

## Major Causes of the Rapid Longevity Extension in Postwar Japan

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The length of human life, usually measured collectively by the life expectancy at birth ( $e_0$ ), increased substantially in high-income countries during the twentieth century, and has so far been rising further in this century. The pace of progress was particularly fast in Japan, where  $e_0$  reached 86.44 for females and 79.59 for males in 2009. The increasing life expectancy in Japan during the last few decades led to an accelerating growth of the extremely old population (Robine, Saito and Jagger, 2003).

The progress in Japan has been faster than those in most Western high-income countries (Figure 1). Why has Japan achieved such a rapid longevity extension? Previous studies pointed out such factors as progress in medical technology and development of the national medical insurance system (Ohno, 1985). These factors, however, are observed in many other high-income countries as well. Thus this paper focuses on factors that may be peculiar to, or particularly pronounced for, Japan: rapid economic growth, overlapping epidemiological transitions, dietary patterns, traditional health culture, genetic factors, distribution of income and wealth, and social structure.

Data limitations make it difficult to quantify effects of these factors on the life expectancy at the national level and compare them internationally. Thus the objective of this paper is to present some hypotheses about reasons for the rapid longevity extension in Japan. Substantiation of those hypotheses is considered future tasks.

It should be noted that factors that lengthen the lifespan (level factors) and factors that expedite the lifespan increase (pace factors) are not necessarily the same. For example, gene distributions in a population should affect the life expectancy, but usually the gene distributions in a human population do not change much in a few decades, or even in a few centuries.

However, there may be some interactions between level factors and pace factors. For example, in some societies, only a small group of most privileged people benefit from new, expensive medical technologies, whereas in more egalitarian societies, the majority of people may gain access to those medical technologies. In this case, social structure, a relatively stable factor, and medical technology, which may change rapidly, interact in affecting the life expectancy. Furthermore,

if a factor is closely related to a certain type of diseases, the importance of the factor for overall mortality does not remain constant but varies with the proportion of deaths from those diseases. For example, a level factor contributing to prevention of chronic diseases may become important as major medical causes of death shifts from acute infectious diseases to chronic diseases, thereby accelerating the overall mortality decline accompanying the change of cause-of-death structure. Thus, this paper discusses both level factors and pace factors without strictly distinguishing them.

### REASONS FOR INCREASED LIFESPAN

#### Rapid economic growth

It is well known that the economic growth was markedly fast in postwar Japan. The economy reached the pre-war level in the mid-1950s. The average rate of economic growth per year was about 10% in the 1960s, 5% in the 1970s, and 4% in the 1980s.

Economic development is associated with major factors of decline in older adult mortality in the high-income countries during the twentieth century. Those factors, reviewed previously (Costa, 2005; Cutler et al., 2006), include the progress of medical technology, improved access to and availability of medical services, better diet and nutrition, rise in the standard of living in various aspects of life such as housing and clothing, reduced episodes of infection, and increased level of education. These factors contributed to the decline of older adult mortality in postwar Japan (Goldman and Takahashi, 1996). The rapid economic growth provided financial, human, and material resources for making those improvements faster.

Some high-income countries, however, have higher levels of per-capita GDP than Japan. Thus the level of economic development does not seem to fully explain why Japan has higher life expectancies than those countries. It should also be noted that the economic trend and lifespan trend in Japan are not tightly linked with each other. Japan experienced a serious long-term economic recession in the 1990s. But the life expectancy continued to increase before, during, and after the recession. The recession and recovery do not appear to be sensitively reflected in the life expectancy trend.

### **Overlapping epidemiological transitions**

It is known that the longevity extension in high-income countries during the twentieth century proceeded through two distinct stages (reviewed in Horiuchi, 1999). The progress in the first half of the century was mainly due to reduction in mortality from infectious and parasitic diseases, as well as maternal, perinatal, and nutritional disorders. Then, in the second half of the century, a substantial decline in mortality from degenerative diseases, particularly from cardiovascular diseases, started.

Although the reduction in mortality from infectious and parasitic diseases is still proceeding, the dominant periods of these two transitions can be distinguished fairly clearly for many Western countries. For example, the United States had even a period of relatively slow progress between the two transitions (Crimmins, 1981). The shift from the first to second stage in Sweden is estimated to have occurred around 1955-1960 (Horiuchi and Wilmoth, 1998). However, both of the transitions proceeded rapidly and simultaneously in Japan during the third quarter of the twentieth century (Horiuchi and Wilmoth, 1998). Thus, the fast increase in life expectancy in the period is partly attributable to this heavy overlapping of two transitions.

### **Dietary patterns**

The Japanese diet is characterized by more consumption of vegetables, fish, and soybean products and less intake of calorie and animal fat than the Western diet (Kromhout et al., 1989; Willett, 1994). This might have been a health disadvantage when under-nutrition was a serious health problem, but should be a health advantage in contemporary societies in which the metabolic syndrome has become a major health threat. Previous studies suggest that this diet pattern helps to reduce the risk of cardiovascular diseases (Shimazu et al., 2007) and metabolic syndrome (Sakata, 1995) in Japan.

### **Traditional health culture**

Japanese people in the pre-industrial Tokugawa Era (1603-1868) were fairly concerned about health and exercised a relatively high level of personal hygiene. They practiced various regimens that were believed to promote good health (Fukuda, 1994). Regular bathing was widespread, and a fairly healthful system of water supply and sewage was developed (Hanley, 1997). A book entitled *Yojokun* (Maxims of Regimen) by Kaibara (2009, originally 1713), comprising many recommendations for health promotion over a wide range of

activities such as diet, exercise, sleep, breathing, stress management and sexual intercourse, was widely read and followed.

The high levels of health concern and personal hygiene in preindustrial Japan seem to be rooted partly in the historical influence of Chinese medicine (Powell and Kanasaki, 1990), and partly in the traditional virtue of cleanliness (Ohnuki-Tierney, 1984), to which strong importance is attached in the indigenous religion of Shintoism (Underwood, 2007). High levels of health concern lead people to healthy life styles and make them sensitive to early signs of diseases. Thus effects of health concern on mortality should be strong in circumstances in which risks of major diseases are closely linked to life style factors and detection of chronic diseases in early stages makes considerable differences in treating them.

### **Genetic factors**

It has been found that the frequency of Apolipoprotein e4 allele, which is strongly associated with the risk of ischemic heart disease and Alzheimer's disease, is substantially low among Japanese (Eto et al. 2008). Thus, there is a possibility that some genetic factors might be involved in the rapid longevity extension in Japan. Some genes may have strong effects on the risk of chronic diseases at old ages, to which an increasing proportion of all deaths are attributed. Therefore, although the gene pool in the Japanese population probably has remained almost unchanged during the last few decades, the importance of some genes for life expectancy might have arisen. More research is needed on relationships of genetic factors to international mortality differences, about which little is known.

### **Distribution of income and wealth**

Previous studies have shown that greater inequality in income and wealth is associated with higher mortality at the national and regional levels (Wilkinson, 1996; reviewed in Wilkinson and Pickette, 2006)<sup>1</sup>. Although dispersion (inequality) and location (level) can be considered as different aspects, the very poor may increase the mortality level of the population considerably more than the very rich decreases it, making the aggregate mortality higher in societies with less egalitarian income/wealth distributions.

Inequality in the income distribution in Japan during the 1970s and 1980s was lower than that in many other high-income countries (Bauer and Mason, 1992; Buss et al., 1989; Wolf, 1996)<sup>2</sup>, which likely contributed to the long lifespan in Japan (Marmot and Smith, 1989). However, the

level of income inequality in Japan has been rising noticeably during the last few decades (Ohtake, 2008), which does not seem to be fully compatible with the continuation of rapid longevity extension in the period.

## **SOCIAL STRUCTURE**

### **Psychosocial aspects of socio-economic health differentials**

Socio-economic inequality is a crucial factor for understanding health differentials within and among countries. Obviously, more resources mean more chances to use them for enhancing health and preventing and treating diseases. However, some previous studies also suggest that this is not simply an issue of resource distribution, but social structure and population health may be linked through some psychosocial pathways. Marmot (2004) argues that in less egalitarian societies, people have lower degree of cooperation and trust as well as less control over their lives, which have deleterious effects on their health.

Wilkinson (1996) also claims that underprivileged people in less egalitarian societies tend to have more “social stress, poor social networks, low self-esteem, high rates of depression, anxiety, insecurity, the loss of control”, all of which could undermine their health. Kawachi and Kennedy (1999) maintain that in societies with more unequal income distribution, less investment is made in human capitals such as education and public health, social fabrics more likely erode, and individuals have greater risks to experience frustration by comparing themselves with each other in terms of socio-economic success. These tendencies have adverse impacts on population health.

### **Socio-economic differentials in mortality and health in Japan**

Both Marmot and Wilkinson attribute the rapid increase of life expectancy in Japan to the high level of social cohesion, which is reflected in the low crime rates. In relation to this conjecture, we need to examine if socio-economic mortality differences are smaller in Japan than in Western countries.

However, this question is difficult to investigate, because previous studies on socio-economic mortality differentials in Japan (reviewed in Fukuda and Imai, 2007) are limited in both quantity and data type. The differentials have been studied mainly by analyzing relationships between socio-economic indicators and mortality measures at the prefectural and municipal levels (Fukuda et al., 2004a, 2004b; Fukuda, Nakamura and Takano, 2007; Suzuki, 2003). Results of these aggregate-

level analyses, however, need to be interpreted with caution because of the risk of ecological fallacy.

Occupational differences in mortality have also been analyzed using information on occupation in death certificates and censuses (Kagami-mori et al., 1998; Ogino, 1967). The results show higher mortality for manual than non-manual workers, which is consistent with the patterns observed in other countries. However, occupation in the death certificate is the current occupation of the decedent, not reflecting the socio-economic status of many retired persons and homemakers.

The most desirable type of data for studying SES mortality differentials is longitudinal surveys or mortality follow-ups combined with cross-sectional base-line surveys. In either case, the sample size must be large, because deaths are rare events in modern, high-income societies. To my knowledge, there is only one study on SES mortality differentials in Japan using this type of data (Liang et al., 2002), although a nationwide longitudinal survey on the elderly is currently in progress<sup>3</sup> and mortality data from the survey are expected to be analyzed soon.

An additional problem is that even if more data on socio-economic mortality differentials in Japan become available, international comparison should be made cautiously because data from countries that have substantially different distributions of SES characteristics may not be straightforwardly comparable. For example, only a small group of selected elite receive education above the high school level in some countries, whereas nearly 50% of people go to college in others. It is questionable whether mortality differences between college graduates and non-graduates are really comparable between these two types of countries.

Previous studies suggest that the association between socio-economic status and mortality in Japan is, overall, in the expected direction. However, a few unusual patterns are also observed. First, the association between SES and mortality at the aggregate level seems relatively weak. In fact, no obvious association was found in a municipal level study (Nakaya and Dorling, 2004). A well-known anomalous case is Okinawa, which is socio-economically the least developed prefecture but kept the highest rank in life expectancy for many years (Cockerham, Hattori and Yamori, 2000; Goldman and Takahashi, 1996).

Second, the association is weaker, or even reversed, for females. Suzuki (2003) has shown that the pattern of association between socio-economic indicators and  $e_0$  at the prefectural level is notably

different between males and females. In particular, the life expectancy of Japanese women exhibits an anomalous covariate profile, including a negative correlation (-0.302) with per capita income in the prefecture (Suzuki, 2003). The association is less clear for females than for males at the municipal level as well, and again, higher income is related to higher female mortality (Fukuda et al., 2004b). This may be due to the tendency for women in lower-income rural areas to have healthier life styles (Fukuda, Nakamura and Takano, 2005).

Third, some unexpected results were obtained for the elderly. Although diminishing effects at old ages have been observed for various risk factors (Forette, 1999), the expected pattern is reversed among older persons in Japan: higher income is associated with higher old-age mortality at the municipal level (Nakaya and Dorling, 2004). In addition, data from a 5-round panel survey in 1987-1999 indicate an age-related cross-over of educational effect on mortality: education and mortality are negatively associated among those in the 60s of age, fairly independent of each other in the 70s, and positively associated for those aged 80 and above (Liang et al., 2002).

More research results are available on SES differentials in health and risk factors than those in mortality. Many of those studies are based on data for company employees and civil servants in Japan, often compared with their British and Finnish counterparts (Chandra et al., 2004; Ishizaki et al., 2000; Ishizaki et al., 2001; Lallukka et al., 2008; Martikainen et al., 2001; Martikainen et al., 2004; Morikawa et al., 2004; Sekine et al., 2006a; Sekine et al., 2006b; Sekine et al., 2006c). Here again, Japanese patterns, though in the expected direction overall, are often difficult to interpret: the socioeconomic gradient in ill health is less systematic for males in Japan than in England and Finland, and small and inconsistent for females in Japan (Martikainen et al., 2004); higher positions are associated with higher BMI, waist-to-hip ratio, and lower HDL cholesterol among company employees in Japan, though the associations were in the expected direction for civil servants in England (Martikainen et al., 2001); there are no significant differences by employment grade in physical and mental functioning or sleep quality for female civil servants in Japan (Sekine et al., 2006a; Sekine et al., 2006b); the grade difference in sickness absence rate is smaller for Japanese factory workers than British civil servants (Morikawa et al., 2004).

Risk factors of being overweight for old persons aged 70 and over are compared between Japan and the U.S., with nationally representative

surveys (the 1999-2001 Nihon University Japanese Longitudinal Study of Aging and the U.S. Longitudinal Study of Aging II). Education is statistically significantly associated with the risk of being overweight among American men and women, but not among Japanese men and women (Reynolds et al., 2008).

In summary, previous studies seem to indicate that whereas the overall relationship of SES to mortality and health in Japan is in the expected direction, the association appears to be weak, inconsistent, and often anomalous. Thus SES differentials in mortality and health may actually be smaller in Japan than in Western countries, though existing evidence is far from conclusive.

### **Communicative equality and cultural equality**

In order to understand dynamics of social stratification, not only political equality (distribution of political power and political rights) and economic equality (distribution of income and wealth) but also two other concepts of equality seem useful: communicative equality, which is the extent to which persons at different locations in the social hierarchy communicate and interact with each other; and cultural equality, which is the extent to which persons at different locations in the social hierarchy have similar values, attitudes and interests.

The Japanese society is characterized by high degrees of communicative equality and cultural equality<sup>4</sup>. In a well-known social-anthropological study of the Japanese society, Nakane (1967, 1970) distinguished “vertical” and “horizontal” societies. In a horizontal society, communications and interactions occur mostly among persons who are at the same level or comparable levels in the social hierarchy. In a vertical society, individuals at significantly different levels actively communicate and interact with each other. Communications and interactions across different sectors are frequent and active in a horizontal society but limited in a vertical society. Two Asian societies, Japan (vertical) and the caste system of India (horizontal), are located toward the both ends of the spectrum, placing Western societies between them. Nakane also claims that the verticality of the Japanese society is based on the high level of homogeneity (corresponding to “cultural equality” in this paper)<sup>5</sup>. The origin of communicative equality and cultural equality in Japan is beyond the scope of this paper, but a possible root may be the farming in rice paddies, the primary economic activity in the past two millennia, which requires closer collaboration of many village residents than many other types of agriculture.

The communicative equality and cultural equality make Japanese people feel close to each other and strongly group-oriented (Reischauer, 1977; Vogel, 1979). This leads to the tendency for them to give priorities to human relations and role expectations within the particular groups to which they belong, rather than some general philosophical, ethical or religious principles (Benedict, 1946; Doi, 1973).

The strong group-orientation is reflected in some survey results. NHK Broadcasting Culture Research Institute (2004, 2009) conducted eight rounds of periodical cross-sectional survey on attitudes and perceptions of Japanese men and women aged 16 and over in five-year intervals between 1973 and 2008<sup>6</sup>. In each round, respondents were asked to select the first and second most important criteria for evaluating job desirability out of the following ten: income, prestige, administrative status and power, independence at work, use of professional skills and knowledge, job security, comfortable collaboration with coworkers, length of work time, low health risk, and contribution to the society. In the last four rounds (1993-2008), the highest proportion (about 20 percent in each round) of respondents selected "comfortable collaboration with coworkers" as the most desirable job characteristic, overtaking "low health risk", which was the top choice in the first four rounds (1973-1988). The highest proportion (about 40 percent) selected "comfortable collaboration with coworkers" as the first or second most important in the latest six rounds (1983-2008). Another question was about the desirable type of (hypothetical) job partner. Consistently through the eight rounds, a large majority of respondents (about 70% in each round) stated that cordial relationship with the partner is more important than professional ability of the partner.

The Institute of Statistical Mathematics conducted 12 rounds of periodical cross-sectional survey on values and views of Japanese men and women aged 20 and over<sup>7</sup> in five-year intervals between 1953 and 2008<sup>8</sup>, as well as similar surveys in nine other populations (Japanese Brazilians, Japanese Americans in Hawaii, non-Japanese Americans in Hawaii, Americans on the West Coast, the British, the Dutch, the French, Germans, and Italians) between 1987 and 1993 for international comparison (Hayashi, 2001; Hayashi and Kuroda, 1997). One of the questions asked in all of those surveys is: Would you prefer to work under a boss (A) who always follows the work rules and never demands any unreasonable work, but never looks after you in matters not connected with your work, or (B) who sometimes demands

extra work in spite of work rules against it, but looks after you in matters not connected with your work. The vast majority of Japanese (in the range of 77 to 89 percent throughout the 12 rounds) prefer B and a small proportion of them (9 to 18 percent) prefer A<sup>9</sup>. In the other nine populations, the proportion of those who prefer the paternalistic supervisor ranged from 48 to 78 percent, and the proportion of those who prefer the rational, business-like supervisor ranged from 17 to 45 percent, suggesting that Japanese people (in Japan) prefer personally intimate relationships at work places more strongly than any of the other study populations.

### **Positive affect and attitude among the low-SES Japanese**

The strong group orientation seems conducive to the psychological well-being of Japanese people with low socio-economic status. It gives them deep feelings of belongingness to organizations and communities, keeping them from feeling alienated in the society. Because interpersonal relationships, loyalty to the group, and conformity to group norms are highly valued (relative to individual abilities and achievements), low-status members can feel that they also have important roles and are satisfactorily meeting the role expectations. The feeling gives them relatively high self-esteem (in spite of their low ranks and salaries), and helps them to have positive perceptions, emotions and attitudes about their lives<sup>10</sup>. This might be more difficult in societies in which individual socioeconomic success is more highly valued than in Japan.

Positive affect and positive attitude contribute to health in at least two ways. First, persons with constructive attitudes toward their lives tend to be concerned about their health, adopt healthy life styles, and make effective use of medical services. Second, an increasing number of studies suggest that positive affect and positive thinking may have positive impacts on health through some physiological (particularly, psycho-neuro-immune and psycho-neuro-endocrine) pathways (Levy et al., 2002; Steptoe, Wardle and Marmot, 2005).

The group orientation has been strong in the Japanese society, and was not necessarily intensified during the postwar period. Thus, it may not seem to be a major driving force of the fast longevity extension. However, this factor possibly amplified health effects of new medical technology and rising standard of living by rapidly spreading benefits of those progresses over the entire society including the underprivileged groups<sup>11</sup>.

## CONCLUSION

This paper discussed several possible reasons for the rapid longevity extension in postwar Japan. Emphasis was placed on the positive effect of the social structure on health, particularly among persons with low socioeconomic status. Although this effect is deeply rooted in the culture of Japan, it seems to have a general implication for countries with different cultural backgrounds: in developing and executing economic, social, and health policies and programs for underprivileged members of the society, not only financial and legal aspects but psychosocial aspects should also be taken into consideration. In order for those people to live long, healthy lives, it is crucial to have positive perceptions and constructive attitudes about their lives.

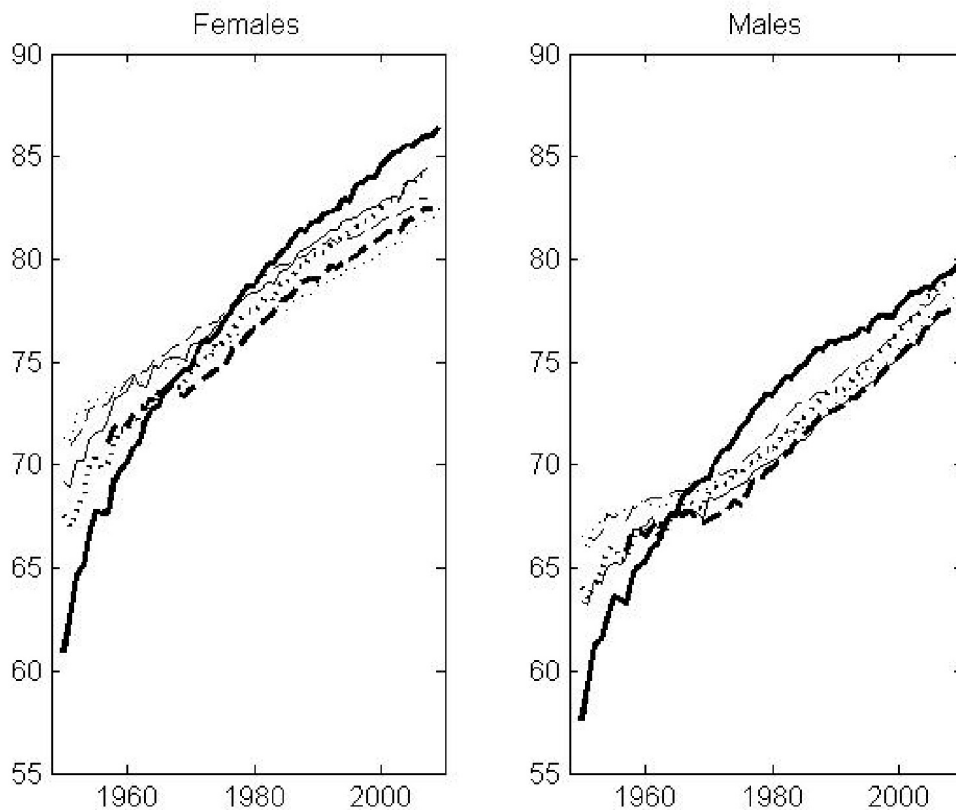
## ACKNOWLEDGMENT

This research was supported by Grant R01-AG11552 (P.I. John R. Wilmoth) from the National Institute on Aging. I am grateful to Ryuichi Kaneko and Futoshi Ishii for their valuable help in literature search for Japanese publications.

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**Figure 1 Trends in life expectancy, 1950-2007, for six G8 countries and regions\*: Canada (thin dashed), England and Wales (thin dotted), France (thin solid), West Germany (thick dashed), Italy (thick dotted), and Japan (thick solid).**



Note: Included in the figure are only G8 countries and regions in which  $e_0$  continued to rise relatively fast for both females and males. Thus the figure does not include two G8 countries: Russia, where  $e_0$  declined notably in some periods, and the USA, where the increase in  $e_0$  for females has been slow since around 1980.

Source: Human Mortality Database ([www.mortality.org](http://www.mortality.org)), downloaded on 1/23/2011.

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#### Notes

- 1) Several different hypotheses have been advanced for explaining the aggregate-level association (Judge 1995; Lynch et al., 2001).
- 2) Tachibanaki and Yagi (1997) claim, however, that Gini index for Japan might have been significantly underestimated in those papers.
- 3) Nihon University Japanese Longitudinal Study of Aging (Reynolds et al., 2008; Tsukuda and Saito, 2006)
- 4) A previous study suggests that many Japanese people do not have a clear idea about which social class they belong to (Mabuchi, 1996).
- 5) The view that the Japanese society is homogeneous has been criticized as exaggerated or stereotypical (Befu, 2001; Sugimoto, 2003; Mabuchi, 2002). There seem to be significant cultural differences among regions, economic sectors, and generations in Japan. The focus here, however, is not on the overall homogeneity/heterogeneity, but the extent of social class differences in the patterns of thinking and behavior.
- 6) The number of respondents ranged from 3103 to 4243 in the eight rounds.
- 7) Aged 20-79 in the 2003 and 2008 surveys.
- 8) The number of respondents ranged from 1875 to 4594 in the 12 rounds.
- 9) The proportions did not show any clear time trend over the 55-year period.
- 10) The attitudinal survey cited previously, a vast majority of the respondents stated that overall, they were satisfied with their current lives. The proportion is very stable, 86 or 87 percent in the last six rounds (1983-2008), in spite of the economic rises and falls during the period (NHK Broadcasting Culture Research Institute, 2004, 2009).
- 11) It is not fully certain, however, if this factor will continue to be in effect. The recent

emergence of the working poor in Japan (NHK Special Team on the Working Poor, 2007; Yuasa, 2007) can be a serious threat to the cohesion of the Japanese society. Many of them are relatively young, educated, but living through an endless succession of low-paying, temporary jobs in urban areas. If this population continues to grow and they feel

increasingly alienated and hopeless, the social fabric may critically erode in the future.

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