (1979) in the United States.

that even when wage contracts included COLA clauses, the indexation of nominal wages was not complete and nominal wages exhibited some rigidity.

Potential reasons for this include the presence of various restrictions within the COLA clause on the amount of COLA payments and the use of a reference inflation rate from a different time period. For example, Vroman (1985) showed that in many COLA clauses, caps on the amount of COLA were established[47] or COLA was not paid until the inflation rate exceeded a given threshold. Another reason, shown by Jadresic (2002), is that the COLA is indexed to the inflation rate of the previous period, rather than the current period.

The lack of a perfect linkage between nominal wage increases and the inflation rate even when there is COLA protection can also be attributed to the fact that if nominal wages were perfectly indexed to prices, firms would lose their ability to adjust real wages in response to real shocks such as supply and technology shocks. Although nominal wage indexation has the advantage of preventing nominal shocks from affecting real wages, it has the disadvantage of allowing real shocks to have a major impact on corporate profits, output, and employment. For example, if prices of goods increase in response to a negative supply shock, the entire increase in goods prices would have to be reflected in a nominal wage increase under full nominal wage indexation. This would make it impossible for firms to lower their real wages and lead to declines in corporate profits as well as cutbacks in both production and employment.[48]

This lack of full indexation of nominal wages to prices in COLA agreements in the US can be attributed to recognition by both labor and management of these disadvantages to indexation and the need to leave firms with some room to adjust real

[47] Card (1983) analyzed COLA clauses in Canada over 1968-75 and found that 30 percent of the agreements capped the amount of COLA and in 90 percent of those the cap was reached.

[48] Indexing nominal wages ensures the flexibility of nominal wages but causes rigidity of real wages. Accordingly, as shown by Friedman (1974), Gray (1976), and Fischer (1977b), indexation can only achieve macroeconomic stability when nominal shocks are more prevalent than real shocks. For example, in Brazil during the 1960s and early 1970s, when nominal shocks led to persistently high inflation, it is understood that the indexation of nominal wages and government bonds led to high rates of economic growth by suppressing capital outflows and encouraging the accumulation of savings and capital (see, for example, Dornbusch, 1997). During the two oil shocks in the 1970s following that, the countries where the indexation of nominal wages was more common were less able to adjust real wages, and experienced more serious stagflation (for details, see Bruno and Sachs [1985]).

wages in response to real shocks. Regarding this point, Shiller (1997), a proponent of making greater use of indexation, noted the possibility that "the aversion to wage indexation currently expressed by firms when negotiating with labor might be interpreted as a recognition of the importance of applying a little 'grease' to the wheels of the labor market. Some obfuscation of the stark realities may help people to accept changes in real income more easily."

2. The Relation between Indexation and the Inflation Rate

Figure A-1 plots the percentage of employees covered by COLA agreements (the COLA coverage rate) at US firms with at least 1,000 employees and the rate of inflation. As seen in the figure, indexation has been widely used only during periods of relatively high inflation. It is evident that the COLA coverage rate was high from the mid 1970s until the mid 1980s, when inflation was high, but low during other periods. Between 1968 and 1995, the correlation between the COLA coverage rate and the inflation rate was high at 0.66.

One conceivable reason that the incidence of nominal wage indexation based on COLA clauses declines as the inflation rate gets lower is that the need for nominal wage indexation under low inflation becomes small because volatility in the inflation rate is small.[49] Since there is greater inflation uncertainty during periods of high inflation, employees may use nominal wage indexation to protect against reductions in real wage brought by unexpected inflation.[50] Under low inflation, however, nominal shocks are less likely to occur, and therefore there is little need for nominal wage indexation. In this case, it is easier for firms to respond to real shocks if they do not adopt nominal wage indexation.

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[49] Since this positive correlation between the level of inflation and uncertainty was pointed out by Okun (1971) and Friedman (1977), there has been considerable empirical research on the subject, including Cecchetti (1987) and Evans (1991), as well theoretical treatment by Logue and Willet (1976), Ball (1992), and others.

[50] Danziger (1984) showed theoretically how inflation uncertainty increases the uncertainty of real wages and thus encourages the indexation of nominal wages. There is also research, including Fischer and Summers (1989) and Ball and Cecchetti (1991), arguing that the causal relationship is one in which the greater use of nominal wage indexing lowers the costs of inflation and thereby raises the inflation rate. Regarding this point, Holland (1995) uses US data from 1957 to 1990 to prove that the COLA coverage rate did not Granger-cause inflation.

There are several studies that support the above argument. For example, Hendricks and Kahn (1983) analyzed 5,570 wage contracts at US manufacturing firms during the period 1969-81 and found a positive correlation between the COLA coverage rate and inflation uncertainty. Likewise, as shown by Holland (1986), there was a positive correlation between the COLA coverage rate and inflation uncertainty in the prior year using US data from 1961-83.

C. Indexation under Deflation

Considering that nominal wage indexation is unlikely to be widely used under low inflation, it also seems unlikely that the indexation can be a tool to enhance the flexibility of nominal wages under deflationary periods, when DNWR becomes a more serious problem. Below, we examine this point based on the experience in Japan and the US.

First, drawing once again on the US experience, Fisher (1934) showed that nominal wage indexation was not common during the deflation of the Great Depression. Furthermore, as explained by Bauman (1991) in a discussion of the design of COLA clauses in the US, COLA clauses often only addressed payments to cover declines in real wages caused by inflation, without applying under deflationary conditions. In other words, COLA agreements in the US would not automatically lower nominal wages under deflation. This feature can also be observed in the structure of US TIPS. Even if deflation occurs and the adjusted principal decreases below the security's original principal, the US treasury guarantees payment of the original principal. In other words, US TIPS are structured asymmetrically in the sense that real values are guaranteed against inflation but nominal values are guaranteed against deflation.

Second, in Japan's recent experience with deflation, we found no examples of wage contracts with indexation provisions as in the US. Nevertheless, even in Japan, the rate of inflation has been a critical determinant of labor-management wage negotiations, particularly in the 1970s. Figure A-2 shows the proportion of firms that used the price trend (inflation) as an important determinant of wage change. During the 1970s, approximately 60 percent of firms considered price trends important and approximately 10 percent of firms considered the price trend the most important. This

suggests that a considerable number of firms indexed nominal wages to inflation during the 1970s in practice, even though this indexation was not expressly written into wage contracts. As the inflation rate declined, however, so did the proportion of firms placing importance on the price trend when setting wages, and under the mild deflation of recent years, in particular, this proportion fell below 10 percent. This suggests that very few firms lowered nominal wages solely because of deflation, and that under deflation, nominal wages tend to be determined based on factors other than the price trend.[51, 52]

Further evidence that indexation is difficult to implement under deflation can be found by looking at developments in the indexation of public pensions in Japan. When Japan's pension system was reformed in 1973, an indexation formula was introduced. Under the formula, pension benefits were indexed to the CPI of the previous year, such that if the prior years' CPI growth rate was three percent, pension benefits would be increased by three percent for that fiscal year. Since the prior year's CPI growth rate has been negative since the year 2000, the amount of benefits should have declined from the previous year under this indexation scheme. As it turned out, however, strong resistance from pensioners led to the exceptional step of freezing indexation from FY2000 until FY2002. Without this freeze, pension benefits would have declined by 0.3 percent in FY2000, 0.7 percent in FY2001, and 0.7 percent in FY2002, which corresponds to a cumulative three-year decrease of 1.7 percent.[53] That is, even though pension benefits were indexed to prices, social norms dictated that pension benefits should not be reduced, and a strong aversion to reductions among pensioners led to a freeze on indexation.

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[51] Important factors to firms when setting wages, in addition to the price trend, include corporate earnings and market trends in wage increases. Of these, the greatest proportion of firms place importance on corporate earnings when setting wages, and this proportion has increased in recent years.

[52] There is a possibility, however, that when deflation becomes severe, the price trend may become a determinant of nominal wages.

[53] The indexation of public pensions was reintroduced from fiscal year 2003, and public pension benefits were reduced by 0.9 percent in fiscal year 2003 and by 0.3 percent in fiscal year 2004, but the adjustments that were foregone during the three prior years have yet to be applied.

Although this example from the public pension system cannot be directly applied to the debate over the indexation of nominal wages,[54] it does suggest the possibility that even though people accept nominal wage indexation under inflation, they are not necessarily going to support it under deflationary conditions.

In this appendix, we summarized the arguments concerning the indexation of nominal wages, and showed that even when nominal wages are indexed, they do not always assure perfect flexibility. We also showed that indexation tends to be adopted only when inflation is high and it may be difficult to implement under deflation. These findings are consistent (over the short run) with the possibility of nominal wages becoming downwardly rigid.

[54] As argued by Renner (1999), since public pensions are a contract between the government and people, they are by nature different from contracts, such as nominal wage indexing, that can be traded on the market by private-sector economic agents.

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Table 1　Selected Literature on the existence of DNWR using micro-data since the 1970s

Paper	Covarage of analysis				Type of analysis	Main results	
	Country	Data source	Period	Type of nominal wages		DNWR	Notes
McLaughlin (1994)	U.S.	PSID	1976–86	Hourly wages, Monthly wages	D, M	No	Argued that wage cuts were not rare, and wage change distributions were skewed regardless of the level of inflation.
Lebow, Stockton, and Wascher (1995)	U.S.	PSID	1968–88	Hourly wages, Monthly wages	D, M, LSW	Yes	Concluded that DNWR did exist, but the aggregated welfare loss from lowering the inflation rate should be small.
Akerlof, Dickens, and Perry (1996)	U.S.	Their own phone survey	1995	Hourly wages, Monthly wages	D	Yes	Confirmed the existence of DNWR by asking directly about the change in nominal wages from the previous year instead of nominal wage levels each year, and concluded almost all wage cuts observed in the PSID were due to measurement errors.
Card and Hyslp (1997)	U.S.	PSID, CPS	1976–93	Hourly wages, Weekly wages	D, CH	Yes	Reported estimation results showing that DNWR emerged as inflation rate declined, and this raised the average real wage change rate by as much as 1 percent.
Kahn (1997)	U.S.	PSID	1970–88	Hourly wages, Monthly wages (transformed into hourly wages)	D, K	Yes (hourly wages), No (monthly wages)	Found that DNWR existed in the 1970s and 1980s for hourly wages, but only in the 1970s for monthly wages.
Shea (1997)	U.S.	PSID	1981–87	Hourly wages, Weekly wages	D	Yes	Concluded that almost all wage cuts observed in the PSID were due to measurement errors, by estimating nominal wage change based on samples from union members and comparing it with the union's announced wage settlement.
Altonji and Devereux (1999)	U.S.	PSID and Payroll records of one large firm in the financial sector	1971–92, 1997	Hourly wages	D, AD	Yes	Argued that much of the wage cuts observed in the PSID were caused by measurement errors, and wage cuts became extremely rare when taking measurement errors into account or when using individual firm's data without measurement errors.
Groshen and Schweitzer (1999)	U.S.	CSS	1956–96	Annual wages including bonuses	Analysis of variance, etc.	Yes	Argued that DNWR existed to some extent, and the optimal inflation rate was about 2.5 percent when considering the cost of high inflation.
McLaughlin (1999)	U.S.	PSID	1971–92	Hourly wages, Monthly wages	D, M, LSW	No	Argued that there was no correlation between the inflation rate and skewness of distributions, and the skewness of distributions was caused by (1) downward rigidity in real wages, (2) sample selection bias, and (3) aggregation bias from the pooling of samples.
Wilson (1999)	U.S.	Payroll records of two large firms in the service sector	1982–94, 1969–88	Monthly wages (transformed into hourly wages)	D, M	Yes	Reported that DNWR emerged as inflation declined, and virtually no wage cuts were observed in individual firm data without measurement errors.
McLaughlin (2000)	U.S.	PSID	1971–92	Hourly wages, Monthly wages	D, M, LSW (disaggregated by employees' characteristics)	No	Pointed out the possibility that nominal wages were generally flexible and it was real wages that were downwardly rigid although the nominal wages of some employees could be downwardly rigid.
Christofides and Stengos (2001)	U.S.	PSID	1977–87	Hourly wages, Monthly wages	D, M, etc. (their own tests)	Yes (hourly wages), No (monthly wages)	Confirmed that hourly wages exhibted downward rigidity as the inflation rate declined.
Gottschalk (2005)	U.S.	SIPP	1986–93	Hourly wages	others (a version of hazard model considering measurement errors, a model identifying structural change)	Yes	Argued that almost all wage cuts observed were due to measurement errors, and downward rigidity was actually quite strong, using frequently surveyed data and taking measurement errors into account.

Table 1 (continued)

Paper	Covarage of analysis				Type of analysis	Main results	
	Country	Data source	Period	Type of nominal wages		DNWR	Notes
Lebow, Saks, and Wilson (2003)	U.S.	ECI	1981–99	Regular salaries (transformed into hourly wages), total compensation (including bonuses and overtime pay), payroll (including social insurance and fringe benefits)	D, LSW, K	Yes	Confirmed the existence of downward rigidities not only in regular salaries but also in total compensation and payroll including bonuses and other allowances such as overtime pay, using establishment data with minimal measurement errors.
Smith (2000)	U.K.	BHPS	1991–96	Weekly wages (including and excluding bonuses and overtime pay)	D, M	No	Found that the majority of downward rigidity stemed from measurement errors, rounding errors, and long-term contracts, and that fraction of nominal wage freezes became only 1 percent when removing these factors.
Nickell and Quintini (2003)	U.K.	NES	1975–99	Hourly wages, Monthly wages (transformed into hourly wages)	D	Yes	Found that although a considerable number of wage cuts were observed even when using data with minimal measurement errors, there were also a considerable number of wage freezes, suggesting the possibility of DNWR to some extent.
Crawford and Harrison (1997)	Canada	HRDC, others	1952–96	Union wage settlements (when multiple data for a single union, used the hourly wage for the lowest skill level) and others	D	Yes	Found that although observing some extent of downward rigidity in regular wages, wage cuts were common (about 30 percent of samples in 1996) when including bonuses and overtime pay, and thus argued that DNWR had minimal impact on the macroeconomy.
Fares and Hogan (2000)	Canada	HRDC	1978–97	Union wage settlements (when multiple data for a single union, used the hourly wage for the lowest skill level)	D, AD (only Tobit)	No	Confirmed by model estimation that no DNWR was detected and that the coefficient representing DNWR in the employment adjustment function actually caused employment to increase.
Crawford (2001)	Canada	HRDC	1978–97	Union wage settlements (when multiple data for a single union, used the hourly wage for the lowest skill level)	D, Others (estimating a distribution without DNWR using hazard model)	Yes (but also found upward rigidity)	Reported estimation results showing that not only DNWR but also rigidity (upward and downward) from menu costs were a cause of wage freezes, and that rigidities increased the average nominal wage change by a maximum of 0.18 percentage points.
Crawford and Wright (2001)	Canada	HRDC	1978–99	Union wage settlements (when multiple data for a single union, used the hourly wage for the lowest skill level)	AD (only Tobit)	Yes (but also found upward rigidity)	Confirmed the existence of small rigidity (upward and downward) from menu costs as well as DNWR.
Christofides and Stengos (2002)	Canada	HRDC, LMAS	1978–96	Union wage settlements (when multiple data for a single union, used the hourly wage for the lowest skill level), Hourly wages	D, M and others (their own tests)	Yes	Showed that DNWR emerged as inflation declined and the extent of DNWR was larger in the public sector than in the private sector.
Christofides and Leung (2003)	Canada	HRDC	1976–99	Union wage settlements (when multiple data for a single union, used the hourly wage for the lowest skill level)	K	Yes	Showed that DNWR emerged as inflation declined and that rigidity (upward and downward) from menu costs also existed to some extent.
Christofides and Stengos (2003)	Canada	HRDC	1976–99	Union wage settlements (when multiple data for a single union, used the hourly wage for the lowest skill level)	D, M and others, LSW, AD (only Tobit)	Yes	Showed that DNWR emerged as inflation declined.

Table 1 (continued)

Paper	Covarage of analysis				Type of analysis	Main results	
	Country	Data source	Period	Type of nominal wages		DNWR	Notes
Fehr and Gotte (2005)	Switzerland	SLFS, SIF	1991–98	Annual Total compensation (excluding social insurance<transformed into hourly wages>), Total compensation (excluding social insurance)	D, AD	Yes	Confirmed that DNWR existed even under near–zero inflation and slow economic growth by model estimation.
Beissinger and Knoppik (2001)	Germany (west)	IABS	1975–95	Payroll per employee (including social insurance and fringe benefits, for full–time male employees)	D, M, LSW, CH, K	Yes	Confirmed the existence of DNWR through various methods.
Knoppik and Beissinger (2003)	Germany (west)	IABS	1975–95	Payroll per employee (including social insurance and fringe benefits, for full–time male employees)	AD	Yes	Reported results confirming a strong existence of DNWR and a possible impact on unemployment under below 3 percent inflation rate, by estimating a model taking account of measurement errors and aggregation biases.
Bauer, Bonin, and Sunde (2004)	Germany (west)	IABS	1976–97	Payroll per employee (including social insurance and fringe benefits, for full–time male prime–age employees)	AD (combined with switching model)	Yes	Confirmed downward rigidity in both real and nominal wages, a greater extent of rigidity in real wages, and a greater extent of real wage rigidity as inflation increases.
Devicienti (2003)	Italy	INPS	1985–96	Daily (including various allowances)	AD (combined with switching model)	Yes	Confirmed a moderate extent of downward rigidity, by estimating a model taking into account measurement errors and aggregation biases.
Knoppik and Beissinger (2004)	Euro area (12 countries)	ECHP	1994–2001	Monthly wages, Annual wages	K	Yes	Confirmed the existence of DNWR in all countries, albeit to differing degrees (Spain had the lowest degree of downward rigidity and Italy the highest).
Castellanos, Garcia–Verdu, and Kaplan (2004)	Mexico	IMSS	1985–2001	Daily (including various allowances)	K	Yes	Found substantial DNWR but its extent gradually diminished over time.
Kuroda and Yamamoto (2003a)	Japan	JPSC	1993–98	Regular monthly wages, Annual wages (for full–time employees), Hourly wages (for part–time female employees)	D, M, LSW	Yes	Found the hourly wages of part–time female employees to be almost perfectly downwardly rigid, while reporting the regular monthly salary and annual wages of full–time employees were downwardly rigid to some extent.
Kuroda and Yamamoto (2003b)	Japan	JPSC	1993–98	Regular monthly wages, Annual wages (for full–time employees), Hourly wages (for part–time female employees)	AD	Yes	Reconfirmed the results from Kuroda and Yamamoto (2003a) by estimating a model to take account of measurement errors and other factors.
Kuroda and Yamamoto (2005a)	Japan	BSWS	1985–2001	Annual wages (disaggregated into prefecture, firm size, sex, and age group, for full–time employees)	K	Yes (1992–97), No (1998–)	Reported that the annual wages of full–time employees were downwardly rigid in 1992–97, but not from 1998 when the recession deepened (analysis was based on aggregated data rather than micro data).
Kawaguchi and Ohtake (2004)	Japan	IILPS	2000	Annual wages, Monthly regular wages	D, Others	–	Reported that approximately 17 percent of all samples experienced wage cuts.

Table 1 (continued)

Notes: 1. Survey abbreviations are as follows:

- PSID: *Panel Study of Income Dynamics*（US）
- CPS: *Current Population Survey*（US）
- CSS: *Federal Reserve Bank of Cleveland Community Salary Survey*（US）
- SIPP: *Survey of Income and Program Participation*（US）
- ECI: *Employment Cost Index*（US）
- BHPS: *The UK British Household Panel Study*（UK）
- NES: *New Earnings Survey*（UK）
- HRDC: *Human Resources Development Canada*（Canada）
- LMAS: *Canadian Labour Market Activity Survey*（Canada）
- SLFS: *Swiss Labor Force Survey*（Switzerland）
- SIF: *Social Insurance Files*（Switzerland）
- IABS: *IAB-Beschaftigtenstichprobe*（Germany）
- INPS: *Italian Institute for Social Security*（Italy）
- ECHP: *European Community Household Panel*（Euro zone）
- IMSS: *Mexican Social Security Institute*（Mexico）
- JPSC: Japanese Panel Survey of Consumers (Japan)
- BSWS: Basic Survey on Wage Structure (Japan)
- IILPS: Institute of Industrial and Labor Policies Survey (Japan)

2. Types of analysis are as follows:

- D : This type of analysis checks for the existence and extent of DNWR by constructing a nominal wage change distribution and observing its shape. This has been used in nearly all research. Normally, nominal wages are deemed to be downwardly rigid when the distribution is skewed to the right due to a large number of samples with a nominal wage change near zero and a small number of samples with a negative change.

Table 1 (continued)

- M : This type of analysis uses skewness and other statistics to test for the symmetry of the nominal wage change distribution. This has been used in many analyses since McLaughlin (1994). A detailed explanation of the statistics is provided by McLaughlin (2000).
- LSW : This type of analysis directly tests for whether there is a relatively smaller portion of the nominal wage change distribution in negative territory, as well as whether there is symmetry of the distribution. This was developed by Lebow, Stockton Wascher (1995).
- CH : This type of analysis, used by Card and Hyslop (1997), non-parametrically estimates the counterfactual symmetric nominal wage distributions (those assuming no DNWR) and looks at differences from the shape of the observed distributions. This analysis assumes that the right side of the nominal wage change distribution is unaffected by downward rigidity and that the left side of the distribution should be symmetric with the right side if nominal wages are not downwardly rigid.
- K : This type of analysis estimates the shape of the nominal wage change distribution (height of the bars in a histogram) through regression with time-series data, and then tests for whether the heights of the bars representing negative nominal wage changes are significantly lower than the heights of bars located the same distance from the median value on the positive side. Since first proposed by Kahn (1997), this method or improvements thereof has been used in many analyses. This analysis is deemed to be a useful method to test for DNWR in the sense that it does not require any assumptions regarding the shape of the notional distribution of nominal wage change and thus makes it harder for the analysts to inject their own arbitrary judgments.
- AD : This type of analysis uses either a friction model or a Tobit model to estimate the structure when the observed nominal wage change is zero if the notional change (the theoretically expected change based on the individual characteristics) is between zero and a certain negative threshold, but becomes negative when that threshold is exceeded. This approach makes it possible to take account of measurement errors and to compare the extent of DNWR using a uniform measure. Since it was developed by Altonji and Devereux (1999), this method or improvements thereof has been used in numerous analyses.

Table 2 Labor Turnover

(percent)

	Hirings (a)	Separations (b)	Labor turnover (a+b)
Japan	20.2	18.9	39.1
U.S.	64.4	61.8	126.4
Switzerland	–	–	–
Canada	48.2	44.4	92.6
U.K.	–	–	–
Germany	31.6	30.4	62.0
France	–	–	58.0

Source: OECD, *Employment Outlook,*1996.

Table 3 Incidence of Long-term Unemployment (12 months and over)

(percent)

	1990	1995	2000
Japan	19.1	18.1	25.5
U.S.	5.5	9.7	6.0
Switzerland	16.4	33.6	29.1
Canada	7.2	14.1	11.2
U.K.	34.4	43.6	28.0
France	38.0	42.3	42.5
Germany	46.8	48.7	51.5

Source: OECD, *Employment Outlook.*

Table 4 Employment Protection Legislation Indices

	Difficulty of Dismissal	Overall Strictness of Protection against Dismissals	Overall EPL (ver. 1)
Japan	22	18	12
U.S.	1	1	1
Switzerland	3	3	6
Canada	6	4	3
U.K.	2	2	2
France	15	13	24
Germany	17	22	20

Source: OECD, "Employment Protection and Labour Market Performance," *Employment Outlook*, June, 2004.

Notes: 1. Rank ordering of EPL strictness for the 28 OECD countries, based on indices compiled by OECD (2004)

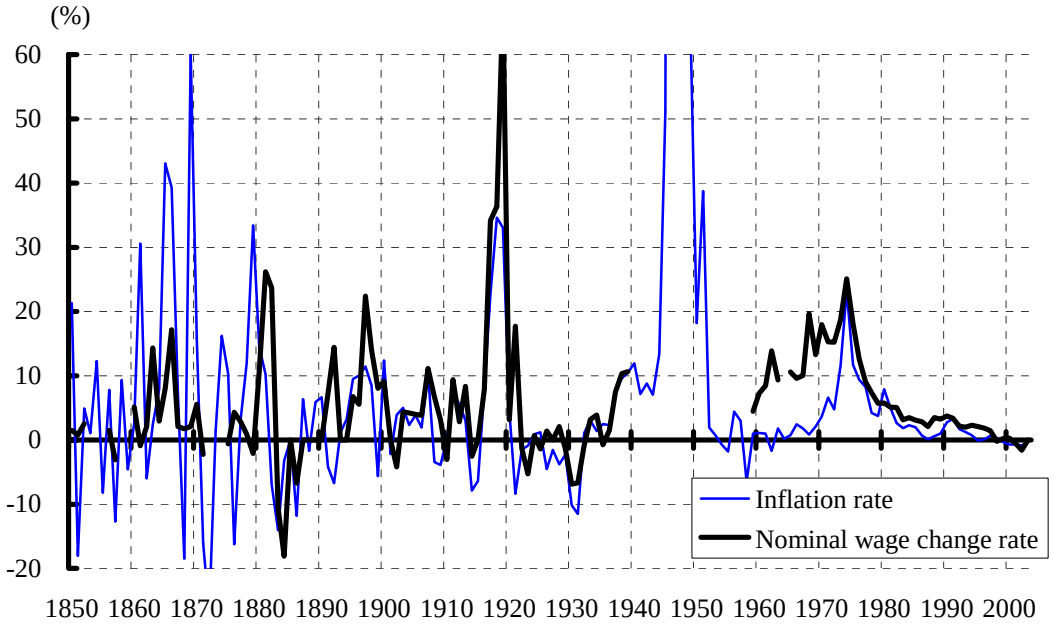
2. Difficulty of dismissal is a measure of the strictness of standards for what constitutes legal dismissal of regular employees.

3. Overall strictness of protection against dismissals is the difficulty of dismissal added to the complexity of procedures that a firm must comply with when dismissing a regular employee ("Regular procedural inconveniences" + "Notices and severance pay for no-fault individual dismissals").

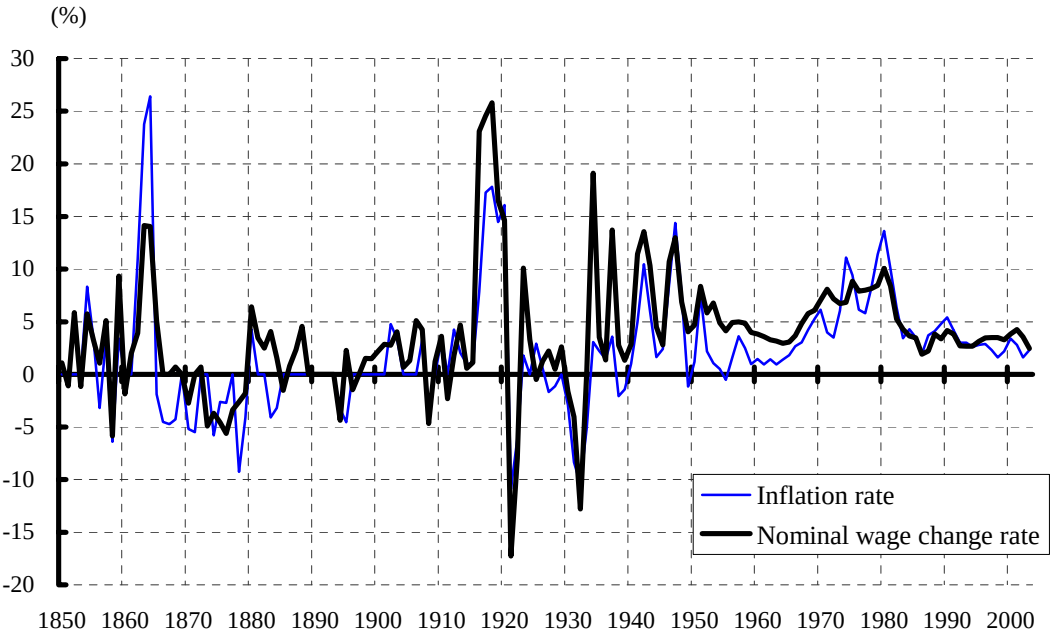
4. Overall EPL (ver. 1) is a weighted average of protections for regular employees and protections for part-time employees.

Figure 1　Inflation and Nominal Wage Change

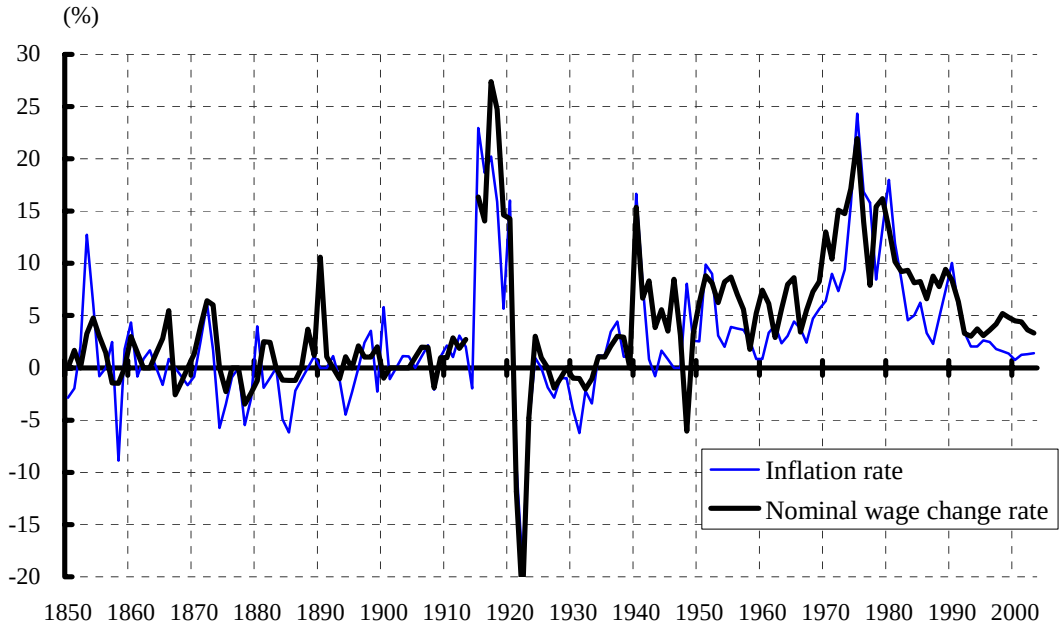
(1) Japan



(2) United States



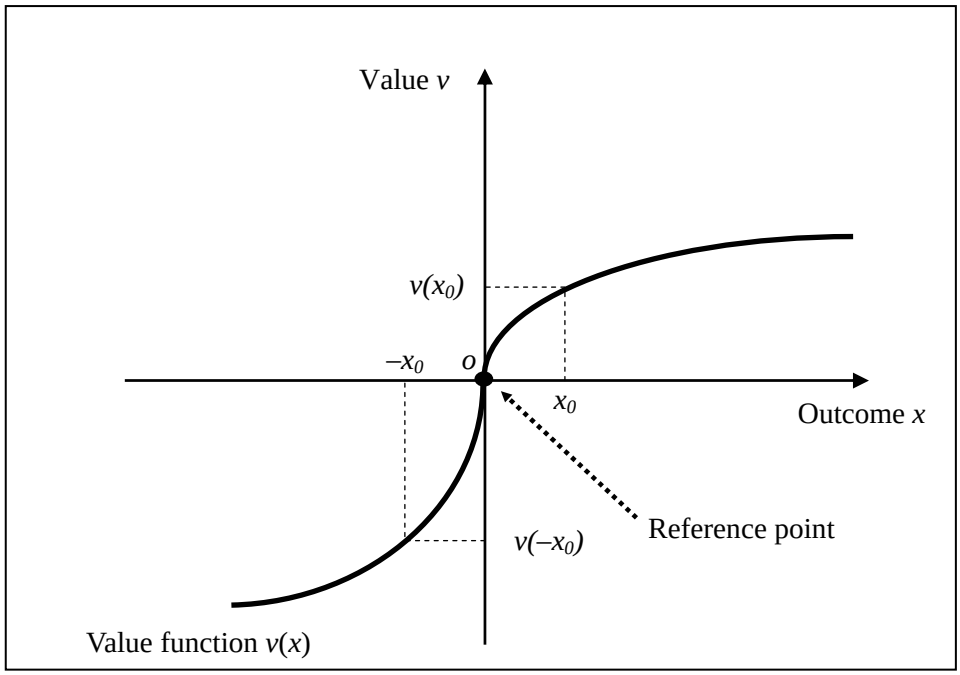
(3) United Kingdom



Sources:1. Japan: Saito (1998), Ohkawa et al. (1966), and *Basic Survey on Wage Structure* (Ministry of Health, Labor and Welfare).
2. U.S.: Mitchell (2003a) and the data compiled by Samuel H. Williamson (http://eh.net/databases/unskilledwage/).
3. U.K.: Mitchelll (2003b) and Labour Force Survey (Office for National Statistics) .

Notes: The details for wage data are as follows:
1. Japan: For 1850–82, the annual regular wages for manufacturers of Choshi soy sauce manufacturing (excluding food and other special allowances; weighted average for brewers, foreman, and young workers) noted in Saito (1998). For 18831939, wages for skilled manufacturing workers (A series until 1889, C series after that) noted in Ohkawa et al (1966). For 1959 and later, the amount of scheduled cash wages (for regular male workers) noted in the *Basic Survey on Wage Structure*.
2. U.S: Hourly wages for unskilled labor compiled by Williamson.
3. U.K.: Until 1992, average weekly manufacturing wage noted in Mitchell (2003), from 1993, the average wage index from the *Labor Force Survey*.

Figure 2 Kahneman and Tversky's Value Function



Note: Based on Kahneman and Tversky (1979)

Figure 3 Change in the shape of Value Function

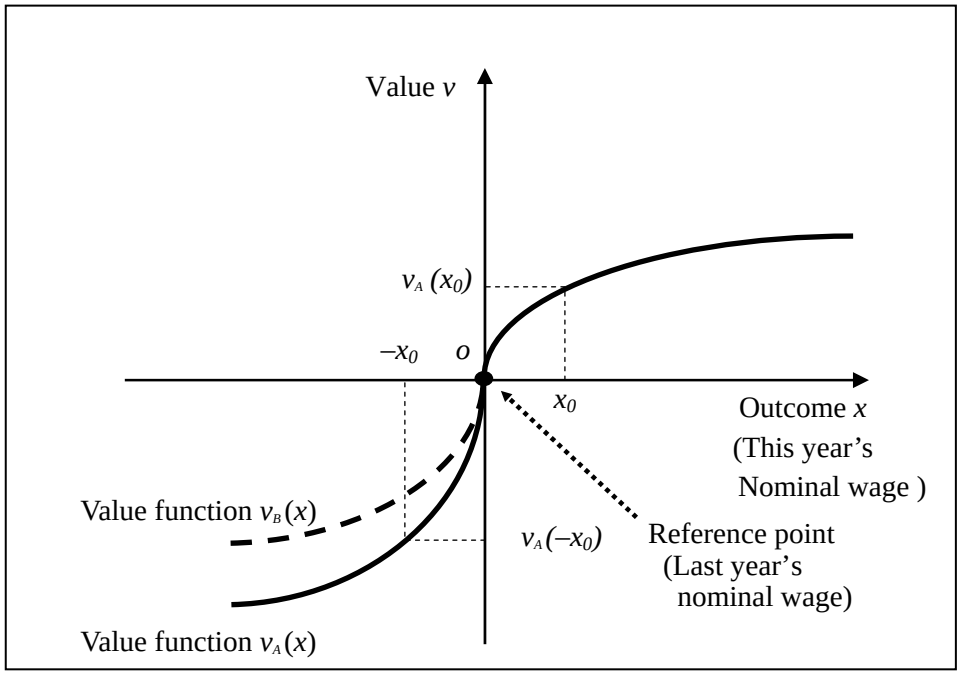
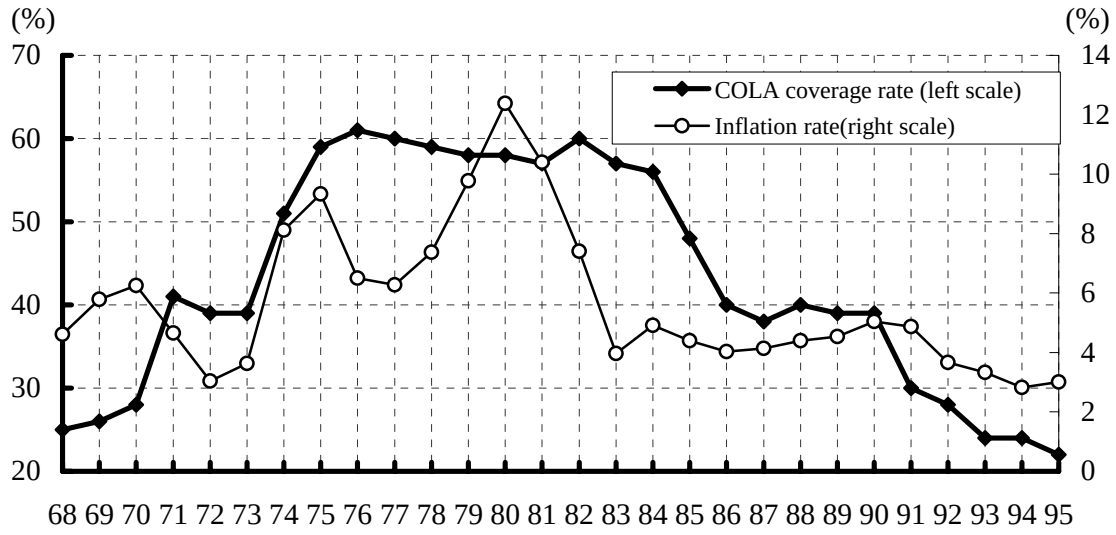


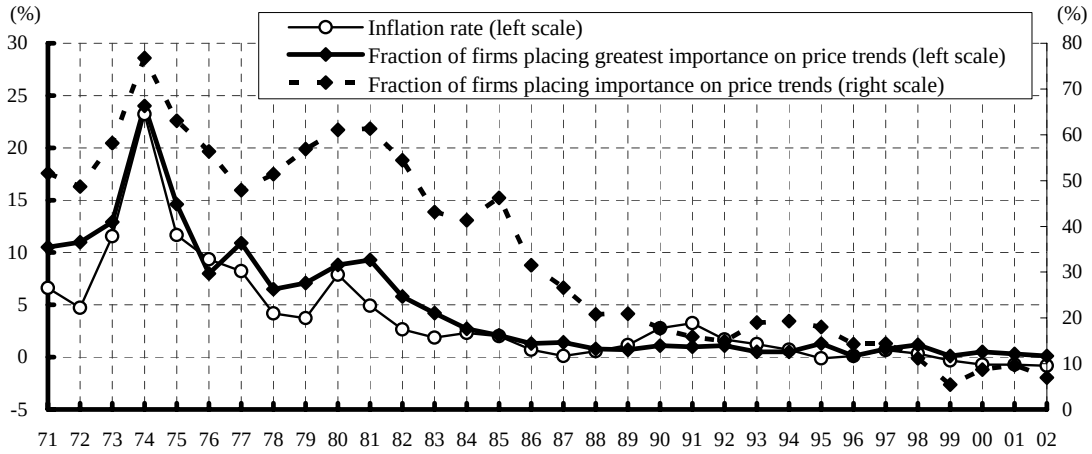
Figure A-1 COLA Coverage Rate and Inflation Rate (the case for the US)



Source: Wasilewski (1976)

Note: Inflation rate is year-on-year change in core CPI

Figure A-2 Inflation Rate and Fraction of Firms Placing Greatest Importance on Price Trends When Setting Wages (the case for Japan)



Source: *Survey on Wage Hikes* (Ministry of Health, Labor, and Welfare)

Note: Inflation rate is the year-on-year change in the CPI (overall, after adjusting for the effects from introducing the consumption tax in April 1989 and from raising the consumption tax rate in April 1997)