Non-regular Workers and the Stagnant Economy

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Abstract

This paper specifically examines features of labor supply heterogeneity in Japanese households and describes how such a structure affects household expenditure, which has stagnated during the last two decades. The particular circumstances represent the increase of non-regular workers but are not necessarily limited to Japan. Non-regular workers are definable in many dimensions, but a common feature is that they have quite unstable contracts of employment. If such labor increases greatly, then one can assess the impact on the actual economy. Therefore, a general equilibrium model was constructed to explain some empirical VAR evidence. The model shows that the reactions of aggregate consumption and housing investment to the shock of increasing non-regular worker ratio are negative and that they are consistent with empirical results. Housing investment exhibits greater sensitivity to the shock. Moreover, decreasing output for consumption goods and housing investment in response to the shock is greater than that decrease of demand. This paper suggests that employing few non-regular workers is preferred and that non-regular workers should not be employed for long periods.

Keywords: non-regular workers, collateral constraint, household demand, DSGE model.

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1. Introduction

Since the bubble era, Japan's economy has not yet emerged from its long-run slump, which has lasted two decades. The development of *non-regular* workers is one noticeable feature that has produced the severely stagnated economy of that period. Figure 1 displays the transition of the share of non-regular workers among total labor (hereinafter, the *non-regular worker ratio*). Actually, the ratio was 17% in 1986 and was 34% in 2008, doubling over that period. In fact, one in three workers is a non-regular worker. Moreover, Figure 1 shows that, after 1990, the number of employees has remained mostly stable at 50 million, which emphasizes that a rise in the non-regular worker ratio is attributable simply to an increase in the number of non-regular workers.

In the 1980s, non-regular workers (often wives) were employees working to cover income that the main supporters (often husbands) earned. This surely meant that the income earned by non-regular workers was less than that of regular workers. However, during more than a decade after the bubble burst, circumstances by which the number of non-regular workers has increased can reflect that non-regular workers also play a role of the main supporters of their own households. If such households increase, then they are not able to support the same amount of consumption as flexibly as regular households might.

In Figure 2, it is readily apparent that the income of non-regular workers is below that of regular workers. As this figure shows, the medians are roughly estimated as around 0.8 million (Non-regular) and around 3.9 million (Regular) in 2002, and to be around 1.2 million (Non-regular) and around 4.1 million (Regular) in 2007. What is the effect of such income inequality on both non-regular workers' consumption and regular workers' consumption? Presumably, no much difference exists between them in basic consumption in support of necessary expenditures (i.e., spending for food or clothing). However, non-regular workers who earn low income are unable to spend for housing investment or durable goods (i.e., automobile or home electronics) to the same degree as regular workers might. Non-regular workers can not afford to consume these additional goods aside from required fundamental consumption[2]: unless non-regular workers borrow additional funds

[2] In January 2009, the Research Institute of Economy, Trade and Industry (RIETI) in Japan investigated employment of non-regular workers, especially dispatched workers, using web questionnaires. The web survey, 'Survey on life and job behavior of dispatched workers,' revealed that non-regular workers who are

from agents such as banks, they are unable to purchase these luxury goods and services. Actually, a high probability exists that they can not pass a bank's examination for borrowing because they are non-regular workers and are unable to prove a stable income.

As described above, one might readily infer that increasing in non-regular workers causes a process of consumption without smoothness. In an economy where a kind of wedge exists, if some usual policies are taken, then the desirable outcomes will not ever be obtained. Now such recognition is being shared, and studies from an economic perspective intended to elucidate effects of rising non-regular workers are developing. Many themes related to the topic of non-regular workers exist to be studied. One approach comprises three steps. First, available data can be used to confirm the degree of impact of an increasing non-regular workers on the economy. Second, based upon results obtained in the first step, one can build a general equilibrium model in which non-regular workers are specified. The model can explain the aggregate time-series evidence. Furthermore, it is possible to ascertain the degree of distortion of the existence of non-regular workers. Third, it is possible to compare some policies used by government in an economy of non-regular workers with some policies in an economy of regular workers only. This paper presents a simple general equilibrium model that reflects the existence of non-regular workers up to the second step of the approach described above.

Details of the effects of the rise in non-regular workers on the economy must be considered. This paper presents specific examination of housing investment as a good that requires the additional funds for purchasing. With respect to the actual Japanese economy, although the growth rate of real GDP was 1.08% during 1991–2008, the growth rate of real residential investment was 0.78%. One factor causing this stagnation is the rise of non-regular workers. Here, a simple mechanism is considered: an increase in the non-regular worker ratio causes a decline in housing investment as explained below. If many regular workers are fired and an equal number of non-regular workers are hired, then they earn income as non-regular workers and consume with plans that forego housing investment. Therefore, housing investment in the whole economy declines because the share of non-regular workers increases, even as total employees remain constant: by increasing the non-regular worker ratio, the spending power in the entire economy falls. An important factor in this mechanism is that the scale of non-regular workers to all workers is not negligible. Increasing the number of non-regular workers might push Japan's economy

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not able to save up money smoothly account for more than 70% of all non-regular workers.

further into stagnation.

To date, although the definition of non-regular workers has not been clear, non-regular workers and the causes of increasing non-regular worker employment are defined simply here. A sharp rise of non-regular workers has occurred not only in Japan but also in the United States, the United Kingdom, European countries, and Korea (Organization for Economic Co-operation and Development, 2002). Generally, non-regular workers are defined as workers who are not regular workers. However, studies by Suzuki (1999) point to a no single common definition of non-regular workers accepted worldwide.

Some definitions of non-regular workers exist in Japan because some government statistics capture non-regular workers[3]. Among them, the "Labour Force Survey", a survey of households usually residing in Japan, provides wide coverage of non-regular workers.

Based on the Labour Force Survey, the definitions of non-regular workers have three varieties. First, non-regular workers are those who work fewer hours than regular workers (fewer than 35 hours per week). Second, non-regular workers are workers who are not designated as "regular employees" at work[4]. Finally, non-regular workers are those workers who have a job contract that expires within a year. The last definition is the same as the definition of 'temporary workers' defined by the OECD (Organization for Economic Co-operation and Development, 2002).

In this paper for Japan's economy, referring to the three definitions presented above, non-regular workers are defined as workers who work shorter hours than regular workers do. Especially, a dynamic general equilibrium model is constructed in which such non-regular workers appear at the later part of this paper, and the model built under the empirical evidence of aggregate time-series. For example, the model used for this study reflects the feature that regular workers work 1.73 times longer than non-regular workers in point of official working hours[5]. A firm that hires regular workers and non-regular workers chooses nonscheduled working hours to maximize its profit.

Empirical evidence of the causes of increasing use of non-regular workers has been widely documented by Cappelli and Neumark (2004), Comin and Mulani (2006), Comin

[3] Statistical data on non-regular workers are issued by a few government ministries, for example, the Ministry of Internal Affairs and Communications and the Ministry of Health, Labour and Welfare

[4] "Non-regular employees" are part-time employees, contract employees, fixed-term employees, and temporary employees.

[5] Based on Labor Force Survey, the average was calculated from 1990Q4 to 2008Q4.

and Phillippon (2006), Ono and Sullivan (2006), Organization for Economic Co-operation and Development (2008), and Vidal and Tigges (2009). These studies have highlighted the swing of corporate performance. Especially, for Japan, Morikawa (2010) and Sano et al. (2011) showed that the reasons underlying increased use of non-regular workers correspond not to the industrial level but to the firm level. Furthermore, another factor from the firm level is that labor force of non-regular workers is gathered easily and labor costs are low. As in Autor et al. (2003) and Ikenaga (2009), such a factor causes firms to decrease regular workers and to hire non-regular workers, which almost work were simplified by information technology.

What impact does the increase in non-regular workers have on the real economy? Actually, many reports in the literature have described that expanding the non-regular worker ratio has had a negative effect on firm productivity in southern European countries[6] (i.e., Sanchez and Toharia, 2000, Dolado and Stucchi, 2008, and Boeri and Garibaldi, 2007). Oshima (2009) surveys details of the relation between non-regular workers and productivity.

No theoretical study described in the literature has examined non-regular workers who play a role as representatives of households. However, some studies specifically examine labor supply heterogeneity with housing investment. Eusepi and Preston (2009) and related studies portray a model comprising employed consumers and unemployed consumers. The model generates some empirical regularities using U.S. labor market data. The idea that family members of two types exist in the model economy, which these studies have highlighted, is adopted here. Moreover, Iacoviello (2005) and Monacelli (2009) studied a general equilibrium (new Keynesian) model that assumes that some households (borrowers) are subject to borrowing constraints by Kiyotaki and Moore (1997) to purchase housing or durable goods. This perspective is also adopted here. Adoption of a borrowing constraint can be justified from results of some empirical studies (Hayashi 1985 and 1987, Kohara and Horioka 1999) and will add to the borrowers some characteristics as non-regular workers.

The household types presented in this paper include non-regular workers and regular workers, not employed and unemployed people. This assumption reflects that the unemployment rate has remained stable during the past half decade: some non-regular

[6] From OECD, 15.6% in 1987 $\rightarrow$ 35.0% in 1995 $\rightarrow$ 29.3% in 2008 in Spain. 4.8% in 985 $\rightarrow$ 12.5% in 2009 in Italy. 14.4% in 1986 $\rightarrow$ 22.0% in 2009 in Portugal.

workers are able to work for a year; others become unemployed temporarily. If this conjuncture arises every quarter, then the unemployment rate will be stable. Although many authors have specifically examined the sharp rise of non-regular workers empirically and have analyzed some theoretical model with unemployment, no study has introduced non-regular workers as one household type into a general equilibrium model that can explain the aggregate time-series evidence.

The paper is organized as follows. Section 2 presents some VAR evidence with the non-regular worker ratio. Section 3 presents the basic model. Section 4 analyzes its dynamics. Section 5 concludes the paper.

2. Empirically increasing non-regular worker shock

To assess the impact of a shock caused by increasing non-regular workers, we estimate Japan's quarterly VAR model specified as

$$Y_t = \sum_{i=1}^{L} A_i Y_{t-i} + B\varepsilon_t , \tag{1}$$

where ε_t is a vector of contemporaneous disturbances. Vector Y_t consists of four variables: (i) detrended TFP, (ii) detrended non-regular worker ratio (s), (iii) detrended real household consumption (Consumption), and (iv) detrended real housing investment (Housing), which represents real private residential investment. This composition includes all goods and services which non-regular workers are unable to obtain easily[7]. The VAR system is estimated over sample 1990Q4 – 2008Q4[8]. This VAR is used to document the key relations in the data. Figure 4 presents impulse responses of four variables to four identified shocks. Dashed lines represent 90-percent bootstrapped confidence bands.

1. A persistent response of the non-regular worker ratio to own shock.
2. To ratio shock, although not significantly, the negative responses of real aggregate consumption and housing investment.

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[7] All data except the calculated TFP are available at the Statistics Bureau of the Ministry of Internal Affairs and Communications and the ESRI of the Cabinet Office

[8] TFP has already been detrended linearly. TFP is estimated based upon Kamada and Masuda (2001) and Kawamoto (2004), who adopted the *TANKAN DI*. The VAR system features a constant and two lags.

3. The response of housing to a shock is greater than that of consumption; and
4. Neither positive nor negative response of the ratio to a positive technology shock.

These results are robust to the specifications of alternative ordering and fewer or additional lags. The remainder of the paper presents development of a model that is consistent with these facts.

3. The model

Considering a discrete time, infinite horizon economy, populated by *entrepreneurs* and households of two types, this economy comprises a continuum of households in the interval of (0,1). Two types of households exist, respectively designated as *non-regular workers* and *regular workers*, of measure s and $1-s$. The households (workers) of two types have heterogeneous preferences by which non-regular workers are more impatient than regular workers. The term "patient" reflects the assumption that non-regular workers have lower discount rates than regular workers and firms[9]. Entrepreneurs produce a homogeneous good, hiring household labor of two types[10]. Households consume, work, and demand housing investment: all households derive utility from consumption of a final good and from possessing housing services. In addition, *retailers* and a *central bank* exist. Retailers are the source of nominal rigidity. The central bank adjusts the short-term nominal interest rate.

3.1. Non-regular worker households

As described above, the existence of non-regular workers is identified here in point of hours worked. Working hours for both non-regular and regular workers are composites of

[9] For earlier models with heterogeneity in discount rates, see Becker (1980), Kiyotaki and Moore (1997), Iacoviello (2005), Campbell and Hercowitz (2006), and Monacelli (2009).

[10] A non-regular worker is not assumed to be promoted to regular worker or a regular to be demoted to non-regular worker unfortunately. Especially, the assumption of the non-switch from a non-regular to a regular worker is justified from 'General Survey on Temporary Workers' Contract 2009/2011' by Ministry of Health, Labour and Welfare (in Japanese only).

scheduled and nonscheduled hours. As the data show, regular workers work 1.73 times as long as non-regular workers in point of official working hours; then their scheduled hours are assumed to be constant. For workers of both types, nonscheduled hours are chosen by firms in view of the corporate performance and are assumed to be varying.

If the assumptions described above are fully adopted, then non-regular worker households maximize the following utility program:

$$E_0\left\{\sum_{t=0}^{\infty}\beta_N^t U(c_{N,t},\mathsf{C}_{t-1},h_{N,t},\mathsf{H}_{t-1},L_{c,t}^N,L_{h,t}^N)\right\} \tag{2}$$

$$U(c_{N,t},\mathsf{C}_{t-1},h_{N,t},\mathsf{H}_{t-1},L_{c,t}^N,L_{h,t}^N)$$
$$= \ln(c_{N,t}-f_c\mathsf{C}_{t-1})+j\ln(h_{N,t}-f_h\mathsf{H}_{t-1})-\frac{1}{1+\eta_N}\left\{(L_{c,t}^N)^{1+\varepsilon_N}+(L_{h,t}^N)^{1+\varepsilon_N}\right\}^{\frac{1+\eta_N}{1+\varepsilon_N}}$$

Therein, household utility depends on the lagged aggregate consumption and housing and housing investment, defined as

$$\mathsf{C}_t = (1-s_t)\times c_{R,t}+s_t\times c_{N,t},$$
$$\mathsf{H}_t = (1-s_t)\times h_{R,t}+s_t\times h_{N,t},$$

and

$$L_{c,t}^N = \overline{L}_{c,N}+L_{cN,t}, \tag{3}$$
$$L_{h,t}^N = \overline{L}_{h,N}+L_{hN,t} \tag{4}$$

subject to the sequence of budget constraints (in nominal terms):

$$P_t c_{N,t}+Q_t(h_{N,t}-(1-\delta_h)h_{N,t-1})+R_{t-1}B_{N,t-1}+\Xi_{hN,t} = B_{N,t}+W_{cN,t}L_{c,t}^N+W_{hN,t}L_{h,t}^N, \tag{5}$$

where E_0 stands for the expectation operator, $\beta_N\in(0,1)$ denotes a discount factor, $c_{N,t}$ signifies consumption at t, $h_{N,t}$ denotes the holding of housing, $L_{c,t}^N$ and $L_{h,t}^N$ respectively represent total hours worked for consumption goods and housing investment, $\overline{L}_{c,N}$ and $\overline{L}_{c,N}$ respectively denote constant scheduled working hours for each sector, $L_{cN,t}$ and $L_{cN,t}$ are variable nonscheduled working hours, Q_t is the nominal housing price, $B_{N,t-1}$ is the end-of-period t nominal one period debt, R_{t-1} is the nominal interest rate on loan between $t-1$ and t, $W_{N,t}$ represents the nominal wage, and $\Xi_{hN,t}$ is the nominal adjustment cost for housing, which is symmetric for each agent.

In real terms, (3) reads

$$c_{N,t}+q_t(h_{N,t}-(1-\delta_h)h_{N,t-1})+\frac{R_{t-1}}{\pi_t}b_{N,t-1}+\xi_{hN,t} = b_{N,t}+w_{cN,t}L_{c,t}^N+w_{hN,t}L_{h,t}^N, \tag{6}$$

where

$$\xi_{N,t} = \frac{\phi_h}{2\delta_h}\left(\frac{h_{N,t} - (1-\delta_h)h_{N,t-1}}{h_{N,t-1}} - \delta_h\right)^2 q_t h_{N,t-1}, \tag{7}$$

and $\xi_{N,t}$ is the real adjustment cost for housing. In addition, $q_t \equiv \frac{Q_t}{P_t}$ stands for the real housing price, $\pi_t \equiv \frac{P_t}{P_{t-1}}$ signifies the gross inflation rate, $b_{N,t-1} \equiv \frac{B_{N,t-1}}{P_t}$ denotes the real debt, and $w_{cN,t} \equiv \frac{W_{cN,t}}{P_t}$ and $w_{hN,t} \equiv \frac{W_{hN,t}}{P_t}$ respectively represent the real wages in sectors of consumption goods and housing investment.

As in Kiyotaki and Moore (1997), a limit is assumed on the obligations of non-regular workers: if the borrowers deny the call from lenders, then the lenders can repossess not the expected complete future value of the housing but a fraction of the value. The borrowers' assets are equal to lenders' collections after depreciation and paying a proportional transaction cost: $mE_t\left(q_{t+1}(1-\delta_h)h_{N,t}\right), 0 < m < 1$. In other words, the value $mE_t\left(q_{t+1}(1-\delta_h)h_{N,t}\right)$ is equal to the value of collateral. Finally, the maximum amount $R_t B_{N,t}$ that a creditor can borrow is set as below in real terms:

$$R_t b_{N,t} \le mE_t\left(q_{t+1}(1-\delta_h.)h_{N,t}\pi_{t+1}\right). \tag{8}$$

Assuming that the collateral constraint (8) is always satisfied with equality in and around the steady state, Equation (8) can be expressed in real terms as

$$R_t b_{N,t} = mE_t\left(q_{t+1}(1-\delta_h.)h_{N,t}\pi_{t+1}\right). \tag{9}$$

3.2. Regular worker households

Aside from non-regular workers, the economy comprises a type of household that offers regular workers. They have already turned up in the dynamic optimization literature as representative agents. Non-regular workers discount the future more heavily than regular workers do: regular workers correspond to patient workers characterized in previous studies.

Moreover, as in previous subsections, regular workers are identified as workers of the opposite to non-regular workers: the official hours are longer than the non-regular worker hours.

If the assumptions described above are fully adopted, then regular workers maximize

the following utility program:

$$E_0\left\{\sum_{t=0}^{\infty}\beta_R^t U(c_{R,t},\mathsf{C}_{t-1},h_{R,t},\mathsf{H}_{t-1},L_{c,t}^R,L_{h,t}^R)\right\} \tag{10}$$

$$U(c_{R,t},\mathsf{C}_{t-1},h_{R,t},\mathsf{H}_{t-1},L_{c,t}^R,L_{h,t}^R)$$
$$= \ln(c_{R,t} - f_c\mathsf{C}_{t-1}) + j\ln(h_{R,t} - f_h\mathsf{H}_{t-1}) - \frac{1}{1+\eta_R}\left\{(L_{c,t}^R)^{1+\varepsilon_R} + (L_{h,t}^R)^{1+\varepsilon_R}\right\}^{\frac{1+\eta_R}{1+\varepsilon_R}},$$

for which the following are true:

$$L_{c,t}^R = \overline{L}_{c,R} + L_{cR,t}, \tag{11}$$
$$L_{h,t}^R = \overline{L}_{h,R} + L_{hR,t} \tag{12}$$

Those expressions are subject to the sequence of budget constraints (in real terms) as

$$c_{R,t} + q_t(h_{R,t} - (1-\delta_h)h_{R,t-1}) + \frac{R_{t-1}}{\pi_t}b_{R,t-1} + \xi_{hR,t} = b_{R,t} + w_{cR,t}L_{c,t}^R + w_{hR,t}L_{h,t}^R + F_t, \tag{13}$$

where

$$\xi_{R,t} = \frac{\phi_h}{2\delta_h}\left(\frac{h_{R,t} - (1-\delta_h)h_{R,t-1}}{h_{R,t-1}} - \delta_h\right)^2 q_t h_{R,t-1}, \tag{14}$$

for which $\xi_{R,t}$ is the real adjustment cost for housing, F_t denotes lump-sum profits received from the retailers (described below), and $\beta_N < \beta_R$. The latter assumption guarantees an equilibrium in which non-regular workers will hit the borrowing constraint.

3.3. Entrepreneurs of intermediate consumption goods

Entrepreneurs produce intermediate consumption goods, which are differentiated and which face perfect competition. They hire workers of two types (non-regular and regular workers) as labor inputs $L_{N,t}$ and $L_{R,t}$ and they have access to a production function in producing intermediate goods:

$$Y_{c,t} = A_{c,t}\left[\left(L_{c,t}^R\right)^{(1-a_{c,t})}\left(L_{c,t}^N\right)^{a_{c,t}}\right]^{\mu_c} \tag{15}$$

and equivalently

$$a_{c,t} = \frac{w_{cN,t}L_{c,t}^N}{w_{cN,t}L_{c,t}^N + w_{cR,t}L_{c,t}^R},$$

where A_t denotes productivity and obeys the AR(1) process[11], which does not affect the non-regular worker ratio as a result of empirical examination, parameter μ_c is the labor income share for intermediate goods, $a_{c,t}$ represents the non-regular wage share between non-regular workers and regular workers in intermediate (consumption) goods market, and s_t is the time-varying ratio of non-regular workers and obeys AR(1) process. Finally, entrepreneurs maximize their own profits as Π_t, subject to Equations (15) and (16).

$$\Pi_{c,t} = \frac{Y_{c,t}}{X_t} - (w_{cR,t} L_{c,t}^R + w_{cN,t} L_{c,t}^N)$$

3.4. Retailers

To introduce the source of nominal stickiness in the model economy, Bernanke et al. (1999) is followed, with the assumption that monopolistic competition occurs at the "retail" level. Final good Y_t^F is a CES composite of a continuum of mass unity of differentiated retailers, indexed by z. They purchase intermediate outputs from entrepreneurs at P_t^E and use them as the sole input. Total final goods are the following composite of individual retail goods:

$$Y_t^F = \left[\int_0^1 Y_t(z)^{(\varepsilon-1)/\varepsilon} dz \right]^{-\varepsilon/(\varepsilon-1)}, \tag{16}$$

with $\varepsilon > 1$. The corresponding price index is given as

$$P_t = \left[\int_0^1 P_t(z)^{(1-\varepsilon)} dz \right]^{1/(1-\varepsilon)}. \tag{17}$$

Therefore, each retailer faces an individual demand curve:

$$Y_t(z) = \left(\frac{P_t(z)}{P_t} \right)^{-\varepsilon} Y_t^F. \tag{18}$$

The retailer chooses the sales price $P_t(z)$, taking as given the demand curve and the price of wholesale goods, P_t^w.

To introduce nominal rigidities, a retailer can adjust its price freely with probability $1-\theta$, following Calvo (1983). Letting $P_t^*(z)$ be the "reset" price set by retailers who are able to revise their prices at period t, and letting $Y_t^*(z)$ be the demand at this price, then the retailer chooses a price to maximize the expected discounted profit, given as

[11] From empirical evidence presented in previous sections, one assumes that technology is unrelated to the non-regular worker ratio directly.

$$\sum_{t=0}^{\infty}\theta^k E_t\left[\Lambda_{t,k}\left(\frac{P_t^*(z)-P_{t+k}^w}{P_{t+k}}\right)Y_{t+k}^*(z)\right], \tag{19}$$

where $\Lambda_{t,k}\equiv\beta(c_{R,t}/c_{R,t+k})$ is the regular worker household relevant discount factor.

Differentiating the objective with respect to P_t^*, the optimal price must satisfy the following condition of

$$\sum_{t=0}^{\infty}\theta^k E_t\left[\Lambda_{t,k}\left(\frac{P_t^*(z)}{P_{t+k}}-\frac{X}{X_{t+k}}\right)Y_{t+k}^*(z)\right]=0, \tag{20}$$

where $X_t(\equiv P_t/P_t^w)$ is the markup, which equals to $X^*=\varepsilon/(\varepsilon-1)$ in a steady state. As in BGG and Iacoviello (2005), this condition states that P_t^* equates the expected discounted marginal revenue to the expected discounted marginal cost. Given that the fraction θ of retailers do not change their price in period t, the aggregate price evolves according to

$$P_t=[\theta P_{t-1}^{1-\varepsilon}+(1-\theta)'(P_t^*)^{1-\varepsilon}]^{1/(1-\varepsilon)}. \tag{21}$$

By combining Equations (22) and (23), and then log-linearizing, it is possible to obtain a forward-looking Phillips curve.

3.5. Housing producers

In a competitive flexible price market, new homes are produced with labor only and without productivity. The production technology is

$$Y_{h,t}=\left[\left(L_{h,t}^R\right)^{(1-a_{h,t})}\left(L_{h,t}^N\right)^{a_{h,t}}\right]^{\mu_h}. \tag{22}$$

Equivalently, the following is useful.

$$a_{h,t}=\frac{w_{hN,t}L_{h,t}^N}{w_{hN,t}L_{h,t}^N+w_{hR,t}L_{h,t}^R}.$$

Housing producers solve the following maximization to hire labor:

$$\Pi_{h,t}=q_tY_{h,t}-(w_{hR,t}L_{h,t}^R+w_{hN,t}L_{h,t}^N).$$

3.6. Central bank

Monetary policy is conducted using a simple Taylor-type rule as

$$R_t=(R_{t-1})^{\gamma_R}\left(\pi_{t-1}^{1+\gamma_\pi}(Y_{c,t-1}^F/Y_{c,t-1})^{\gamma_x}R^*\right)^{1-\gamma_R}\varepsilon_{R,t}, \tag{23}$$

where R^* denotes the steady state real interest rate, Y_{t-1}^F is the final output (total demand) by retailer, and Y_{t-1}^N stands for the natural rate of output. In addition, $\varepsilon_{R,t}$ is a policy shock assumed to have zero mean, with variance σ_{ε_R}.

3.7. Market clearing

The market clearing conditions are given by the following:

$$\mathsf{C}_t = (1-s_t)\times c_{R,t} + s_t \times c_{N,t}, \tag{24}$$

$$\mathsf{H}_t = (1-s_t)\times h_{R,t} + s_t \times h_{N,t}, \tag{25}$$

$$Y_{c,t}^F = \mathsf{C}_t, \tag{26}$$

$$Y_{h,t} = (1-s_t)(h_{R,t} - (1-\delta_h)h_{R,t-1}) + s_t(h_{N,t} - (1-\delta_h)h_{N,t-1}), \tag{27}$$

$$0 = (1-s_t)\times b_{R,t} + s_t \times b_{N,t}, \tag{28}$$

$$Y_{c,t}^F = D_t \times Y_{c,t} \tag{29}$$

and finally,

$$D_t = \theta D_{t-1}\pi_t^{\alpha} + (1-\theta)\left(\frac{1-\theta\pi_t^{\theta-1}}{1-\theta}\right)^{-\frac{\alpha}{1-\theta}}. \tag{30}$$

In those equations, C_t represents the total spending for consumption, H_t stands for the total spending for housing investment, and D_t denotes price dispersion[12]. Equations (19)–(24) respectively represent the goods market, the total household consumption, the borrowing–lending relation, resource constraint for real estate, the linkage between wholesale and retail output, and the price dispersion form.

3.8. Deterministic steady state

In the deterministic steady state, inflation π^* is assumed as one. Therefore, R^* corresponds to the real interest rate. It is equal to the reciprocal of the regular workers' discount rate $1/\beta_R$ from their consumption Euler condition. Because of the assumption that the regular workers' discount rate is greater than the non-regular workers' discount rate, $\beta_N < \beta_R$. In this case, it is necessary to verify that the debt of non-regular workers is always

[12] See Gertler and Karadi (2010).

positive. It is possible to evaluate (8) in the steady state and obtain

$$\frac{b_N^*}{Y^*} = m(1-\delta_h)\beta_R\{f_h\Omega_{5R} + \Omega_{1N}(\Omega_{5N} - f_c)\}, \tag{31}$$

where

$$\Omega_{1N} = \frac{j(1-\beta_N f_h s^*)}{\{1-\beta_N(1-\delta_h) - (\beta_R - \beta_N)m(1-\delta_h)\}(1-f_c s^*)} > 0, \tag{32}$$

and where $\Omega_{5R}, \Omega_{5N} > 0$ respectively represent the steady state of housing price and consumption for non-regular workers[13]. The steady-state debt for regular workers $\frac{b_R^*}{Y^*}$ is always negative $-\frac{s^*}{1-s^*}\frac{b_N^*}{Y^*}$ and corresponds to saving. It is particularly interesting that the amount of saving that regular workers need to prepare for non-regular workers' loans depends on the steady-state non-regular worker ratio s^*, i.e., if the steady state s^* is set to 0.34, a regular worker saves half the amount which a non-regular worker borrows, whereas a regular worker must save more than the required amount by a regular worker when $s^* > 0.50$.

3.9. Calibration and solution method

Some parameters are calibrated based on the data sample means and other studies. The steady-state real rate of interest is set as $R^* = 1.5$. Then, because it is pinned down by the regular workers' discount rate, this setting implies that $(1/\beta_R)^4 = 1.015$, and in turn that $\beta_R = 0.996$. The non-regular worker's discount rate was set as $\beta_N = 0.95$. Next, the parameters η_R, η_N, e_R, and e_N, specifying the disutility of labor, were set respectively to 3.00, 2.00, 0.40, and 0.80[14]. The non-regular worker "loan-to-value" ratio m is set to 0.50 initially. Finally, as in Iacoviello (2005), the parameters j are set to 0.10.

The existence of non-regular workers can be specified further. When scheduled hours worked for regular workers in the market of consumption goods $\bar{L}_{c,R}$ is valued as 1.28, from the empirical result that scheduled working hours for regular workers are 1.73 times as great as those of non-regular workers, non-regular workers' scheduled hours $\bar{L}_{c,N}$ were set to 0.73 (=1.28/1.73). Similarly, if scheduled hours worked for regular workers in the

[13] See Appendix for more information.

[14] These settings follow Horvath (2000).

market of housing $\bar{L}_{h,R}$ are valued as 0.13, then non-regular workers' scheduled hours $\bar{L}_{h,N}$ are 0.08. As economy-wide parameters, an annual depreciation rate for housing is chosen as 0.04 percent: $\delta_h = 0.01$. Furthermore, the habit parameters f_c and f_h are set respectively to 0.11 and 0.00.

As firms' parameters, the income share of consumption goods μ_c, and the income share of housing μ_h were set respectively to 0.63, and 0.70. The elasticity α is 30. The degree of nominal rigidity to generate a frequency of price adjustment of about eight quarters is the probability of not resetting prices θ. Following Sugo and Ueda (2008), who estimated Japan's Bayesian DSGE model, θ equals 0.87. Moreover, the elasticity of substitution of intermediate goods ε is set to 5, implying a steady state mark-up $X^*(=\frac{\varepsilon}{\varepsilon-1})$ of 25%. For the steady state ratio of non-regular workers s^*, it was set to 0.34, which results from the data sample mean. Finally, for the Taylor rule, as in Sugo and Ueda (2008), the following were set: $\gamma_x = 0.11$, $\gamma_\pi = 0.60$, and $\gamma_R = 0.84$.

The solution methods consist in taking a log-linear approximation of the equilibrium conditions in the neighborhood of the deterministic steady state. Dynare was used, which derives the reduced form representation of the DSGE model and which automatically provides stability and eigenvalue analysis.

4. Simulation results

4.1. Baseline responses

It is straightforward to demonstrate the ability to produce an empirically plausible response to non-regular worker ratio shock. Figures 6 and 7 display the impulse responses of selected variables to a persistent ratio shock [15]. These variables are selected as macroeconomic variables described in Section II. Figures show the responses of ten key variables: aggregate consumption, housing investment, output for consumption, output for housing investment, inflation, the output gap, nominal interest rate, housing prices, savings, and borrowing.

[15] It is a 10 basis point innovation.

4.1.1. Consumption goods

Aggregate consumption (i.e. consumption goods) is examined first. Particularly the impact elasticity of consumption to a 10-percent increase in the non-regular worker ratio is around -0.02. This result, in terms of shape, is close to the empirical value. This arises from the realization that the ratio shock has persistence.

This picture highlights the reason underlying the success of the model in tracking down the empirical negative elasticity of spending to ratio. To better understand the result, it is useful to interpret that the figures exhibit responses of each type of worker (non-regular and regular worker). As described in Section 2, s can relate to the share of non-regular worker's wage. Therefore, one can presume that if s goes up, then income for non-regular worker rises and non-regular worker can consume more consumption goods so that income for non-regular workers rises. However, such a mechanism by which non-regular workers' income rises seems not to be at work in the model[16]. The top left and right in Figure 8 display the impulse responses of consumption by regular workers (right) and non-regular workers (left) to the ratio shock. The rise in the non-regular ratio reduces the regular worker's consumption and increases the non-regular worker's consumption. The two responses go in opposite directions, and for a scale of impact, the latter reaction is much greater than the former. Therefore, aggregate consumption declines because the negative effects of both regular workers and ratio itself are dominant.

Details of the mechanism underlying each worker's consumption can be discussed. Therefore, it is useful to reinterpret the linearized optimality condition between the ratio and consumption. For instance, for regular workers, it can be written as

$$\begin{aligned}\hat{c}_{R,t} &= \mathsf{C}_{R,-1}\hat{c}_{R,t-1} + \mathsf{C}_{R,+1}E_t\hat{c}_{R,t+1} - \mathsf{C}_{R,+2}E_t\hat{c}_{R,t+2} + \mathsf{C}_{N,-1}\hat{c}_{N,t-1} - \mathsf{C}_{N,0}\hat{c}_{N,t} \\ &+ \mathsf{C}_{N,+1}E_t\hat{c}_{N,t+1} - \mathsf{S}_{R,-1}\hat{s}_{t-1} + \mathsf{S}_{R,0}\hat{s}_t - \mathsf{S}_{R,+1}E_t\hat{s}_{t+1} - \mathsf{R}(\hat{R}_t - E_t\pi_{t+1}),\end{aligned} \tag{33}$$

where

$$\mathsf{C}_{R,-1}, \mathsf{C}_{R,0}, \mathsf{C}_{R,+1}, \mathsf{C}_{R,+2}, \mathsf{C}_{N,-1}, \mathsf{C}_{N,0}, \mathsf{C}_{N,+1}, \mathsf{S}_{R,-1}, \mathsf{S}_{R,0}, \mathsf{S}_{R,+1}, \mathsf{R} > 0.$$

This equation clearly illustrates that, keeping consumption in regular and non-regular cases, immediately after the shock, the effect of expected non-regular worker ratio is negative and large. Thereafter, by adding to the effect of past ratio, the negative effect on regular worker's consumption expands well. Moreover, this equation is reinterpreted as a demand equation for consumption goods based on the intertemporal work style, which means that

[16] Full details will be explained later in Section 4.2.

the negative sign of the term s_{t-1} is the memory of a past event, that the positive sign of the term s_t is a relief that a present ratio s_t is exactly lower than past ratio s_{t-1}, and that the negative sign of the term s_{t+1} signifies anxiety about an increasing ratio.

Regarding the response of output for consumption goods after shock, it shows the same characteristics of response as aggregate consumption does (bottom left in Figure 6). However, the output gap is slightly positive and hump-shaped. Moreover, the reaction of inflation is sharply negative, but inflation is not negative and the sale price does not fall in terms of a deviation from the steady state because the steady state of inflation is assumed to be 1. From the Taylor rule assumption, the nominal interest rate depends mainly upon the interest rate inertia (middle left in Figure 7).

The mechanism underlying these results ($\pi < 1$ and $\pi \approx 1$ and $x > 0$) can be inferred by referring to Figure 4, which displays the supply demand relation between retailers and wholesalers (entrepreneurs)[17]. Assuming the steady state before shock express a point E in the figure, the results for both retailers and wholesalers as their reactions to a shock stands respectively for points M and N. With respect to each response of price and quantity, as described earlier, because (retail price) inflation is strictly close to 1% but less than 1%, the retail price increases from the steady state price, and from Equation (18), intermediate goods demanded (final goods supplied) by retailers decline. To generate the positive output gap, the output by wholesalers decreases more than the retailers' output. Therefore, wholesale prices are lower than the steady state price for wholesalers. The mark-up X_t ($\equiv p_t/p_t^w$) rises. It consistently brings inflation down according to NKPC $\hat{\pi}_t = \beta_R \hat{\pi}_{t-1} - \kappa \hat{X}_t$.

4.1.2. Housing investment

The top right area of Figure 6 displays the response of aggregate housing investment to a ratio shock. The increase in the ratio reduces aggregate housing investment as well as aggregate consumption. The effect of a ratio shock keeps 1 percent persistently, even at 20 quarters after shock. To ascertain the mechanism behind this result, it is necessary to estimate each response of both regular and non-regular workers to a change in ratio. The bottom right and left in Figure 8 display a positive reaction of non-regular workers' housing investment and a negative reaction of regular workers to the shock. Although the

[17] The goods supplied to households differ from goods produced by retailers. Therefore, a vertical axis in the figure stands for prices of two kinds.

figures in this paper display the responses of model variables until 20 quarters, for instance, the peak response of non-regular workers' housing investment reaches 7.33% at 29 quarters after a shock, and the response of regular workers comes up to -0.16% at 32 quarters. Both responses persistently maintain a situation in which the variables deviate from the steady states.

As in the case of aggregate consumption, the demand equation must be shown for housing investment for a regular worker. Housing investment can be expressed as the following:

$$\hat{h}_{R,t} = -\mathsf{H}_{c_R,-1}\hat{c}_{R,t-1} - \mathsf{H}_{c_R,0}\hat{c}_{R,t} + \mathsf{H}_{c_R,+1}\hat{c}_{R,t+1} + \mathsf{H}_{c_R,+2}\hat{c}_{R,t+2} - \mathsf{H}_{c_N,-1}\hat{c}_{N,t-1}$$

$$+ \mathsf{H}_{c_N,0}\hat{c}_{N,t} + \mathsf{H}_{c_N,+1}\hat{c}_{N,t+1} + \mathsf{H}_{R,-1}\hat{h}_{R,t-1} + \mathsf{H}_{R,+1}\hat{h}_{R,t+1} + \mathsf{H}_{N,-1}\hat{h}_{N,t-1}$$

$$- \mathsf{H}_{N,0}\hat{h}_{N,t} + \mathsf{S}_{R,-1}\hat{s}_{t-1} - \mathsf{S}_{R,0}\hat{s}_t + \mathsf{S}_{R,+1}\hat{s}_{t+1} \tag{34}$$

where

$$\mathsf{H}_{c_R,-1}, \mathsf{H}_{c_R,0}, \mathsf{H}_{c_R,+1}, \mathsf{H}_{c_R,+2}, \mathsf{H}_{c_N,-1}, \mathsf{H}_{c_N,0}, \mathsf{H}_{c_N,+1}, \mathsf{H}_{R,-1}, \mathsf{H}_{R,+1}, \mathsf{H}_{N,-1},$$

$$\mathsf{H}_{N,0}, \mathsf{S}_{R,-1}, \mathsf{S}_{R,0}, \mathsf{S}_{R,+1} > 0 .$$

This equation illustrates clearly that, keeping other terms constant except for the term of the ratio, the current term of ratio on $h_{R,t}$ has a dominant negative effect. Moreover, according to the characteristic of housing that it has durability, i.e., that it is not completely consumed in one period, regular workers need not increase housing at the current period after shock s_t and are able to support their housing demand from s_{t-1} and $E_t s_{t+1}$.

As in the case of aggregate consumption, the positive response of non-regular workers' housing demand is apparently caused by a change in their income. In the sector of housing production, as assumed for simplicity, an increase in ratio can mean that the income share of regular workers changes negatively. Therefore, non-regular workers generally earn more from a housing sector and add to housing investment. However, the results were not what they seem to be[18]. The demand for non-regular workers' housing investment grows mainly because the housing price decreased. After shock, the non-regular workers who provide shorter worked hours than regular workers play a more important role in producing housing, the power of housing production, and its price fall (see the middle

[18] I will document the full details later.

right in Figure 7). However, interestingly, the fall in price can be reinterpreted as follows. Declining housing prices stimulate non-regular workers' housing demand and prevent aggregate housing demand from falling more than necessary.

Although each response is not compatible because the size of shock in the empirical model is not the same as that of the theoretical model, to compare the differences in the empirical responses of both housing and aggregate consumption with the differences in the theoretical responses is insightful. In an empirical model, the degree of the response in housing is 6.25 times as great as that of aggregate consumption. Housing is 6.93 times as great, in terms of consumption, in the theoretical model. The results are not particularly different. Consequently, in the part of this paper describing calibration, it seems certain that the choices of values in deep parameters are consistent with those of the actual economy.

4.1.3. Saving and borrowing

The bottom right and left in Figure 7 display the responses of negative borrowing (i.e. saving) by regular workers to a ratio shock (left) and the response of positive borrowing (i.e. usual borrowing) by non-regular workers (right). Increasing in non-regular workers, regular workers reduce saving[19]. They decrease it from the steady state by more than 6% and remain around 2%, even at 20 quarters. It is sure to be persistent. After the shock, non-regular workers change borrowing to a low level by more than 5%. Furthermore, they maintain such a low level. From 10 quarters, the response becomes positive. These results can be interpreted as follows. The increase in non-regular workers is simply equivalent to the decline in regular workers' income here. Therefore, if it occurs, then they reduce saving. Furthermore, non-regular workers are temporarily able to attain self-finance for purchasing housing without borrowing because of the fall in housing prices, and it is mostly during 10 quarters. Thereafter, when housing prices revert to the steady state and nominal interest rates fall, they recommence borrowing using housing as collateral.

4.2. Each response in between non-regular and regular

[19] When 'saving' is expressed as a kind of 'borrowing,' the steady state of saving is expressed as a negative sign. Therefore, what the positive response in this figure show is that saving is lower than the steady state level.

The immediately preceding subsection presented an exploration of the effects of an increasing ratio shock on some basic variables representing the economy. This subsection presents an examination of the reaction of each type of worker (non-regular worker or regular worker) to the shock. Although the demands of consumption and housing by non-regular workers and regular workers have been described, they are reviewed below.

After a shock, the demand for aggregate consumption declines. Non-regular workers add to consumption and regular workers decline. Therefore, because of the increase in non-regular workers who are part-time workers, output for consumption goods declines less than demand. A positive output gap occurs, and inflation increases slightly. According to total housing demand or each demand, the results are similar to those in the case of consumption goods. Non-regular workers need not turn to borrowing to purchase housing because they earn constant income irrespective of the shock and housing price fall. Regular workers, who have declining income, decide to decrease borrowing (see Figures 6–8).

Some discussion of the responses of income for each worker should be made. In the model, results of both all worked hours and every wage are displayed in Figure 9. Based upon the assumption of model, an increase in the ratio of non-regular workers means that the income of non-regular workers grows up. However, reading the figure, it can be readily understood that to generate such a mechanism is not easy. Although income for regular workers declines[20], income for non-regular workers mostly remains unchanged. In the labor markets of both consumption goods and housing, the decline in worked hours offsets the rise in wages.

Moreover, as the figure shows, the changes in labor demand and supply have results related to the impulse responses. First, the responses of worked hours and wage in labor market of consumption goods for regular workers are that worked hours decline by 0.02% and that wages also decline by 0.84%. Figure 5-(i) explains these results. In raising the ratio, the demand of labor force to regular workers declines: this indicates a leftward shift of curve. Furthermore, then, regular workers emphasize working rather than consumption and supply more worked hours (a rightward shift). Second, the responses of worked hours and wages in the labor market of housing for regular workers are that worked hours rise by 0.06% and that the wage decreases by around 0.79%. Some shifts in Figure 5-(ii) occur for mostly the same reasons as the case of consumption goods. Finally, the responses of

[20] In the labor market related to housing, because the increasing rate of worked hours is greater the decreasing rate of wage, income is lowered.

worked hours and wage in labor market of consumption goods and housing for regular workers are that worked hours decline by 13.0% and 26.9% and that wages rise by 12.7% and 26.6%. Because housing declines completely, despite the emphasis on non-regular workers, they reduce their worked hours (a leftward shift) (see Figure 5-(iii)). Firms of both consumption goods and housing need not change demand for non-regular workers so that they attain minimum cost.

4.3. Comparison of responses in different parameter values

The responses of model variables under the baseline settings were examined. This subsection, in changing some parameter values, presents some novel implications of the model.

The chosen parameters, selected for various reasons, are s^*, m, and ρ_s. First, s^* represents the steady-state ratio of non-regular workers to all workers. To revalue this parameter is equivalent to a change in non-regular workers in the economy. The new values of s^* are set as 0.17 and 0.51. Values greater than 0.51 are not considered because it is not feasible that non-regular workers account for more than 50% of all workers in a real economy. Second, m is the parameter reflecting how non-regular workers' borrowing is close to their housing value. The higher m is, the closer their borrowing is to the maximum limits. However, if m is low, then borrowing is small even though housing is valued highly. Here m is assumed to be 0.30 and 0.80. Finally, parameter ρ_s sets the persistence in the law of motion of the ratio shock. The model variable has been defined as the exogenous variable. Therefore, if the definition of s_t can be loosened, high persistence is interpreted to be a situation by which non-regular workers have been hired for a longer time because they increased by more than steady state. Therefore, when ρ_s was set for 0.30 and 0.50 respectively, non-regular workers have a shorter term of employment.

Figures 10 through 15 portray how model variables respond to the ratio shock under alternative values of the three chosen parameters. First, for s^*, Figures 10 and 11 display the natural and clear result: the fewer the non-regular workers are, the better. The figures of both demand and supply of every good particularly illustrate that the smaller the steady state ratio of non-regular workers is, the smaller the negative deviations are. Next, the results of m (see Figures 12 and 13) are noteworthy. Iacoviello (2005) emphasized that the higher the value of loan-to-value is, the more non-regular workers consume in the

reaction to asset price rising. Therefore, generally speaking, m amplifies some effects of consumption (Iacoviello's "asset price"). Although the sign is opposite to that presented by Iacoviello, the same results are not found from results of this study. The larger the value of the loan-to-value is, the less consumption declines because of the negative effect of the ratio shock (and the negative response of asset price). Therefore, as results show, parameter m , which is expected to play a role to increase borrowing and to expand consumption, contrarily amplifies the negativeness of consumption. Finally, in Figures 14 and 15, when the persistence of shock process is low, the convergence is naturally rapid or the change to the shock is small. The salient implications are as follows. To avoid the negative deviation from the steady state, the added non-regular workers should be not contracted for employment for long periods.

5. Conclusions

This paper has explained that an increase in non-regular workers can account for the current stagnated demand in Japan. Use of a dynamic stochastic general equilibrium (DSGE) model yields some policy implications. The key idea is that, by raising the number of non-regular workers who face borrowing constraints, expenditures on goods that require external finance such as housing investment decline, which causes stagnated demand in Japan.

By the increase of non-regular workers, results show that expenditures on consumption and housing decrease, and that housing is more sensitive to a non-regular workers' shock than consumption is. These results support the empirically obtained results. As featured results coming from the model, although income for regular workers declined, against expectations, the non-regular workers' income was constant. Under such circumstances, increasing housing demand of non-regular workers results from a fall in housing prices.

The model presents three implications as follows: 1) it is better to lower the number of non-regular workers; 2) even though it is easier to borrow, spending does not increase; and 3) even if non-regular workers are employed, they should not be employed over the long term.

One limitation of the model is that, for simplicity, the ratio of non-regular workers

was examined as an exogenous variable. In fact, the variable should be controlled as a problem of firm optimization.

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Table 1: Baseline Parameter Value

Parameters	Descriptions	Value	Reference
Regular workers			
β_R	discount factor	0.996	Original
η_R	labor supply aversion	3.000	Sugo and Ueda (2008)
e_R	labor supply aversion	0.800	Sugo and Ueda (2008)
Non-regular workers			
β_N	discount factor	0.950	Original
η_N	labor supply aversion	2.000	Sugo and Ueda (2008)
e_N	housing depreciation	0.400	Original
m	loan-to-value	0.500	Original
Entrepreneurs & Retailers			
μ_c	income share	0.630	Original
μ_h	income share	0.700	Original
θ	probability fixed price	0.875	Sugo and Ueda (2008)
α	elasticity of substitution	30.00	Sugo and Ueda (2008)
Economy			
f_c	consumption habit	0.110	Original
f_h	housing habit	0.000	Original
j	weight on housing services	0.100	Iacoviello (2005)
δ_h	housing depreciation	0.010	Original
Monetary Policy & Shocks			
γ_R	lagged interest rate	0.842	Sugo and Ueda (2008)
γ_π	inflation	0.606	Sugo and Ueda (2008)
γ_x	output gap	0.110	Sugo and Ueda (2008)
ρ_A	productivity	0.949	Sugo and Ueda (2008)
ρ_s	non-regular worker ratio	0.900	Original

σ_A	productivity	0.843	Sugo and Ueda (2008)
σ_s	non-regular worker ratio	0.100	Original
σ_R	monetary policy	0.066	Sugo and Ueda (2008)

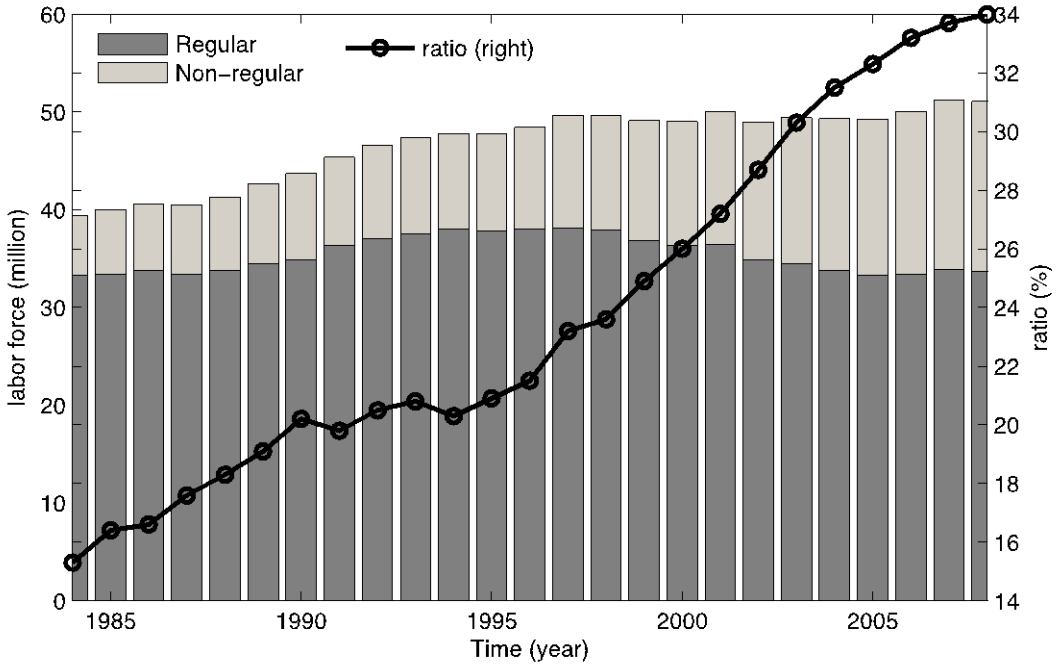

Figure 1: Employee by type of employment and non-regular worker ratio, Japan.

Source: Special Survey of the Labour Force Survey, 1984–2008.

Note: Bar graph shows the number of employees by type of employment. The unit is millions. The charcoal bar denotes regular workers, and the light gray denotes non-regular workers. The line graph shows the fraction of non-regular workers, for which the unit is percentage on the right axis. Non-regular workers include part-time workers, temporary workers, dispatched workers from temporary labor agency, contract employees or entrusted employees, and others. The regular workers are regular staff or employees.

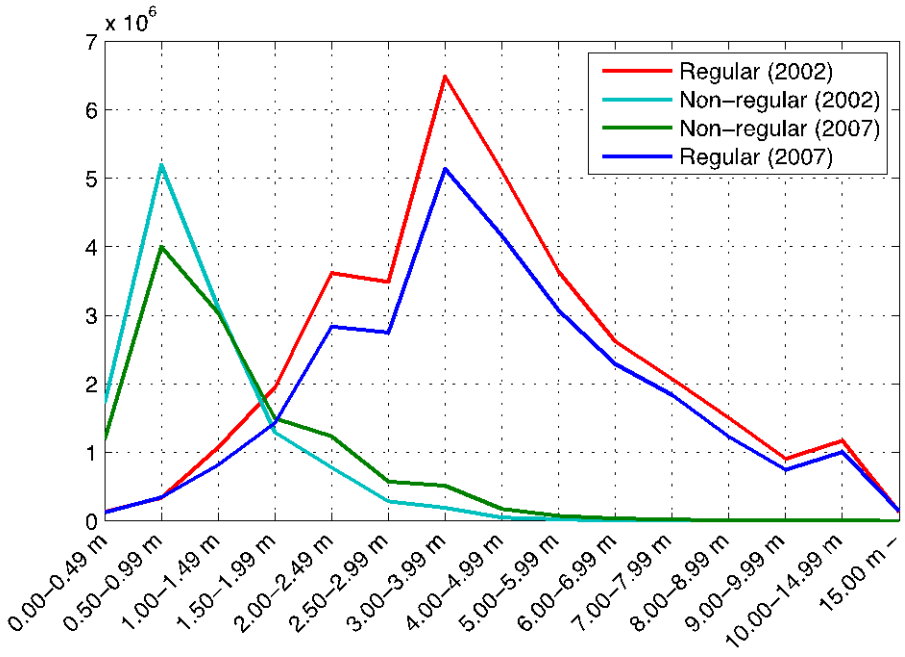

Figure 2: Distribution of Annual Income, Japan.

Source: Employment Status Survey, 2002 and 2007.

Note: The definition of non-regular workers is the same as that in Figure 1. The vertical axis expresses the number of employees. The unit is millions. The horizontal axis shows the class of annual income earned by the employees. The unit is millions of yen. The medians are roughly estimated as around 0.8 million (Non-regular) and around 3.9 million (Regular) in 2002, and to be around 1.2 million (Non-regular) and around 4.1 million (Regular) in 2007.

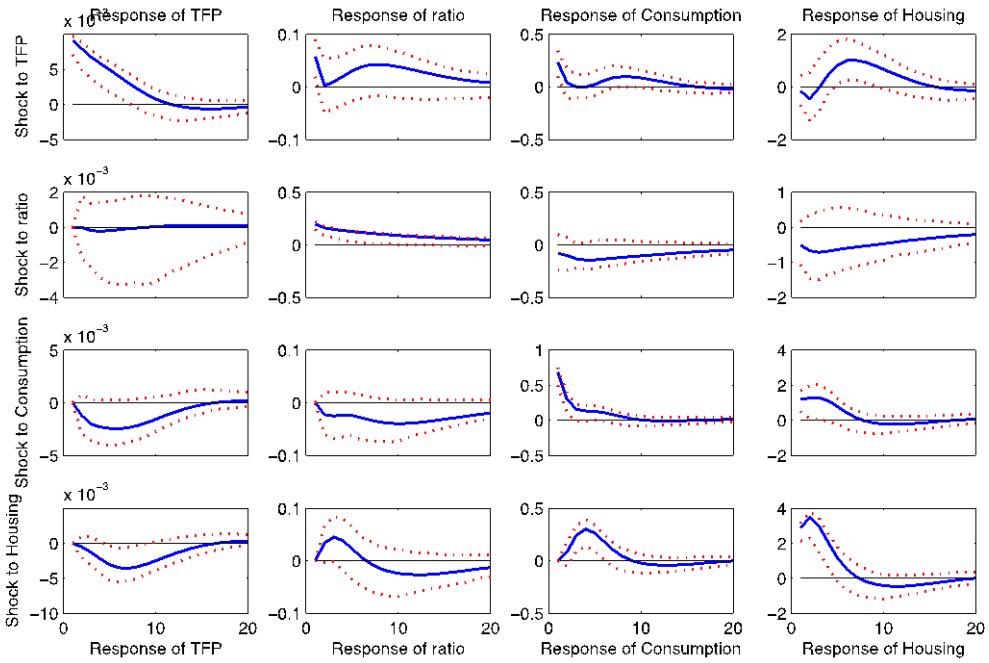

Figure 3: VAR Evidence, Japan.

Note: VAR estimated during 1990Q4 – 2008Q4. The dashed lines represent 90-percent confidence bands. The Choleski ordering of the impulse responses is *TFP*, *ratio*, *Consumption*, *Housing*. Coordinate: percent deviation from the baseline. TFP is calculated based upon Kamada and Masuda (2001) and Kawamoto (2004), who adopted the *TANKAN DI*.

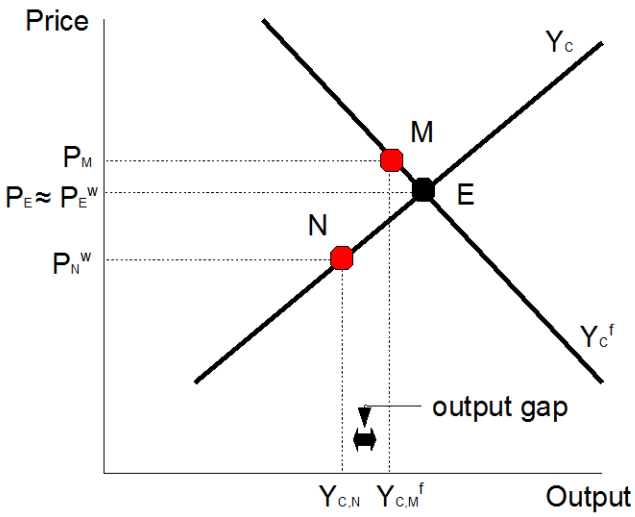

Figure 4: Diagram of the relation between the entrepreneurs' production function Y_c and the retailers' demand function Y_c^f.

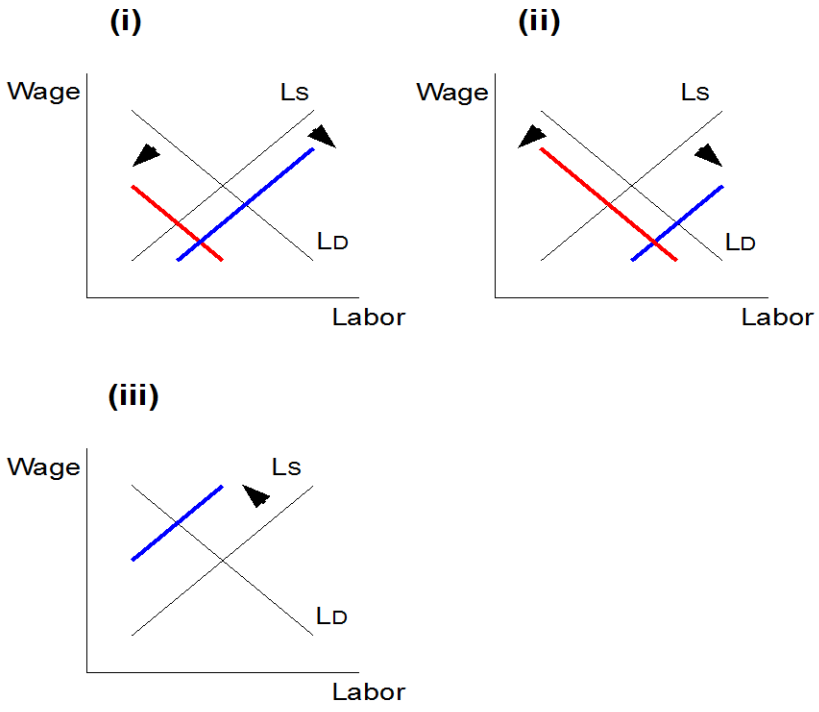

Figure 5: Diagram of the relation between the labor supply and labor demand: (i) shows the regular workers market for consumption goods; (ii) shows the regular worker market for housing investment; and (iii) shows the non-regular worker market for consumption goods and housing investment.

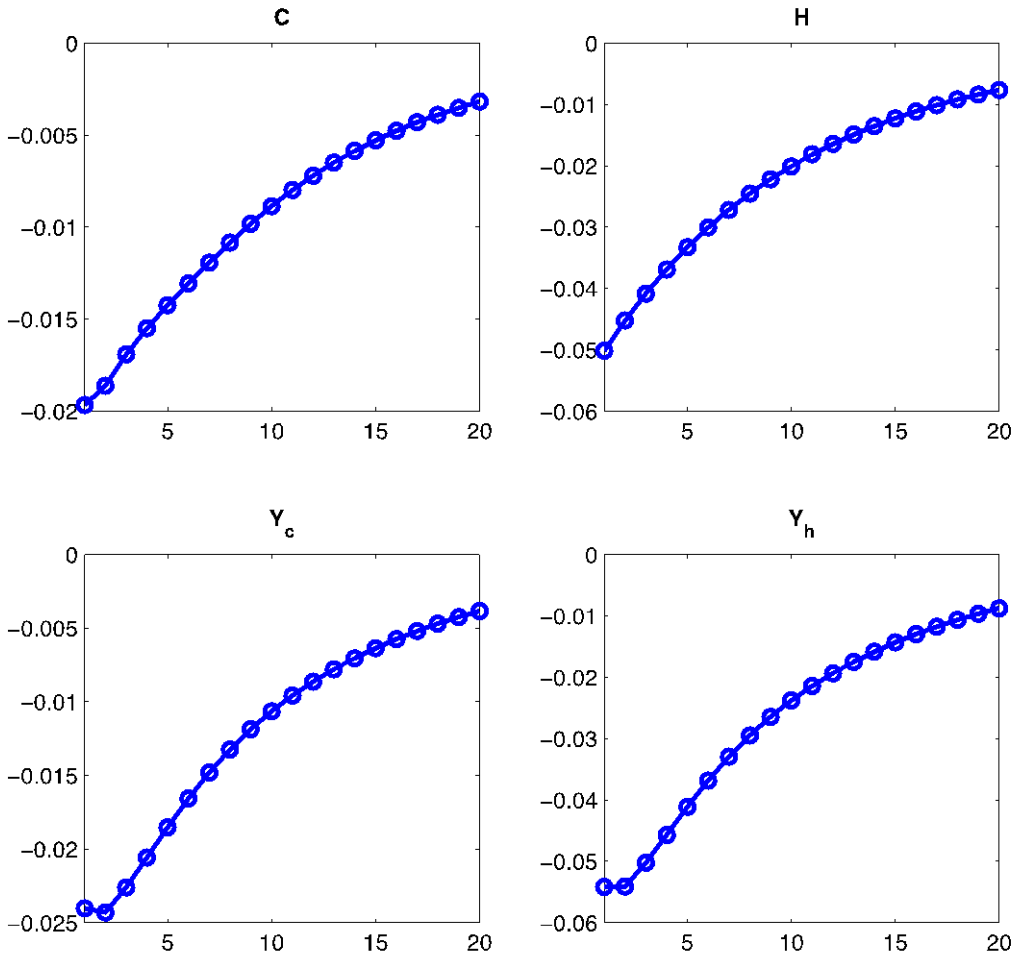

Figure 6: Impulse responses to an increasing ratio shock.

Note: Vertical axis: deviation from steady state. Horizontal axis: time horizon in quarters.

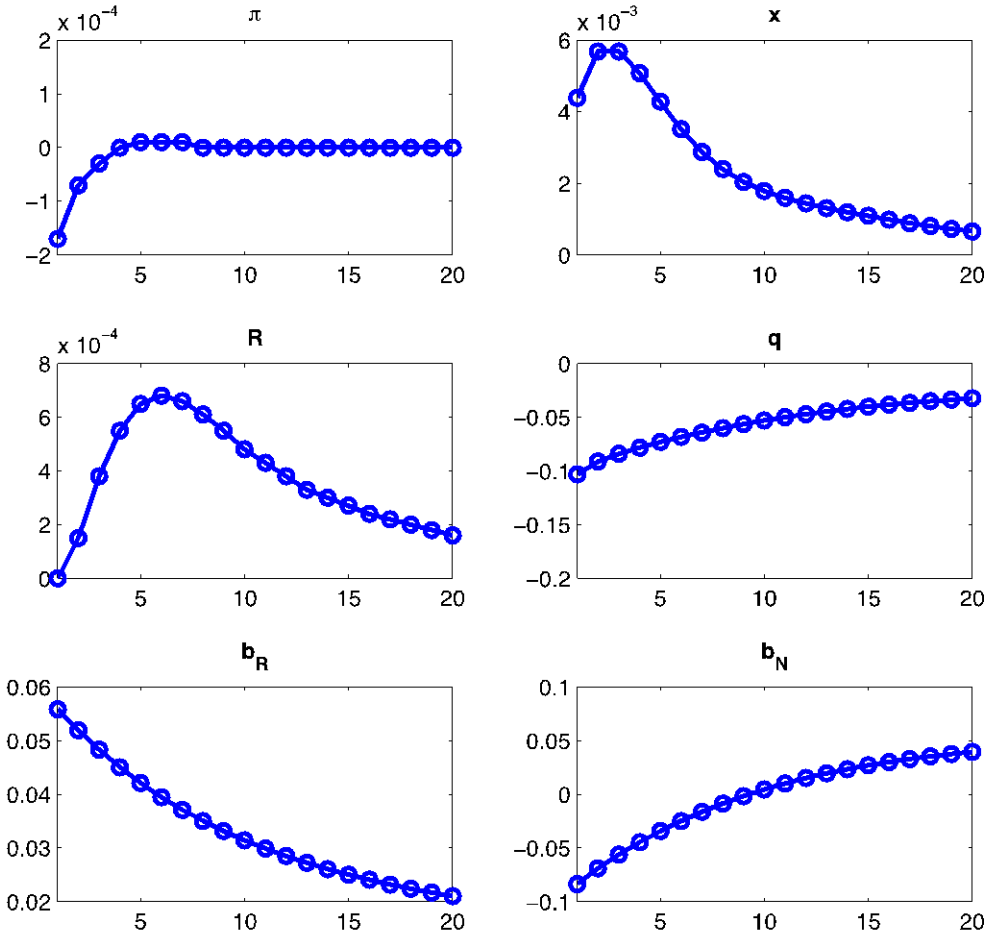

Figure 7: Impulse responses to an increasing ratio shock.

Note: Vertical axis: deviation from steady state. Horizontal axis: time horizon in quarters.

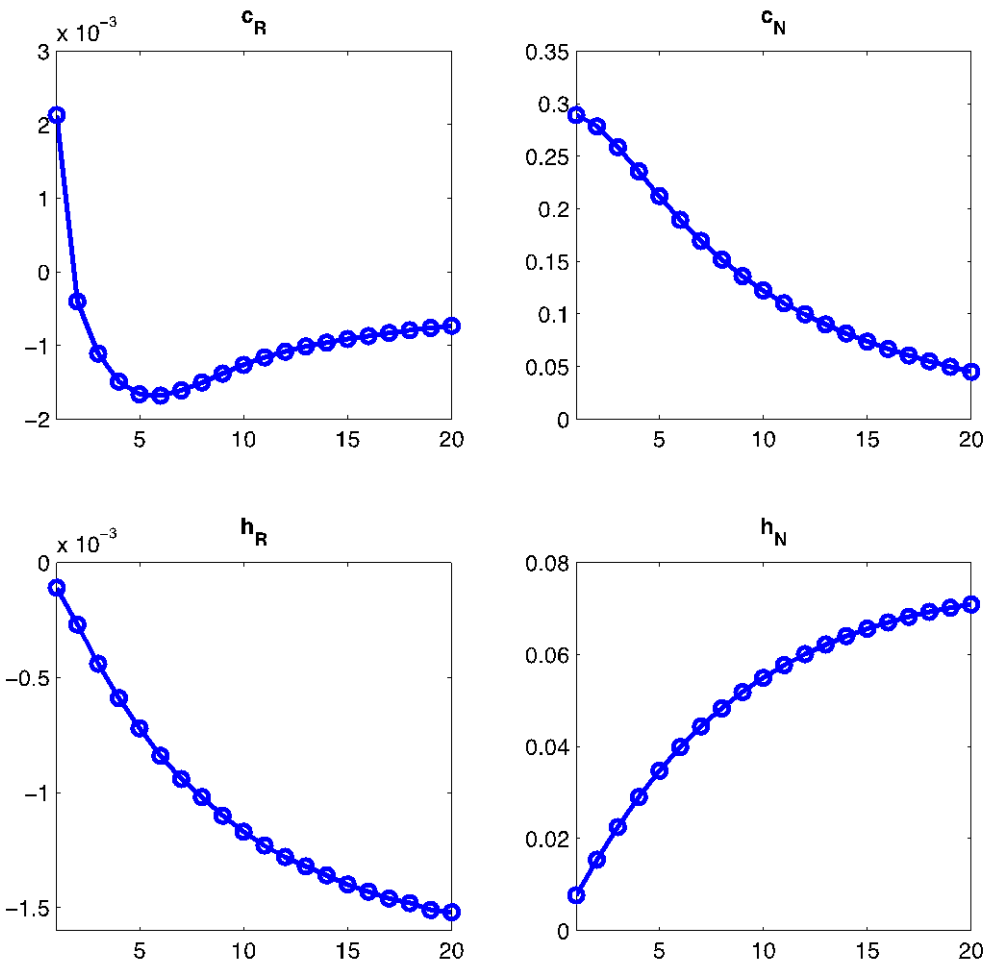

Figure 8: Impulse responses to an increasing ratio shock.

Note: Vertical axis: deviation from steady state. Horizontal axis: time horizon in quarters.

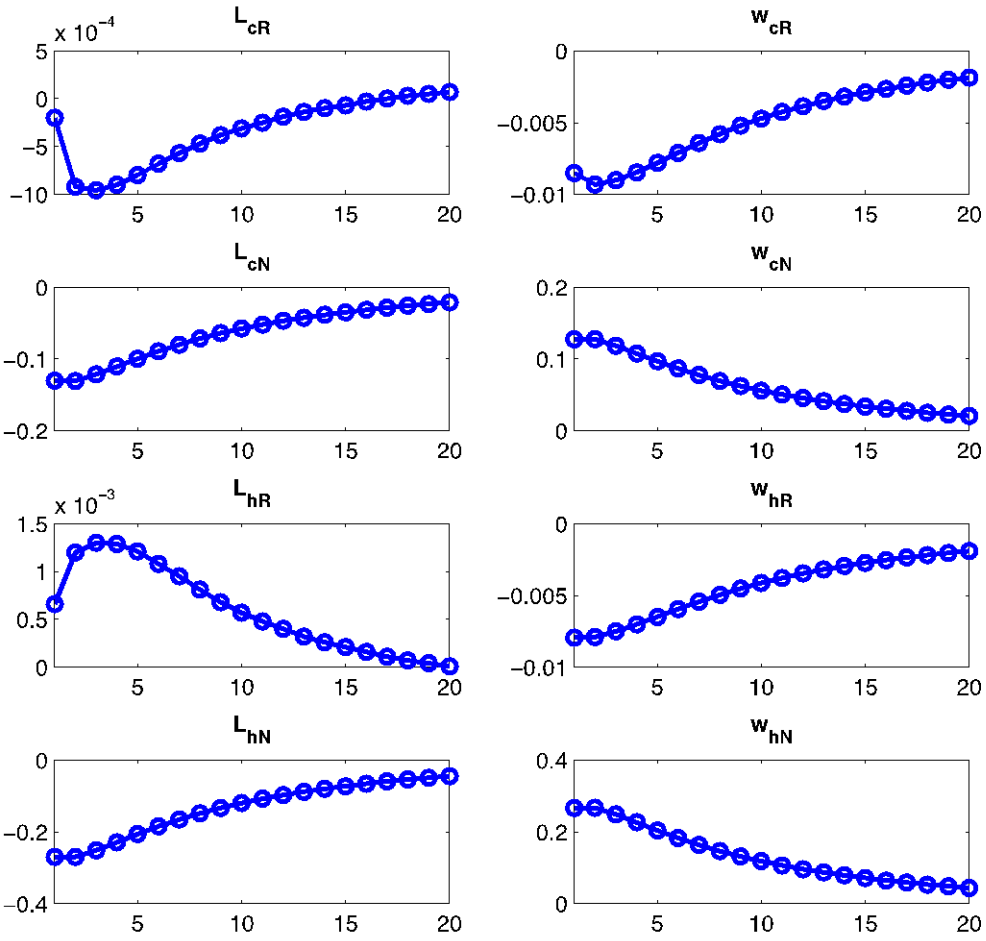

Figure 9: Impulse responses to an increasing ratio shock.

Note: Vertical axis: deviation from steady state. Horizontal axis: time horizon in quarters.

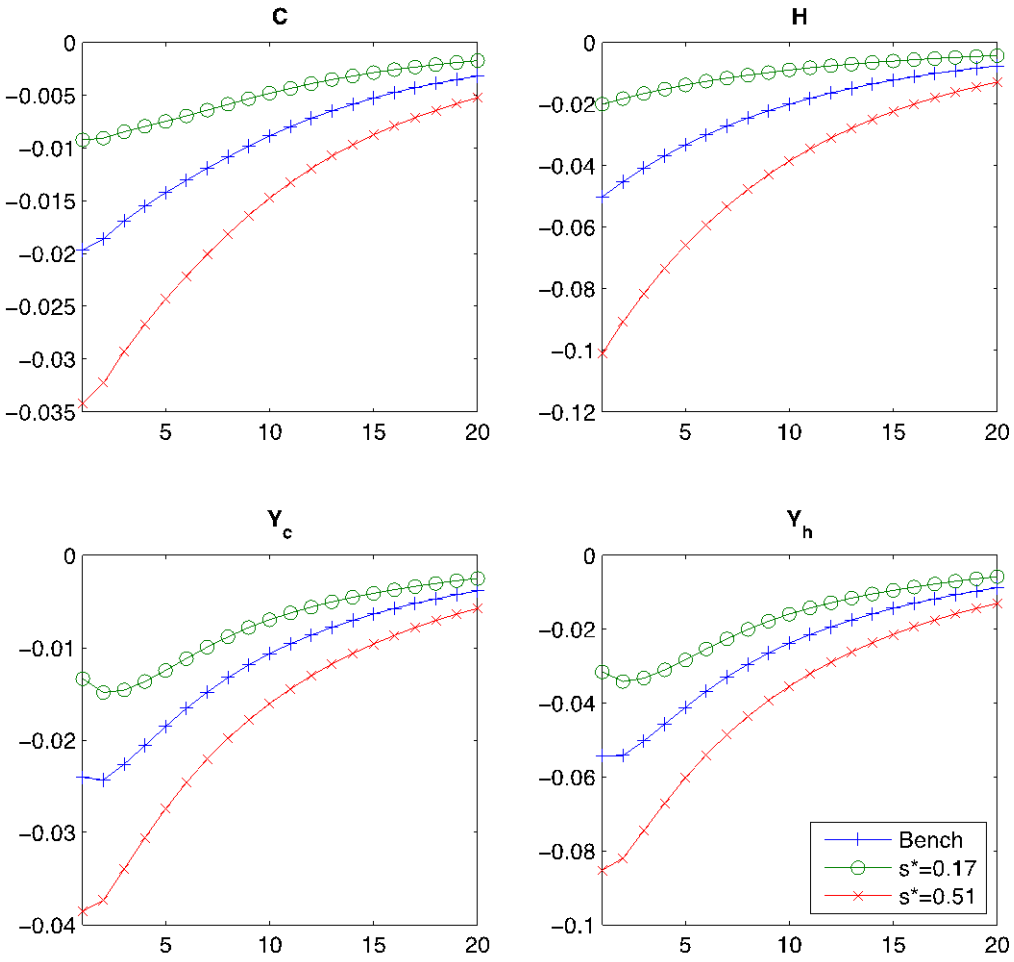

Figure 10: Impulse responses to an increasing ratio shock: effects of varying the steady state of ratio.

Note: Vertical axis: deviation from steady state. Horizontal axis: time horizon in quarters.

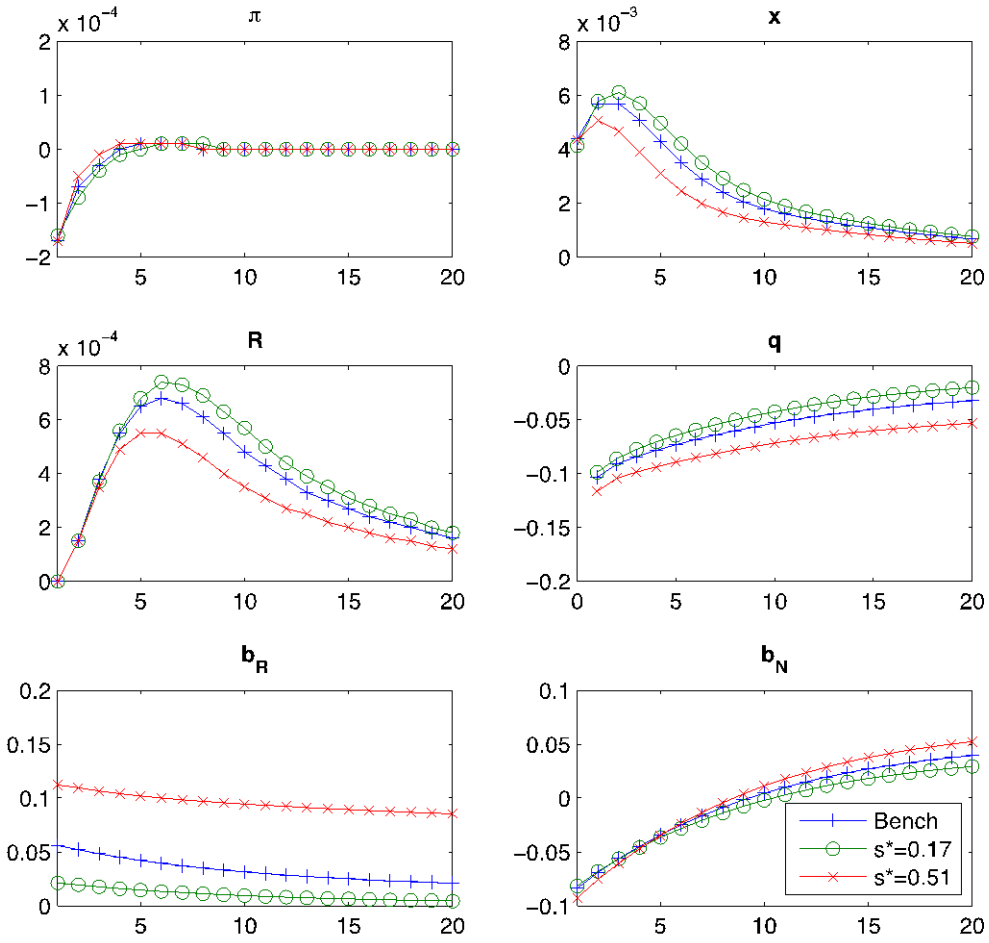

Figure 11: Impulse responses to an increasing ratio shock: effects of varying the steady state of the ratio.

Note: Vertical axis: deviation from steady state. Horizontal axis: time horizon in quarters.

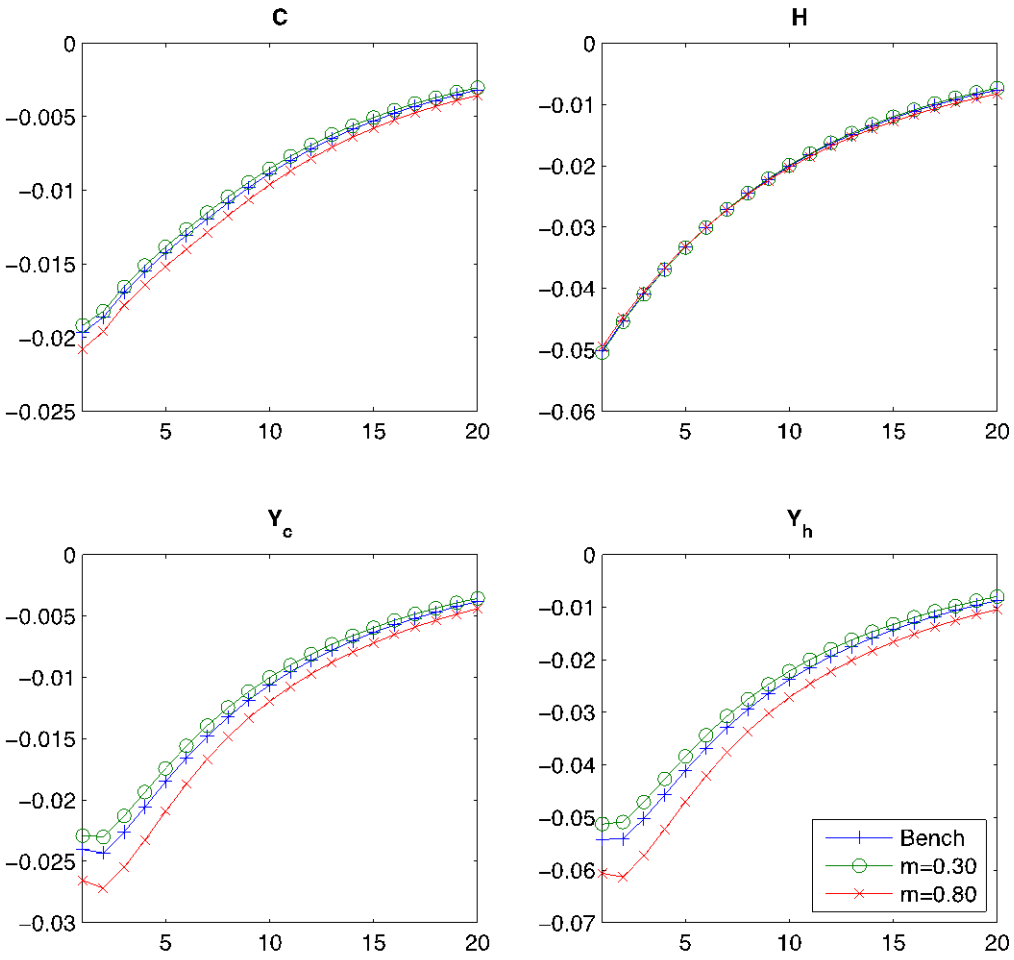

Figure 12: Impulse responses to an increasing ratio shock: effects of varying 'loan-to-value'.

Note: Vertical axis: deviation from steady state. Horizontal axis: time horizon in quarters.

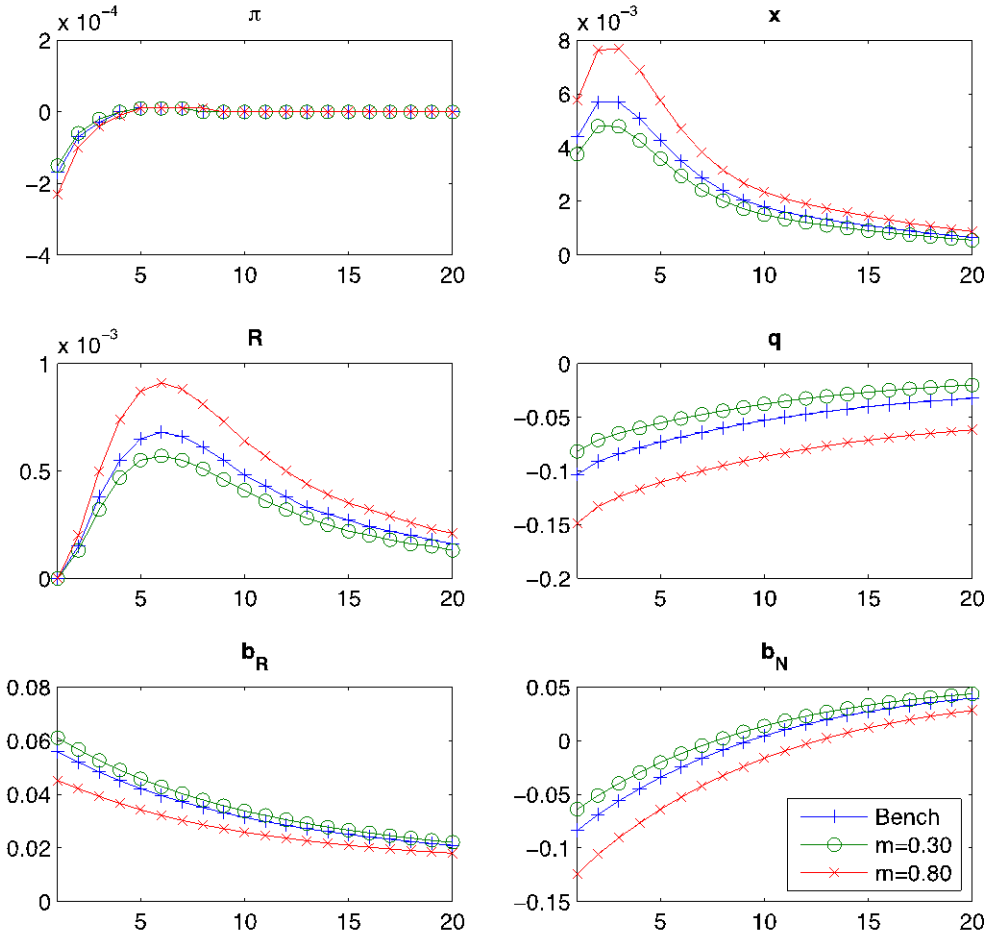

Figure 13: Impulse responses to an increasing ratio shock: effects of varying 'loan-to-value'.

Note: Vertical axis: deviation from steady state. Horizontal axis: time horizon in quarters.

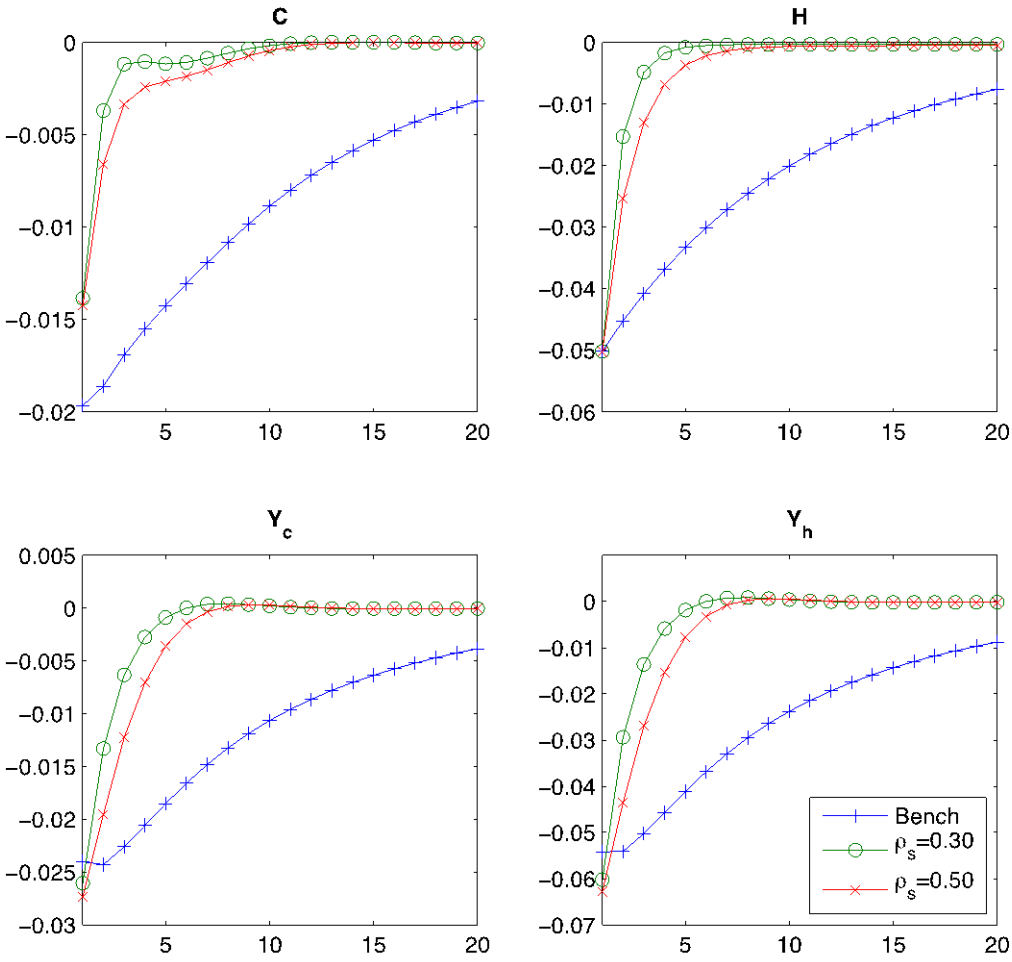

Figure 14: Impulse responses to an increasing ratio shock: effects of varying degrees of persistence.

Note: Vertical axis: deviation from steady state. Horizontal axis: time horizon in quarters.

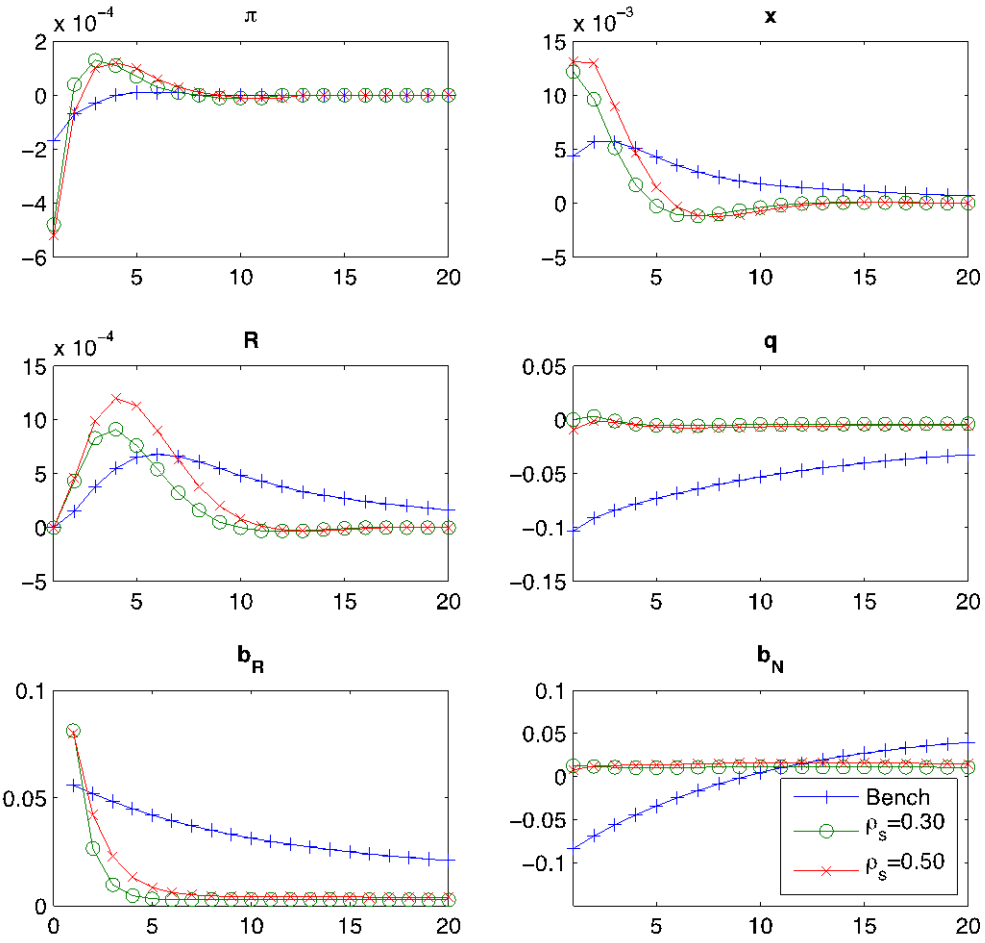

Figure 15: Impulse responses to an increasing ratio shock: effects of varying degrees of persistence.

Note: Vertical axis: deviation from steady state. Horizontal axis: time horizon in quarters.