Rational Inattention and the Effects of Complex Tax Incentives on Labor Supply*

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September 10, 2024

Abstract

It is well known that the complex tax incentives such as means-tested tax transfers distort labor supply (Chetty and Saez, 2013). I conduct a randomized experiment to test whether information provision about taxation helps consumers choose optimal labor supply. I find that providing tax information significantly increases labor supply by 1.2%. I also find that consumers who have a "conservative" gender norm are less likely to increase hours worked compared to the previous year. I present a rational inattention model in which agents are likely to stop working at a certain threshold of annual income when tax incentives are complex, or when agents have the norm that men go to work and women stay at home.

JEL Classification: H24; J20; J22
Keywords: gender norm; information friction; labor supply; rational inattention

*I thank Naohito Abe, Nobuyuki Hanaki, and participants in the 27th Experimental Social Science Conference for their comments and suggestions. Takahashi acknowledges financial support from JST SPRING, Japan Grant Number JPMJSP2179. I have no conflicts of interest to report.

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1 Introduction

It is well known that the complex tax incentives such as means-tested tax transfers distort labor supply (Chetty and Saez, 2013; Kostol and Myhre, 2021). For example, Japanese women tend to adjust annual income to no more than 1.03 million yen, which is so-called "1.03 million yen ceiling." Figure 1 suggests that married women who are non-regular workers stop working just below the annual income of 1.03 million yen.[1] They are eligible to receive several types of benefits when their annual income does not exceed 1.03 million.[2]

One of the most famous benefits is the exemption from income tax. The tax system is structured so that income tax is levied on annual income in excess of 1.03 million yen. For example, if annual income is 1.20 million yen, the tax rate is 5% . In this case, the tax rate of 5% is applied to 0.17 ($= 1.20 - 1.03$) million yen and the amount of tax paid is 8,500 yen. The ratio of income tax to annual income is 0.7%. Although the amount of tax paid is extremely small, Japanese women tend to avoid working more and paying income tax. In fact, Abe (2009) and Kondo and Fukai (2023) report the discontinuity in annual income per year at 1.03 million yen.

I hypothesize that the tax incentives in Japan are so complicated that women prefer not to increase their hours worked beyond a certain threshold, such as the 1.03 million yen ceiling. If so, providing information on tax incentives reduce uncertainty about tax paid that may prevent women from increase their hours worked.

To test the hypothesis, I conduct a randomized control trial to test whether information provision to reduce the complexity of tax incentives can influence labor supply. I find that providing tax information significantly increases labor supply by 1.2%. As a result, it increases those who earn more beyond the 1.03 million yen ceiling by 4.7%. I also find that consumers who have a "conservative" gender norm are less likely to increase their hours worked. To interpret the empirical evidence, I present a rational inattention model in which agents are likely to stop working at a certain threshold of annual income such as the 1.03 million yen ceiling when they face the high uncertainty about tax incentives, or when they have a gender norm that men go to work and women stay at home.

2 Model

I present a model that is the application of Matějka and McKay (2015). Matějka and McKay (2015) consider agents who maximize expected utility but incur costs of information acquisition and processing. I consider an agent who is choosing whether to increase her hours worked ($i = 1$) or not ($i = 0$). The agent does not know the precise amount of wage earning after deduction of tax and social insurance premium. The unknown state x summarizes the utility from the disposable wage and has a prior distribution $g(x)$. Thus, utility from choosing to increase her hours worked from the previous year is equal to x ($U(1, x) = x$), while utility from choosing not to increase her hours worked equals a known reservation utility R ($U(0, x) = R$). The objective is to maximize the expectation of $U(i, x)$ less the cost of information $C(f)$. The agent's problem then is:

$$\max_f \int U(i,x) f(i,x) dx di - C(f) \tag{1}$$

$$\text{subject to } \int f(i,x) di = g(x), \forall x, \tag{2}$$

where the first term in Equation (1) is the expectation of U. $C(f) = \lambda I(i; x)$, where $I(i; x)$ is the Shannon mutual information between i and x. Mutual information is defined as $I(i; x) \equiv H(x) - E[H(x \mid i)]$, where $H(x)$ is entropy of x.[3] The parameter $\lambda \geq 0$ is the unit cost of information. Under the maximizing problem, the agent chooses whether to increase her hours worked or not. The conditional probability that hours worked increase compared to the previous year is written as $f(i \mid x) = P(i \mid x)$

[1] I plot Figure 1 using the Japanese Panel Study of Employment Dynamics from 2016 to 2023 conducted by the Recruit Works Institute every year since 2016.

[2] Abe (2009) explains the means-tested tax transfers in Japan, while I do not present the details to save space.

[3] The entropy of x is $H(x) = -\int f(x) \log [f(x)] \, dx$.

The first-order condition to Equations (1) and (2) is given by:

$$P(i \mid x) = \frac{e^{\frac{U(i,x)+\alpha(i)}{\lambda}}}{\sum_{j=1}^{2} e^{\frac{U(j,x)+\alpha(j)}{\lambda}}}, \tag{3}$$

where $\alpha(i) = \lambda \log P(i)$ and $P(i) > 0$ is the marginal probability of the choice i. Note that the quantities of $\alpha(i)$ reflect biases toward action i. The biases are independent of state x, but endogenous to the prior preferences that determine the agent's choice of attention. For example, an agent has a negative preference for working more if she has a "conservative" gender norm that men go to work and women stay at home.

Equation (3) has two implications. First, the probability of deciding working more $P(1 \mid x)$ depends on the cost of information λ. If the agent has to pay more attention to the complex tax incentives in order to process information about the amount of incentives she can get, the (conditional) probability of working more ($P(1 \mid x)$) decreases. The more complex the tax incentives are, the more consumers are likely to stop working at a certain threshold of annual income such as the 1.03 million yen ceiling. Second, $P(1 \mid x)$ depends on the difference between $\alpha(1)$ and $\alpha(0)$. For example, if the agent has a "conservative" gender norm that women should stay at home, $\alpha(1) < \alpha(0)$. The biased preference for the traditional gender norm decreases $P(1 \mid x)$. The model predicts that consumers are likely to stop working at a certain threshold of annual income such as the 1.03 million yen ceiling when they face the high uncertainty about tax incentives, or when they have a "conservative" gender norm that men go to work and women stay at home.

Figure 2 summarizes the implications. First, the solid line in Figure 2 shows the probability of choosing to increase her hours worked from the previous year. Under unlimited information-processing capacity, that is $\lambda = 0$, the probability jumps from 0 to 1 at $x = R$. Under rational inattention, however, the probability decreases at $x = R$ as the cost of information λ increases. Second, the dashed line in Figure 2 shows the choice probability if the agent a priori believes that the disutility of working more dominates. In this case, the endogenous biases α enter in $P(1 \mid x)$. The bias toward choosing to increase her hours worked becomes strictly negative, $\alpha(1) - \alpha(0) < 0$, and the probability is decreased for each x. For example, if the agent has a "conservative" gender norm that men go to work and women stay at home, the bias can be negative.

3 Evidence from a Randomized Control Trial

3.1 Design of a Randomized Control Trial

I conducted an information provision experiment using an online survey platform from August 16 to August 23, 2024, with a sample size of 1,006 participants of women. I pre-screened respondents on the basis that they are married, their annual income are not more than 1.03 million yen in 2023, and the expectation of their annual income in 2024 are not more than 1.03 million yen. The age distribution was representative of Japan's demographics, ranging from 25 to 64 years old. Table 1 shows the basic statistics.

Step 1: Eliciting annual income and hours worked in the previous year First, I elicit annual income and average hourly wages in the previous year. I ask respondents to provide the total wages per year and the average wages per hour in 2023. Then, I impute the total hours worked in 2023 by dividing the annual income by the hourly wages. I also elicit the expectation of average hourly wages in this year.

Step 2 : Information provision After eliciting information labor supply and wages, I ask respondents to answer the hypothetical question; " *Think about how much you will have to pay in income tax if you earn 1.20 million yen this year.* The question aims to elicit the prior belief about the amount of income tax to be paid. I then inform the treatment group that the amount of income tax is 8,500 yen.

Step 3: Eliciting annual income and hours worked in this year I ask respondent to answer the expectation of annual income in this year. I impute the total hours worked in this year worked by dividing the annual income by the hourly wages. To check the model prediction around the income threshold of 1.03 million yen, the subsequent analysis covers samples with an annual income of 0.9 million yen or above.

3.2 Results

Does information provision about complex income tax incentives change labor supply? If consumers overestimate the amount of income tax paid, the provision of information is likely to induce them to increase her hours worked beyond the 1.03 million yen ceiling. To test the effects of information about the precise amount of income tax paid, I estimate the following equation:

$$y_j = \alpha + \beta_1 \times D^T + \beta_2 \times \textit{Gender Norm}_j + \beta_3 \times D^T \times \textit{Gender Norm}_j + \beta_4 \times \textit{Forecast Error}_j + \gamma \mathbf{X} + \varepsilon_j, \quad (4)$$

where y_j and D^T are denoted as the outcome variables of individual j and the dummy variable which takes one for the treatment group; otherwise zero, respectively The outcome variables are (1) the dummy that takes one if (the expectation of) income in this year is more than 1.03 million yen; otherwise zero and (2) the year-on-year changes in hours worked from the previous year. *Gender Norm*$_j$ take 1 for strongly agree, 2 for agree, 3 for disagree, and 4 for strongly disagree with the gender norm that men go to work and women stay at home. *Forecast Error*$_j$ is defined as (the logarithm of) the difference between the actual amount (8,500 yen) and the j's expectation. $\mathbf{X}$ is a vector of control variables which include age, educational attainment, region level dummies, and the degree of loss aversion.

Table 2 shows the estimation results. First, you can see that the coefficients of D^T are significantly positive. Columns (1) and (2) in the table suggest that information provision increases hours worked by 1.2% and the probability of earning more than 1.03 million yen by 4.6%, respectively. I also examine whether consumers who have a "conservative" gender norm are less likely to increase her hours worked from the previous year. The coefficients (β_3) of the cross term in Columns (3) and (4) suggest that the gender norm matters in determining labor work: consumers who do not agree with the "conservative" gender norm increase her hours worked by 1.4%. Information provision also increases the probability of earning more than 1.03 million yen by 5.2%.

4 Conclusion

I conduct a randomized control trial to test whether information provision to reduce the complexity of tax incentives can influence labor supply. I find that providing tax information significantly increases labor supply by 1.2%. As a results, it increases those who earn more beyond the 1.03 million yen ceiling by 4.7%. I also find that consumers who have a "conservative" gender norm are less likely to increase her hours worked even when information is provided. To interpret the empirical evidence, I present a rational inattention model in which agents are likely to stop working at a certain threshold of annual income when they face the high uncertainty about tax incentives, or when they have the norm that men go to work and women stay at home.

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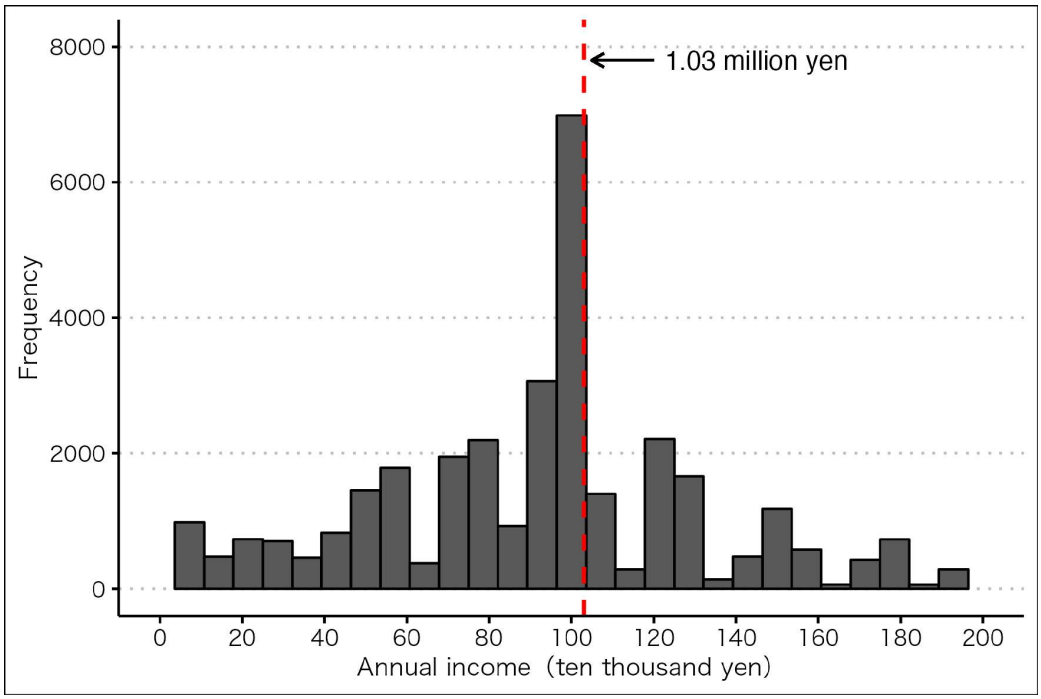

Figure 1: 1.03 million yen ceiling: annual income of married women who are non-regular workers

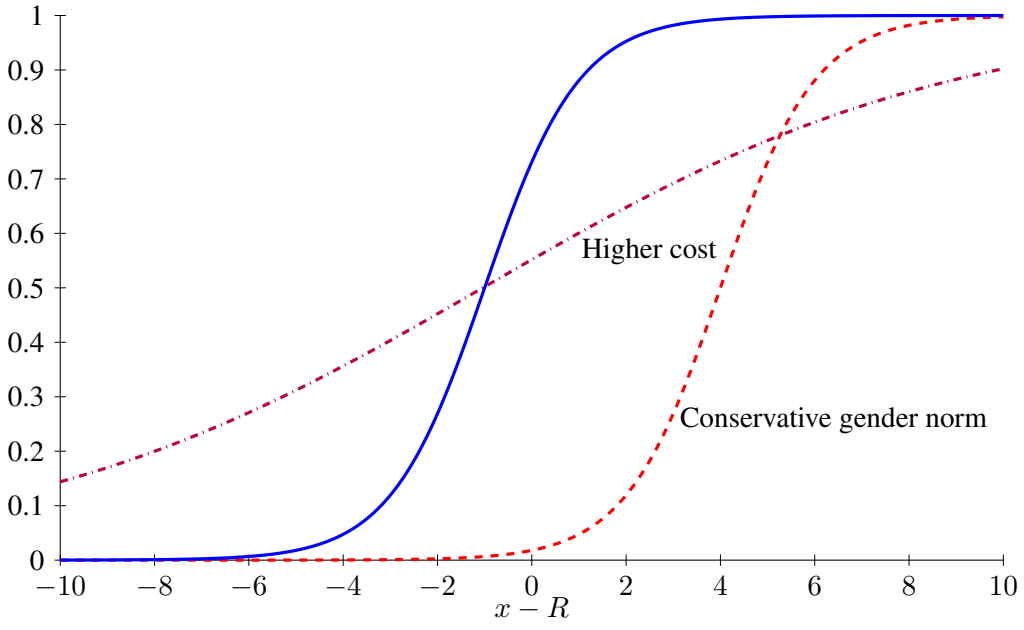

Figure 2: Probability that hours worked increase compared to the previous year, $P(1 \mid x)$

Table 1: Basic statistics of a randomized control trial

Variables	Control group [$N = 377$]			Treatment group [$N = 357$]		
	Last year CY2023 (1)	This year CY2024 (2)	Difference (2) − (1) (3)	Last year CY2023 (4)	This year CY2024 (5)	Difference (5) − (4) (6)
(1) Earnings (ten thousand yen)	98.22	98.99	0.77	98.43	100.13	1.69
(2) Hourly wage (yen)	1,121.80	1,138.79	16.98	1,108.20	1,122.04	13.84
(3) Hours worked (per year)	903.50	897.67	−5.84	911.04	915.96	4.92
(4) Respondents who earn more than 1.03M yen (%)	—	3.71	—	—	7.56	—
(5) Gender norm	—	2.99	—	—	3.00	—

Note: The variable of *Gender Norm*$_j$ take 1 for strongly agree, 2 for agree, 3 for disagree, and 4 for strongly disagree with the gender norm that men go to work and women stay at home.

Table 2: Does information provision change labor supply?

	(1) Δ*Labor supply*	(2) $D^{1.03M}$	(3) Δ*Labor supply*	(4) $D^{1.03M}$
β_1: D^T	0.012^{*}	0.047^{***}	-0.0420^{**}	-0.1658^{*}
	(0.006)	(0.018)	(0.0207)	(0.0911)
β_2: *Gender Norm*			-0.0087^{**}	-0.0222
			(0.0037)	(0.0189)
β_3: $D^T \times$ *Gender Norm*			0.0143^{**}	0.0520^{*}
			(0.0063)	(0.0280)
β_4: *Forecast Error*			-0.0011	-0.0063^{*}
			(0.0011)	(0.0037)
Observations	718	718	402	402

Note: I show the estimation results from Equation (4). Δ*Labor supply* in Columns (1) and (3) are the year-on-year changes in hours worked from the previous year. $D^{1.03M}$ in Columns (2) and (4) represents the dummy that takes one if (the expectation of) income in this year is more than 1.03 million yen; otherwise zero. *Gender Norm*$_j$ take 1 for strongly agree, 2 for agree, 3 for disagree, and 4 for strongly disagree with the gender norm that men go to work and women stay at home. *Forecast Error* is defined as (the logarithm of) the difference between the j's expectation and the actual amount (8,500 yen). I use the subsample of respondents earning 0.9 million yen or above per year. $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$