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Abstract

This paper provides a measure of the cost of stagnation and measures the cost of the Japanese long stagnation from January 1990. We define the cost of stagnation as the compensation to consumption during a stagnation period that is required to leave consumers indifferent between utility in a base paradigm and that in a stagnation paradigm. We identify differences in the cost of stagnation between consumers. Consumers in the lower income quintile and those in urban districts have higher costs of stagnation. Our results are robust, being independent of the sizes of preference parameters.

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1. Introduction

The Japanese stagnation has continued for a long time and seems to have become worse recently. Average annual GDP growth rates were 10.4% in the 1960s, 5.0% in the 1970s, 3.8% in the 1980s, but only 1.6% in the 1990s and only 0.7% in the 2000s (2000–2001).[2] These figures suggest that the stagnation of the 1990s and the 2000s is the longest and deepest of the last fifty years.

However, why do consumers feel this stagnation to be costless? At least two reasons are considered. First, the cost of stagnation differs between consumers according to individual economic conditions: the cost is low for some consumers and high for others. Second, until now, the cost of stagnation has typically been measured by reductions in GDP growth and other similar economic indicators. Whereas producers and firm managers have strong concerns about such cost measures, consumers generally do not. Since such measures are not directly related to welfare costs, consumers are not concerned about these costs and do not recognize the costs experienced by other consumers.

Extensive recognition of the costs experienced by other consumers produces a public opinion for the cost-full stagnation, which motivates governments to implement effective policies in the early stages of serious stagnation. However, to our knowledge, there have been few attempts to calculate the welfare cost of stagnation.

Lucas (1987, pp. 20–31) has measured the compensation that would leave consumers indifferent to a decline in the growth rate of consumption, and the compensation that would leave consumers indifferent between consumption instability and a perfectly smooth consumption path. Lucas calls the former type of compensation "a cost of reduced growth" and the latter type of compensation "a cost of economic instability". These types of

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[2] See Annual Report on National Accounts of 2003, Cabinet Office, the Government of Japan.

compensation may serve as an alternative to GDP growth as a measure of the cost of stagnation. However, since stagnation incorporates reduced growth and economic instability, the cost of stagnation should include the costs of both. Since Lucas defines both costs independently of each other, it is difficult to combine them to define the cost of stagnation.[3]

The purpose of this paper is to provide a measure of the welfare cost of stagnation by using the Lucas model and to measure the welfare cost of the Japanese long stagnation among different consumers from 1990 to 2002. The paper also evaluates differences in the cost of stagnation between consumers by using panels of different consumer groups (incorporating five income quintiles and nine districts groups). For each panel, we calibrate the model by using the model's parameter estimates, which are supplemented by estimates from previous research, and carry out robustness checks. This paper finds cost of stagnation differences between consumers. The costs for consumers in the lower income quintile and those in urban districts are higher. These results are robust, being independent of the sizes of the preference parameters. This paper suggests that such cost measurements are needed to recognize the costs of stagnation for other consumers and to produce a public opinion for the cost-full stagnation.

This paper relates to previous research as follows. Krusell and Smith (1999), Storestetten (2001) and Beaudry and Pages (2001) have pointed out theoretically that the representative consumer considered by Lucas should be replaced by heterogeneous consumers who are affected differently by economic instability. This paper measures costs for heterogeneous consumers (who differ in income levels and districts of residence). Saito (1996) and Dolmars (1998) have considered the Lucas model combined with a unit root

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[3] A useful survey of this field is Lucas (2003). He understated the cost of the business cycle. Much subsequent research has debated whether the cost of the business cycle is low.

process for the consumption series. We also investigate stationary and unit root processes. Consequently, we partly respond to previous critiques in this field.

This paper is organized as follows. In Section 2, we review the Lucas model and define the cost of stagnation by using the parameters in the consumption and utility functions. In Section 3, we describe the data set and the statistical methodology used for estimating the parameters. In Section 4, we estimate the costs of stagnation and discuss the estimates. In Section 5, we calibrate the model and check the robustness of the results. Section 6 concludes the paper.

2. Economic Models and Statistical Methodology

2.1. Model 1

We sketch the Lucas model. Consider a pure exchange economy with no production, no storable goods and no borrowing. Then, optimal consumption C_t for an agent is subject to exogenous income I_t in each period: $C_t = I_t$ for all t. The representative agent lives infinitely and maximizes an expected utility function V by choosing real consumption at time t, and has preferences specified by:

(1) $$V = E\left[\sum_{t=0}^{\infty} \beta^{t} \frac{1}{1-\gamma} C_t^{1-\gamma}\right],$$

where $\beta\Box(0,1)$ is a constant discount factor and $\gamma>0$ is the constant coefficient of relative risk aversion. We assume a class of exogenous consumption (or income) streams C_t with trend and cycle components, given by:

(2) $$C_t = \lambda(1+\mu)^t e^{-\frac{1}{2}\sigma^2} z_t,$$

where μ is the growth rate of consumption and $\ln z_t$ is assumed to be a stationary stochastic process distributed as $N(0, \sigma^2)$. Due to the property of the log-normal distribution, $E(z_t.\exp(-\sigma^2/2)) = 1$, mean consumption is $\lambda(1+\mu)^t$. Hence, mean consumption at $t = 0$ is λ. We use λ subsequently to measure 'compensation' for variations in the parameters μ and σ^2.

We now define the cost of stagnation. Given any choice of $(\lambda, \mu, \sigma^2 | \gamma, \beta)$ we can calculate the value of (1) given the consumption process described by (2) and denote the resulting indirect utility function by $V(\lambda, \mu, \sigma^2 | \gamma, \beta)$. This is derived as follows:

(3) $$V(\lambda,\mu,\sigma^2 | \gamma,\beta) = \frac{1}{(1-\gamma)(1-\phi)} \exp\left\{(1-\gamma)(\ln\lambda - \frac{\gamma}{2}\sigma^2)\right\} \quad \text{if } \phi < 1,$$
$$\phi = \exp\{\ln\beta + (1-\gamma)\ln(1+\mu)\}.$$

Details of the derivation are given in the Appendix. We define the cost of stagnation as follows.

Definition 1. The cost of stagnation is given by λ^*, which satisfies the following equation:

(4) $$V(\lambda_S + \lambda^*, \mu_S, \sigma_S^2 | \bar{\gamma}, \bar{\beta}) = V(\lambda_B, \mu_B, \sigma_B^2 | \bar{\gamma}, \bar{\beta}),$$

where the subscripts S and B denote the stagnation and base periods, respectively.

We compare two indirect utilities. One is $V(\lambda_S, \mu_S, \sigma_S^2 | \bar{\gamma}, \bar{\beta})$, which is based on actual consumption growth λ_s and its variance σ_s^2 in the stagnation period (called *the stagnation paradigm of consumption*). The other is $V(\lambda_B, \mu_B, \sigma_B^2 | \bar{\gamma}, \bar{\beta})$, which is based on expected consumption (called *the base paradigm of consumption*) under the assumption that the growth rate and variance of the base period persists indefinitely, starting from the beginning of the stagnation period, as shown in Figure 1. Thus, we compare both paradigms of consumption from the beginning of the stagnation period. Although γ and β differ between periods, we assume that they remain constant over time at $(\bar{\gamma}, \bar{\beta})$.

[INSERT Figure 1]

The key concept relating to the cost of stagnation is the following. The consumption parameters are different between the stagnation and base paradigms of consumption. Consumer preferences, given by $(\bar{\gamma}, \bar{\beta})$, transform the difference in consumption parameters into a difference in utility levels. The cost of stagnation is measured by the compensation, uniform across all periods, required to leave consumers indifferent between the consumption paradigms.[4]

The calculation of λ^* is given by:

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[4] Lucas defines the cost of reduced growth by λ^*:

$$V(1+\lambda^*, \mu_S, \bar{\sigma}^2 | \bar{\gamma}, \bar{\beta}) = U(1, \mu_B, \bar{\sigma}^2 | \bar{\gamma}, \bar{\beta}),$$

so that λ^* is the compensation required to leave the consumer indifferent between the growth rate of consumption in the stagnation paradigm μ_S and the growth rate of consumption in the base paradigm μ_B. Lucas normalized the equivalent of $\lambda_S + \lambda^*$ in our model as λ_S so that λ^* in his model is λ^*/λ_S in our model. The other parameters are assumed to be the same in both paradigms. Lucas also defines the cost of consumption instability by:

$$V(1+\lambda^*, \bar{\mu}, \sigma_S^2 | \bar{\gamma}, \bar{\beta}) = U(1, \bar{\mu}, 0 | \bar{\gamma}, \bar{\beta}).$$

Thus, our model incorporates each of the costs defined by Lucas (1987,p.24,27) so his model is a special case of ours.

(5)
$$\lambda^* = \exp\{\Psi\} - \lambda_S,$$
$$\Psi = \frac{1}{1-\bar{\gamma}}\left\{\ln\left(\frac{1-\phi_S}{1-\phi_B}\right) + (1-\bar{\gamma})(\ln\lambda_S - \bar{\gamma}\sigma_S^2/2)\right\} + \bar{\gamma}\sigma_B^2/2$$
,

where

$$\phi_S = \exp\{\ln\bar{\beta} + (1-\bar{\gamma})\ln(1+\mu_S)\} \text{ and } \phi_B = \exp\{\ln\bar{\beta} + (1-\bar{\gamma})\ln(1+\mu_B)\}.$$

The derivation is given in the Appendix.

2.2. Model 2

In model 1, consumption is assumed to be trend stationary, but there is empirical evidence against this assumption. Although Lucas (1987, p.22) argues that the importance of the random walk component is overstated, there is debate about the stochastic process followed by consumption. Subsequent studies (e.g., Saito:1996; Dolmars:1998) assume the following random walk process for consumption to compute the cost of business cycles:

(6)
$$\ln(C_{t+1}) - \ln(C_t) \sim N(m, \sigma^2), \quad t = 0,1,2$$

This formulation responds to the critique of trend stationarity in (2). We can derive the following indirect utility function:

$$V(\mathrm{m},\sigma^2\,|\,\gamma,\beta)=\frac{1}{(1-\gamma)(1-\varphi)}C_0^{\,1-\gamma}\qquad \text{if } \varphi<1,$$

(7) $$\varphi=\exp\left\{\ln\beta+(1-\gamma)\mathrm{m}+\frac{1}{2}(1-\gamma)^2\sigma^2\right\},$$

where C_0 is the consumption level at time 0. As in model 1, we compare the indirect utility $V(\mathrm{m}_S,\sigma_S^2\,|\,\bar{\gamma},\bar{\beta})$ for the stagnation paradigm with the indirect utility $V(\mathrm{m}_B,\sigma_B^2\,|\,\bar{\gamma},\bar{\beta})$ for the base paradigm, where C_0 is consumption at the beginning of the stagnation period. We define the cost of stagnation as follows.

Definition 2. The cost of stagnation is given by m*, which satisfies the following equation:

(8) $$V(\mathrm{m_S}+\mathrm{m}^*,\sigma_{\mathrm{S}}^2\,|\,\bar{\gamma},\bar{\beta})=V(\mathrm{m_B},\sigma_{\mathrm{B}}^2\,|\,\bar{\gamma},\bar{\beta}).$$

The cost of stagnation m* is the growth rate of consumption, which is the same in all periods, that would leave the consumer indifferent between the consumption paradigms, analogous to *Definition 1*. The direct calculation for m* gives:

(9) $$m^*=\frac{1}{1-\bar{\gamma}}(\varphi_B-\varphi_S):\quad \varphi_B=\exp\left\{\ln\bar{\beta}+(1-\bar{\gamma})\mathrm{m_B}+\frac{1}{2}(1-\bar{\gamma})^2\sigma_B^2\right\},$$
$$\varphi_S=\exp\left\{\ln\bar{\beta}+(1-\bar{\gamma})\mathrm{m_S}+\frac{1}{2}(1-\bar{\gamma})^2\sigma_S^2\right\}.$$

To calculate the welfare costs of stagnation, we proceed as follows. First, by using data for the whole period, we estimate the parameters (λ,μ,σ^2) for each consumption paradigm and then estimate the preference parameters (γ,β). These parameter estimates are reported in Table 2. Second, we measure the costs of stagnation, which are reported in Table 3. Third, we measure the costs of stagnation for consumers in different income quintiles and districts, which are reported in Tables 4 and 5. Fourth, we calculate these costs for varying values of the parameters (γ,β) to check the robustness of the results. These results are reported at the last panels of Table 4 and Table 5.

3. Data and Summary Statistics

The data used in this paper are monthly data from January 1975 to August 2002 (i.e., 1975:M1 to 2002:M8), which gives 332 observations. To estimate the parameters (λ, μ, σ^2) for consumption in the model, we use total consumption expenditure for workers' households from the *Monthly Report on Family Income and Expenditures Survey* (FIES). Since the FIES reports non-seasonally adjusted data, we apply the census X-11 method to obtain the seasonally adjusted series. The per capita series is constructed by dividing consumption expenditure by the number of family members in the household. These data are converted to real values by using the consumer price index (for general prices in 2000) from the *Monthly Report of the Consumer Price Index.* All data are taken from the NIKKEI NEEDS and the NIKKEI QUICK databases.

To compute the preference parameters (γ,β), we require data on asset returns. For stock returns, we use the stock price index from the *Rates of Stock Returns CD-ROM 2002* from the Japanese Securities Research Institute (JSRI) and for risk-free returns, we use data on the call-money market rate.[5] These nominal returns are converted to real returns by using the

[5] The JSRI index is a value-weighted index constructed from all the brand names traded on the first section of the Tokyo

consumer price index.

We partition the whole sample (1975:M1 to 2002:M8) into two sub-samples. The first sub-sample is from 1975:M1 to 1989:M12 and the second is from 1990:M1 to 2002:M8. The base period is the first sub-sample. Our objective is to estimate the cost of stagnation during the second period by comparing with the base paradigm of consumption. This partition of periods seems appropriate, and consistent with previous research including Hayashi and Prescott (2002). We suggest that stagnation began in 1990:M1, since the NIKKEI 225 peaked at a stock price of 38,926 yen in 1989:M12, since when it has fallen gradually, as has the price of land. These events are said to define the collapse of the so-called Japanese bubble economy. We maintain the importance of these events in defining the starting point of stagnation, as has previous research.

Figure 2 plots consumption in logs, which shows the behavior of the data in model 1. Table 1 reports selected summary statistics for the data in model 2. Figure 2 suggests a trend break in the log of consumption (which reduces consumption growth) around 1990:M1. In addition, Panels B and C of Table 1 show reduced mean consumption growth (–0.0000132) in the second period, which compares with growth of 0.00121 in the base period. These figures suggest an obvious structural change. Therefore, we do not implement a formal test for structural change between sub-periods.

[INSERT Table 1 and Figure 2]

We need to set the parameters $(\lambda,\mu,\sigma^2|\gamma,\beta)$ for model 1 and the parameters $(m,\sigma^2|\gamma,\beta)$ for

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Stock Exchange. An advantage of this index over frequently used indices such as the TOPIX and NIKKEI 225 is that we can take account of dividend payments.

model 2. The first three parameters for model 1 can be estimated by OLS after taking logs of equation (2), and the first two parameters for model 2 can be obtained by exploiting information on the sample mean and variance of consumption growth in Table 1. The other two parameters (γ and β) represent preferences that are typically estimated by applying the GMM (Generalized Method of Moments) estimator. However, Table 1 shows that the correlation between consumption growth and the excess return appears to be negative, which would make interpretation of the estimation results difficult even if tests of the overidentifying restrictions were to support the model. In addition, the mean excess return is negative in the second period, which would also prevent us from obtaining theoretically plausible estimates.

To overcome these problems, we use the method of Hansen and Singleton (1983), which has been widely applied in recent studies (see, e.g., Campbell, 1999). We assume a perfect correlation between consumption growth and the excess return, following Campbell (1999).[6]

4. Estimation Results and Discussion

Table 2 reports the estimated parameters for consumption and utility for workers' households. The parameters for model 1 were estimated by OLS. All parameter estimates are statistically

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[6] Hansen and Singleton's method is useful for finding the values of the parameters consistent with the observed data. More concretely, the values of γ and β are calculated by using the following relations:

$$E_t[\ln(1+r_{i,t+1})-\ln(1+r_{f,t+1})]+\frac{1}{2}\sigma_i^2=\gamma\sigma_{ic} \;\; ; \;\; \frac{1}{\beta}-1=E_t[\ln(1+r_{f,t+1})]-\gamma E_t[\ln(C_{t+1}/C_t)]+\gamma^2\sigma_c^2/2,$$

where $\gamma_{i,t+1}$ and $\gamma_{f,t+1}$ are the rates of return on risky and risk-free assets between t and t+1, respectively, σ_i^2 is the variance of $\ln(1+\gamma_{i,t+1})$, σ_c^2 is the variance of $\ln(C_{t+1}/C_t)$ and σ_{ic} is the covariance between $\ln(1+\gamma_{i,t+1})$ and $\ln(C_{t+1}/C_t)$. In practice, the population moments are replaced by the sample moments, reported in Table 1. See Campbell (1999, pp.1249-1250) for more details.

significant at the 1% level. The estimated monthly consumption growth rate falls from 0.106% in the base period to –0.00197%. The standard deviation (which represents instability) of the error term in the log of consumption increases from 0.01531 to 0.01986. The estimate of initial consumption in 1975:M1 is 78,074.60 yen in the base period and 99,028.21 yen in the stagnation period. This implies that λ_S in equations (4) and (5) is 99,028.21 yen.

In model 2, the mean monthly consumption growth rate falls from 0.121% to –0.00132% and the standard deviation of consumption growth in equation (6) increases from 0.01705 to 0.02057. The monthly consumption growth rates imply annual rates of $(1.00121)^{12}-1 = 1.4617\%$ and $(0.99999)^{12}-1 = -0.016\%$, respectively. The initial levels of consumption C_0 in equation (6) are the observed values in 1975:M1 and 1990:M1, which are taken from Table 1. What is the estimated cost of stagnation according to models 1 and 2? As explained in Section 3, to measure these costs, we calculate the preference parameters by using Hansen and Singleton's (1983) method. For the whole period, the value obtained for $\bar{\gamma}$ is 2.55994, while the value of $\bar{\beta}$ is (at most) 0.99889.

[INSERT Table 2]

As Table 3 shows, by using these parameters in equation (3) for model 1, we obtain a utility level of –3.74021E (–06) for the base paradigm and one of –9.57848E (–06) for the stagnation paradigm. This implies that stagnation reduces utility. Our cost measure λ^* enables us to convert the reduction in the utility level into a level of compensation in Japanese yen, which is the same for all time periods. The cost of stagnation is 81,990.25 yen. Similar results are obtained from model 2. The utility level decreases in the stagnation period.

The cost implied by the mean consumption growth rate is 0.132%, which roughly equals the difference between the consumption growth rates of 0.121% and –0.00132% in the two sub-period periods, as seen in Table 2.

[INSERT Table 3]

To check the robustness of the results, we calibrate the preference parameters in (1). We use $\gamma = 0.5, 1.5, 2.5, 5.0$ and $\beta = 0.99889$ (for simplicity), which encompass the range of parameter values used in previous research (see, e.g., Pallage and Robe, 2003). Note here that $\gamma > 0$ implies risk aversion. The costs in model 1 range from 50,490.88 yen to 270,900.55 yen as γ decreases. The ratio of costs based on the assumed values of γ to the cost estimated in model 1 ranges from 0.62 to 3.30.

Corresponding figures for the costs in model 2 range from 0.119% to 0.148%, with the ratio ranging from 0.90 to 1.12. Hence, the magnitudes of cost in model 2 are quite robust, being independent of the magnitude of γ.

Thus, the proposed welfare cost measure λ^*, which is particularly relevant to consumers, suggests that the cost of stagnation is large for consumers as a whole (i.e., when the representative agent is assumed). However, why do consumers perceive the cost of stagnation to be low? To address this question, we consider only the cost in model 1.

We measure the welfare costs of workers' households in different categories. Figure 3 plots the consumption series for workers' households in five income quintile groups. For example, the five income quintiles observed in 2002 are (in millions of yen per year): less than 4.56; from 4.56 to 6.03; from 6.03 to 7.62; from 7.62 to 9.79; and greater than 9.79.[7] We

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[7] The same household will belong to some income quintile in the current year and to another quintile in the subsequent year.

evaluate the changes in these consumption series by using model 1.

Panels A and B of Table 4 report the consumption parameters (λ, μ, σ^2) and the preference parameters (γ, β) for each income quintile. By using these estimated preference parameters, we evaluate the difference in consumption parameters between the base and stagnation paradigms. The larger the difference in consumption parameters between the paradigms and the smaller the associated preference parameters, the higher the costs of stagnation.

There is substantial variation in the differences in (μ, σ^2) between the five income quintile groups. For the first and fourth groups, the differences in (μ, σ^2) between the stagnation and base periods are (–0.00126, –0.01898) and (–0.00124, 0.01280), respectively, and that for the fifth group is (–0.00092, –0.01801). These differences are computed from the figures in Table 4. However, the preference parameters (1.39364, 0.99866) and (1.42708, 0.99822) for the first and fourth groups are larger than those for the fifth group. Consequently, the larger differences in consumption parameters are associated with higher costs of stagnation (i.e., 86,206.13 yen and 92,302.02 yen), when compared with the cost of 57,213.74 yen for consumers in the fifth group. The cost is around twice as high as that for consumers in the upper income quintile. The costs of 86,206.13 yen and 92,302.02 yen are approximately 119% and 85% of the initial levels of consumption, 72,359.35 yen and 107,990.66 yen, prevailing in 2000:M1. The cost of 57,213.74 yen amounts to 43% of this level. Hence, the costs for the first and fourth groups are three times as high as the cost for the fifth group. Thus, there are large differences in the costs of stagnation for consumers in different income quintile groups. These findings are supported by Figure 3, which shows that consumption growth increases and decreases more for the first and fourth groups in both

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We suppose that the household changes the preference and consumption parameters from one year to the next.

sub-periods.

[INSERT Table 4]

Similar investigations are applied to the cost for consumers living in different districts. As Table 5 shows, the costs for consumers living in rural districts such as Hokkaido (19,233.64 yen, or 20% above initial consumption in the stagnation period), Shikoku (–13,925.79 yen, or 16% *below* initial consumption) and Kyusyu (13,271.89 yen, or 15% above initial consumption) are low. In fact, consumers in the Shikoku district benefited during the stagnation period. By contrast, the costs for consumers in urban districts such as Kanto (146,454.10 yen, or 135% above initial consumption in the stagnation period) and Kinki (60,134.28 yen, or 61% above initial consumption) are high. Thus, there are large costs of stagnation differences for consumers living in different districts.

High costs are attributable to a large decrease in the growth rate μ and the associated small preference parameter γ. Why does the consumption growth rate μ for these groups decrease by more than it does for those in the upper income quintile and those in rural districts? This is an interesting question for future research.

[INSERT Table 5]

5. Robustness of Costs in Different Categories

We calibrate the model by using $\gamma = 0.5, 1.5, 2.5, 5.0$ and the estimates of β for consumers in different categories, as in the previous section. We check the robustness of the effects by using different values of γ. The results are shown in Tables 4 and 5. The smaller the value of γ, the larger the cost. When the value of γ is the same for the consumers in each income quintile group, the cost for the first group is the largest for $\gamma = 0.5$. For all γ values, cost tends to fall as income levels increase. Moreover, the costs in lower groups account for more than 50% of initial level of consumption, even when $\gamma = 5.0$, while those in higher groups account for no more than 50%, even when $\gamma = 0.5$. Thus, higher costs appear in lower groups, while lower costs appear in the upper income quintiles, approximately independently of the value of γ.

Similarly, we check the robustness of the costs in different districts when the value of γ is the same for consumers in each district. For all values of γ, Kanto, Kinki and Hokuriku remain the highest cost districts, while Hokkaido, Kyusyu and Shikoku remain the lowest cost districts, since the order of magnitude for cost does not change. Moreover, the highest cost (for $\gamma = 0.5$) of the low-cost districts exceeds the lowest cost (for $\gamma = 5.0$) of the high-cost districts. Hence, costs for consumers living in the urban districts are high, and are low for those in the rural districts, approximately independently of the value of γ.

6. Concluding Remarks

In general, Japanese consumers do not feel the stagnation to be cost-full.

At least two reasons are considered. First, since there are cost differences between consumers, the costs are not high for some groups of consumers. Second, there are no welfare measures of the cost of stagnation, so consumers are not concerned with this cost and fail to recognize the high costs to other consumers. Recognition of the costs to other consumers would motivate governments to implement effective policies in the early stages of serious stagnation.

This paper has provided a measure of the cost of stagnation and has calculated the cost of the Japanese long stagnation beginning in January 1990. We found that the cost of stagnation for consumers as a whole is high. In particular, the costs of stagnation for consumers in low income quintiles and for consumers living in urban districts are the highest. These findings illustrate differences in costs between consumers and then explain why some consumers do not feel the stagnation to be cost-full. We suggest that a welfare measure of cost is necessary for consumers to recognize the costs of stagnation to other consumers. Finally, we confirmed the robustness of the results by calibrating the model by using values of the preference parameters that have been widely used in previous research.

We did encounter at least two problems. First, we include the period of the Japanese bubble economy (1985 to 1989) in our base period. Hence, the base period is simply the previous period, as is standard. Second, in the context of estimating the preference parameters (γ, β), we encountered a negative excess return rate and negative correlations between the excess return rate and consumption growth. The preference parameters are sensitive to these problems, and so too, therefore, are the estimated costs of stagnation. These problems are expected to be resolved in the future, but our approach remains useful for understanding the costs of stagnation.

Appendix

Derivation of equation (3)

Taking the logarithm of consumption in (2) and defining the first three terms as α_t, we obtain the following:

(A-1) $$\ln C_t = \alpha_t + \ln z_t, \quad \alpha_t = \ln \lambda + t \cdot \ln(1+\mu) - \frac{1}{2}\sigma^2 .$$

Clearly, $E(\ln C_t) = \alpha_t$ and $Var(\ln C_t) = \sigma^2$. In addition, due to the property of log-normality, $E(C_t) = \exp\{\alpha_t + \sigma^2/2\}$. In the utility function (1), we take logarithms and obtain the following:

(A-2) $$\ln E[\beta^t c_t^{1-\gamma}] = \ln E[\beta^t \eta_t^{1-\gamma} z_t^{1-\gamma}], \eta_t \equiv \lambda(1+\mu)^t e^{-\frac{1}{2}\sigma^2} .$$

Using the above property of log-normality, we can rewrite the above equation as:

(A-3) $$\ln E[\beta^t \eta_t^{1-\gamma} z_t^{1-\gamma}] = E[\ln(\beta^t \eta_t^{1-\gamma} z_t^{1-\gamma})] + Var[\ln(\beta^t \eta_t^{1-\gamma} z_t^{1-\gamma})]/2 .$$

Extensive rearrangement yields the following:

(A-4) $$E[\ln(\beta^t \eta_t^{1-\gamma} z_t^{1-\gamma})] = t\ln\beta + (1-\gamma)(\ln\lambda + t\ln(1+\mu) - \sigma^2\gamma/2),$$
$$\mathrm{Var}[\ln(\beta^t \eta_t^{1-\gamma} z_t^{1-\gamma})] = (1-\gamma)^2\sigma^2.$$

Hence,

(A-5) $$\ln E[\beta^t \eta_t^{1-\gamma} z_t^{1-\eta}] = [\exp(\ln\beta + (1-\gamma)\ln\mu)]^t \exp\{(1-\gamma)(\ln\lambda - \sigma^2\gamma/2)\} .$$

Thus, inserting these relations into (1) yields the following indirect utility function:

(A-6) $$V = \frac{1}{(1-\gamma)}\sum_{t=0}^{\infty} E[\beta^t \eta_t^{1-\gamma} z_t^{1-\gamma}] = \frac{1}{(1-\gamma)}\exp\{(1-\gamma)(\log\lambda - \sigma^2\gamma/2)\}\sum_{t=0}^{\infty}\phi^t,$$
$$\phi = \exp\{\ln\beta + (1-\gamma)\ln(1+\mu)\}.$$

■

Derivation of equation (5)

Substituting (4) into (3) yields:

$$\text{(A-7)}\quad \frac{1}{1-\phi_S}\cdot\exp\left\{(1-\bar{\gamma})(\ln(\lambda_S+\lambda^*)-\frac{\bar{\gamma}}{2}\sigma_S^2)\right\}=\frac{1}{1-\phi_B}\cdot\exp\left\{(1-\bar{\gamma})(\ln\lambda_S-\frac{\bar{\gamma}}{2}\sigma_B^2)\right\}.$$

Taking logarithms of (A-7) yields:

$$\text{(A-8)}\quad \ln(\lambda_S+\lambda^*)=\frac{1}{(1-\bar{\gamma})}\left\{\ln(\frac{1-\phi_S}{1-\phi_B})+(1-\bar{\gamma})(\ln\lambda_S-\frac{\bar{\gamma}}{2}\sigma_B^2)\right\}+\frac{\bar{\gamma}}{2}\sigma_S^2.$$

We replace the right-hand side of (A-8) by Ψ to obtain equation (5).

References

Atkeson, A. and C. Phelan (1994), "Reconsidering the cost of business cycles with incomplete markets", NBER Macroeconomics Annual 1994, MIT Press Cambridge, MA:187–207.

Beaudry, P. and C. Pages (2001), "The cost of business cycles and the stabilization value of unemployment insurance", European Economic Review 45:1545–1572.

Campbell, J.Y., (1999), "Asset prices, consumption, and the business cycle", J.B. Taylor and M. Woodford (eds.) Handbook of Macroeconomics, Vol.1C:1231–1303.

Dolmars, J.(1998), "Risk preferences and the welfare cost of business cycles", Review of Economic Dynamics 1:646–676.

Hayashi, F. and E.C. Prescott (2002), "The 1990s in Japan: A lost decade", Review of Economic Dynamics 5:206–235.

Hansen, L.P., and K. J. Singleton (1983), "Stochastic consumption, risk aversion, and the temporal behavior of asset returns", Journal of Political Economy 91:249–265.

Imrohoroglu, A. (1989), "Cost of business cycles with indivisibilities and liquidity constraints", Journal of Political Economy 97: 1364–1383.

Lucas, R.E. (1987), Models of Business Cycles, Blackwell, Oxford.

Lucas, R.E. (2003), "Macroeconomic priorities", American Economic Review :1–14.

Krusell, P. and Smith, A.A.Jr. (1999), "On the welfare effects of eliminating business cycles", Review of Economic Dynamics

2: 245–272.

Pallage, S. and Robe, M.A. (2003), "On the welfare cost of economic fluctuations in developing countries", International Economic Review 44: 677–698.

Saito, M.(1996), A New Macroeconomics (in Japanese), Yuhikaku, Tokyo.

Storestetten, K., Telmer, C.I. and Yaron, A. (2001), "The welfare cost of business cycles revisited: Finite lives and cyclical variation in idiosyncratic risk", European Economic Review 45:1311–1339.

Table 1. Summary Statistics for Consumption Growth and Asset Returns

(A) 1975:M1-2002:M8 (observations = 332)					
	Mean	Std. Dev	Max	Min	Correlation
Consumption	0.00065	0.01872	0.08356	–0.07490	1
Stock return	0.00276	0.05131	0.15256	–0.22791	–0.03948
Call return	0.00162	0.00554	0.01589	–0.01969	0.26958
Excess return	0.00114	0.05107	0.15483	–0.22642	–0.06893

(B) 1975:M1-1989:M12 (observations = 180)					
	Mean	Std. Dev	Max	Min	Correlation
Consumption	0.00121	0.01705	0.08356	–0.05428	1
Stock return	0.01116	0.03900	0.15256	–0.11243	0.03976
Call return	0.00202	0.00654	0.01589	–0.01922	0.36892
Excess return	0.00914	0.03803	0.14807	–0.11094	–0.02270
Initial consumption level = 76,566.00 (yen)					

(C) 1990:M1-2002:M8 (observations = 152)					
	Mean	Std. Dev	Max	Min	Correlation
Consumption	–1.32E(–05)	0.02057	0.05362	–0.07490	1
Stock return	–0.00719	0.06151	0.15024	–0.22791	–0.10013
Call return	0.00114	0.00402	0.01086	–0.01969	0.14452
Excess return	–0.00832	0.06193	0.15483	–0.22642	–0.10884
Initial consumption level = 97,603.83 (yen)					

Note: Consumption is the consumption growth, which is calculated as the first difference in the of log real consumption. Stock return and call return are the log of the real return: log(1+x), where x is the rate of return. Excess return is defined as stock return minus call return. E(–x) denotes 10^{-x}.

Table 2. Estimated Parameters for Utility and Consumption (Aggregate)

(A) Consumption Parameters		
Model 1	Base period	Second period
λ	78074.60	99028.21
μ	0.00106	−1.97E(−05)
σz	0.01531	0.01986
Model 2		
m	0.00121	−1.32E(−05)
σ	0.01705	0.02057
C_0	76,566.00	97,603.83
(B) Utility Parameters		
γ	2.55994	
β	0.99889	

Note: These parameters are for the monthly consumption and utility. C_0 is consumption in yen: 1975:M1 and 1990:M1. The λ, μ, and σ_z are the estimated parameters by using OLS on:

$$\ln C_t = \ln \lambda - \frac{1}{2}\sigma_z^2 + t \cdot \ln(1+\mu) + \ln z_t$$

The σ_z is the estimated standard error, while λ and μ are derived from estimated coefficients of constant and trend terms. Both coefficients were significantly positive. E(−x) denotes 10^{-x}.

Table 3. Costs of Stagnation (Aggregate)

Models		Indirect Utility Base period	Second period	Costs of Stagnation	
Model 1				λ* (\ yen)	λ* (γ)/λ* (γ*)
γ= γ*	β = β*	–3.74021E(–06)	–9.57848E(–06)	81,990.25	1
γ= 0.5	〃	1,087,523.95	562,785.70	270,900.55	3.30
γ= 1.5	〃	–3.87924	–5.78376	121,186.70	1.48
γ= 2.5	〃	–7.93304E(–06)	–1.98274E(–06)	83,417.96	1.02
γ= 5.0	〃	–4.87532E(–06)	–2.53006E(–06)	50,490.88	0.62
Model 2				m*	m* (γ)/m* (γ*)
γ= γ*	β = β*	–4.01028E(–06)	–1.84007E(–05)	0.00132	1
γ= 0.5	〃	1,329,586.88	588,120.34	0.00119	0.90
γ= 1.5	〃	–3.82330	–6.10134	0.00125	0.95
γ= 2.5	〃	–8.44934E(–06)	–3.56419E(–05)	0.00132	1.00
γ= 5.0	〃	–7.65087E(–19)	1.18219E(–18)	0.00148	1.12

Note: λ* (γ)/λ* (γ*) denotes the ratio of cost based on γ to cost based on γ*, where γ* is estimated as 2.55994 in this model.

β* is 0.99889.

Table 4. Cost of Stagnation (Income Quintile Groups)

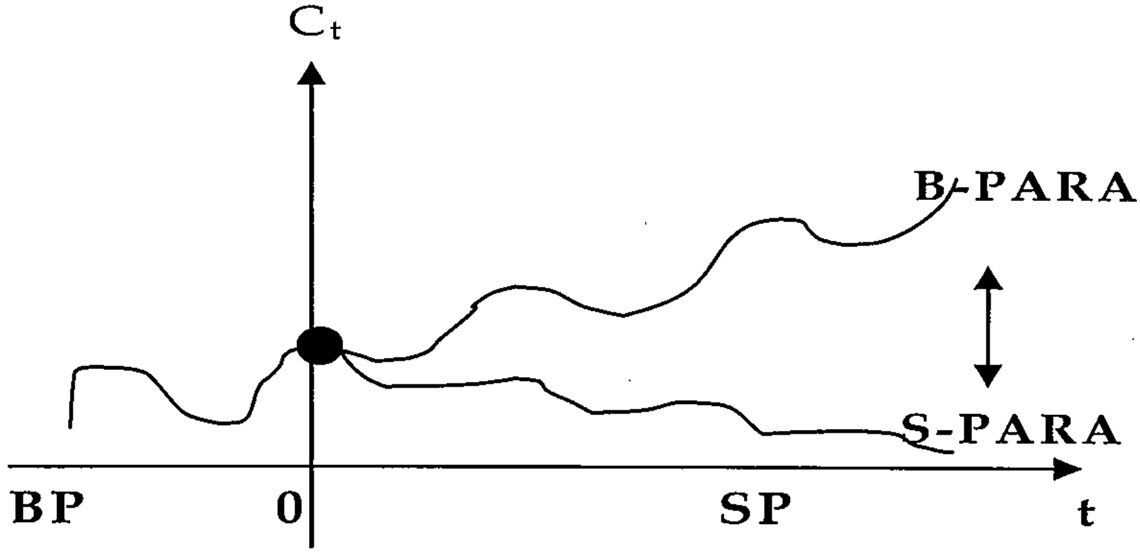
	Period	Group 1	Group 2	Group 3	Group 4	Group 5
(A) Consumption Parameters						
λ	Base	55,359.86	65,277.98	73,142.88	82,800.55	108,663.37
	Second	72,359.35	81,970.93	95,077.73	107,990.66	132,660.70
μ	Base	0.00136	0.00112	0.00104	0.00118	0.00089
	Second	0.00010	0.00013	−0.00023	−0.00006	−0.00003
σ	Base	0.05306	0.03082	0.02731	0.02444	0.05304
	Second	0.03408	0.02635	0.03276	0.03724	0.03503
(B) Utility Parameters						
γ		1.39364	1.59063	1.38929	1.42708	1.32368
β		0.99866	0.99879	0.99809	0.99822	0.99758
(C) Cost of Stagnation						
$\gamma = \gamma^*$	$\beta = \beta^*$	86,206.13	71,915.78	81,675.36	92,302.02	57,213.74
		(119)	(88)	(86)	(85)	(43)
$\gamma = 0.5$	"	206,960.31	169,043.79	107,425.56	142,178.38	68,813.10
		(286)	(206)	(113)	(132)	(52)
$\gamma = 1.5$	"	81,048.78	75,271.54	79,667.10	90,078.72	55,330.68
		(112)	(92)	(84)	(83)	(42)
$\gamma = 2.5$	"	52,789.23	50,229.70	67,050.62	69,098.75	47,004.24
		(73)	(61)	(71)	(64)	(35)
$\gamma = 5.0$	"	29,158.03	28,223.11	55,118.55	46,809.71	35,137.48
		(40)	(34)	(58)	(43)	(26)

Note: The β^* and γ^* are estimated parameters for each income quintile group. The numbers in parentheses denote the ratio (%) of cost to the estimated initial consumption λ in the second period.

Table 5. Cost of Stagnation (Districts)

	Period	Hokkaido	Tohoku	Kanto	Hokuriku	Tokai	Kinki	Chugoku	Shikoku	Kyusyu
(A) Consumption Parameters										
λ	Base	81460.21	79495.84	79979.85	74178.53	72998.93	78794.62	79037.68	78196.49	77118.62
	Second	96693.36	91257.46	108097.62	97227.61	93003.28	98959.90	95397.72	87880.22	90211.30
μ	Base	0.00065	0.00054	0.00136	0.00139	0.00121	0.00101	0.00100	0.00064	0.00045
	Second	0.00027	0.00003	-0.00029	0.00037	0.00037	-0.00013	-0.00003	0.00102	0.00019
σ_z	Base	0.04459	0.04630	0.02682	0.05509	0.03752	0.02630	0.052150	0.05936	0.04603
	Second	0.05766	0.05214	0.02633	0.07139	0.04889	0.04088	0.057470	0.06490	0.04095
(B) Utility Parameters										
γ		0.83614	0.90987	1.58713	0.66309	0.96124	1.38105	0.86062	0.70810	1.13972
β		0.99781	0.99764	0.99835	0.99762	0.99795	0.99777	0.99753	0.99757	0.99810
(C) Cost of Stagnation										
$\gamma=\gamma*$	$\beta=\beta*$	19233.64	22269.87	146454.10	61682.52	47600.70	60134.28	52198.98	-13925.79	13271.89
		(20)	(24)	(135)	(63)	(51)	(61)	(55)	(-16)	(15)
γ=0.5	〃	20842.63	23577.76	260983.32	67802.51	61253.66	75475.21	57694.73	-15032.15	14974.48
		(22)	(26)	(241)	(70)	(66)	(76)	(60)	(-17)	(17)
γ=1.5	〃	16634.92	20676.31	150647.39	42872.07	38039.25	58687.14	45135.98	-10878.47	12477.75
		(17)	(23)	(139)	(44)	(41)	(59)	(47)	(-12)	(14)
γ=2.5	〃	13928.23	18535.52	118402.07	31784.68	27954.15	49595.36	37872.33	-8508.73	10707.13
		(14)	(20)	(110)	(33)	(30)	(50)	(40)	(-10)	(12)
γ=5.0	〃	10079.25	14973.12	102711.39	19878.18	17115.28	38248.56	28125.97	-5442.65	7900.49
		(10)	(16)	(95)	(20)	(18)	(39)	(29)	(-6)	(9)

Figure 1. Base and stagnation paradigms of consumption



Note: BP (B-PARA) and SP (S-PARA) denote base and stagnation periods (paradigms of consumption), respectively.

Figure 2. Per capita total consumption in logarithm (Aggregate)

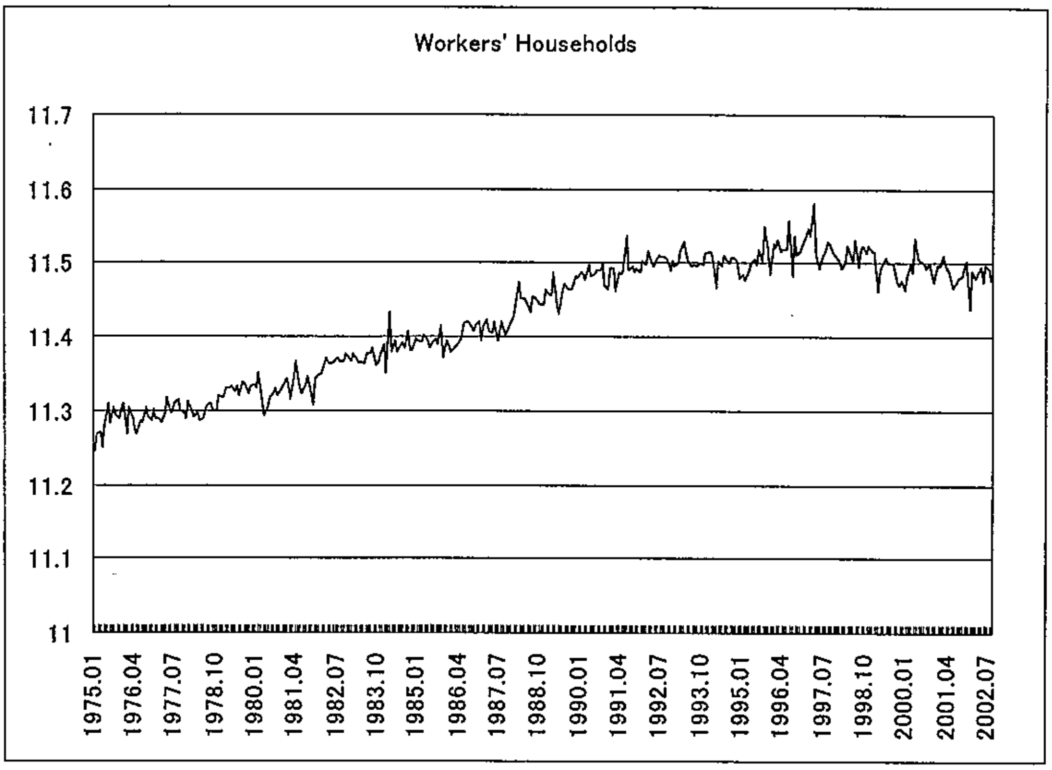


Figure 3. Per capita total consumption in logarithm (Income Quintile Groups, Workers' Households)

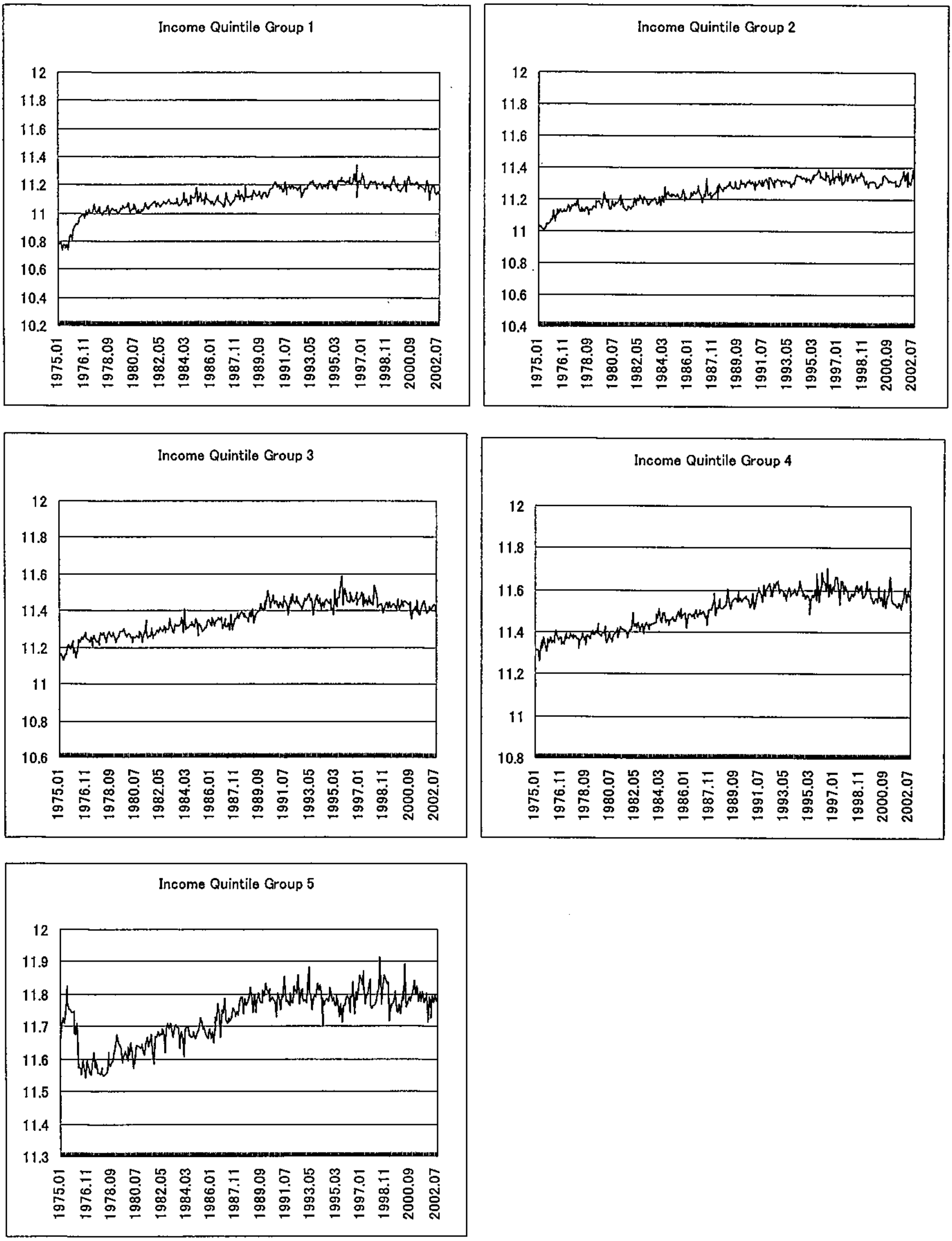


Figure 4. Per capita total consumption in logarithm (Districts, Workers' Households)

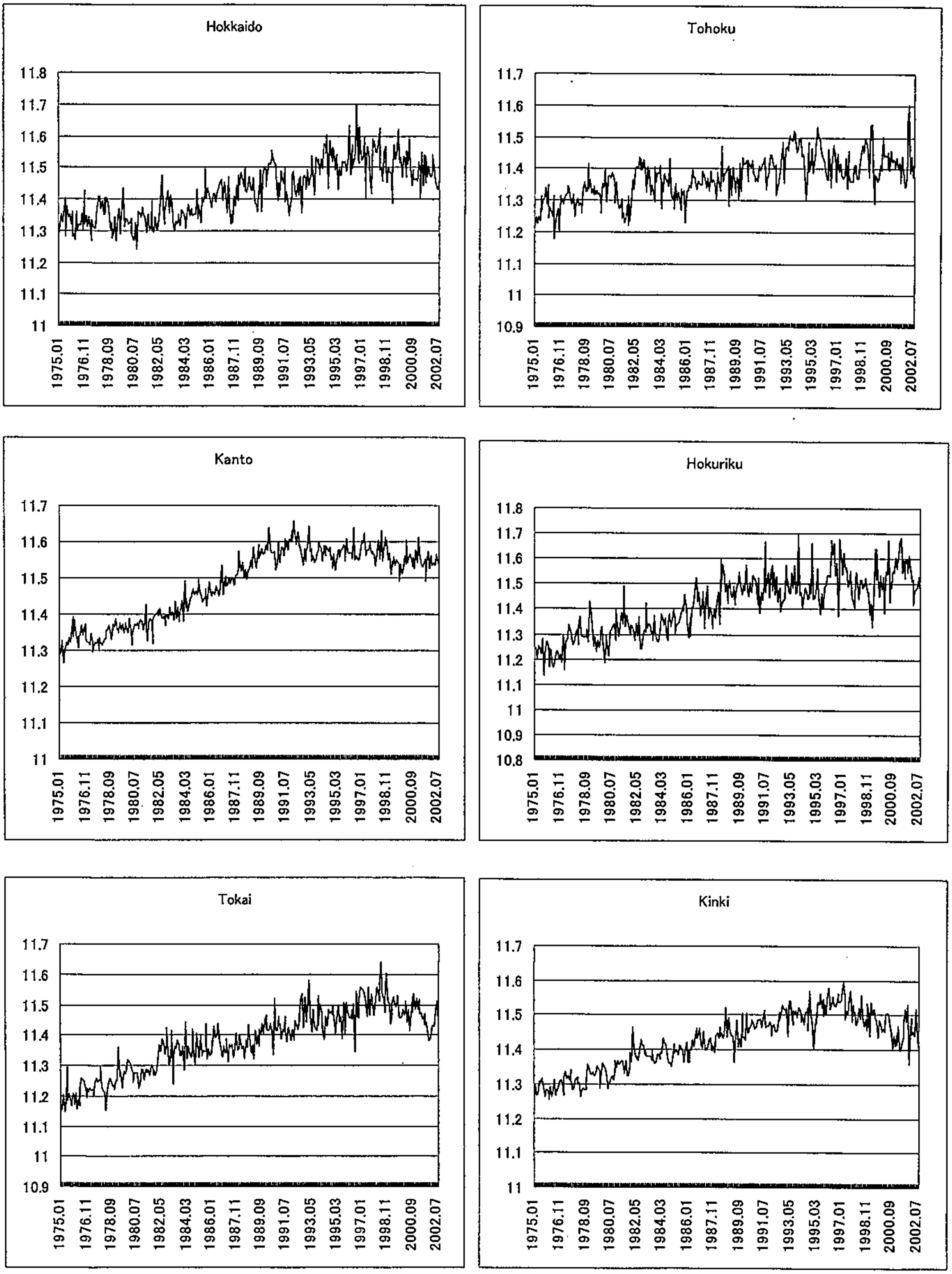


Figure 4. Per capita total consumption in logarithm (Districts, Workers' Households, continued)