Stigma model of welfare fraud and non-take-up: Theory and evidence from OECD panel data

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29 July 2020

Stigma model of welfare fraud and non-take-up: Theory and evidence from OECD panel data

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Abstract

This paper attempts to challenge two puzzles in the welfare program. The first puzzle is 'non-take-up welfare,' which occurs when needy people do not take up welfare. Second, in some countries, the benefit level is high, but the recipient ratio is low; while the other nations have lower benefit levels but higher recipient ratios. We present a model of welfare stigma in which both non-take-up and welfare fraud exist within the equilibrium. This shows the possibility for the recipient ratio to decrease as the benefit level increases in the comparative statics. Our empirical results are consistent with our theoretical results.

Keywords: Stigma, Welfare fraud, Non-take-up, Welfare program, OECD panel data

JEL classification: H31, H53, I38

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1 Introduction

In developed countries whose economic conditions are not as diverse, each situation in the welfare benefit program is different. In Japan and Germany, the level of welfare is high, but the recipient ratio, which is the number of welfare recipients divided by the total population, is low. In contrast, the United Kingdom and the United States have lower levels of welfare but higher recipient ratios (Tachibanaki and Urakawa, 2006).

The standard model can explain 'welfare fraud' but not 'non-take-up of welfare': welfare fraud occurs when households take up welfare even though they are non-eligible; non-take-up welfare signifies that needy people do not take up welfare even though they are approved to take up it. However, 'non-take-up' occurs in most developed countries (Currie, 2006; Immervoll, 2009; Plueger, 2009). Moreover, the result of comparative statics in the standard model cannot explain this relationship between the level of welfare and the recipient ratio since the increase in the level of welfare always increases the incentive of taking-up welfare. Thus, the standard model cannot illustrate two phenomena: non-take-up and the counterintuitive relationship between the welfare level and the recipient ratio among developed countries such as the United States, the United Kingdom, Germany and Japan.

The contributions of this study include the following: first, we construct a model in which non-take-up and welfare fraud coexist in equilibrium, and show that a comparative statistic analysis reveals the possibility that the recipient ratio decreases as the benefit level increases. Second, in the empirical analysis using the macro panel data, we find that this association is observed and that the benefit level and the recipient ratio exhibit an inverse U-shaped relationship.

We construct a model that can explain non-take-up by introducing stigma. Stigma is a sociological concept describing a negative label applied to behavior by society or a social group (Goffman, 1963). In particular, stigma is an important concept in social psychology (Major et al., 2018). The term welfare stigma refers to the socio-psychological effects and psychological costs associated with taking-up welfare (Besley and Coate, 1992). The mechanisms of the occurrence of welfare stigma have primarily been discussed mainly in sociological studies (Spicker, 1984). Welfare stigma is thought to arise from a negative social image of recipients based on the perception that recipients are inferior to non-recipients. Consequently, recipients are treated as socially undesirable compared to non-recipients, thus reducing the utility of recipients. This study aims to explain the abovementioned two phenomena by analyzing the interdependence between the welfare stigma level and decision-making of the needy and non-needy type individuals. This study extends the model of Besley and Coate (1992) to explain the occurrence of non-take-up of welfare benefits. Unlike Besley and Coate (1992), we endogenize decision-making for needy poor people. The result in our comparative static analysis indicates that an increase in the benefit level can decrease the ratio of welfare recipients to population. To verify the result, this study conducts an empirical analysis using panel data. The results of the empirical analysis are consistent with the theoretical analysis.

Our model considers two types of an individual: the needy type and the non-needy type. The needy type chooses whether to take up welfare or not, while the non-needy type chooses whether to work or take up welfare. If individuals take up welfare benefits, they suffer from disutility due to social stigma. This stigma cost is endogenously determined, and the higher the conditional probability that a recipient is a fraudulent recipient, the higher the stigma cost. Sensitivities to stigma costs are distributed among needy and non-needy types, respectively. Among the non-needy type, less sensitive individuals take up welfare and more sensitive individuals choose to work. On the other hand, for the needy type, less sensitive individuals choose to take up welfare, while more sensitive individuals do not take up it. In the equilibrium, the decision of the non-needy type, the decision of the needy type and the level of stigma cost are determined interdependently.

In our empirical analysis, we use panel data obtained by OECD.stat from 2007 to 2012 for 25 developed countries to examine the relationship between the level of social welfare receipts and the recipient ratio as indicated by the model described above. Regression analysis using five estimation methods that take into account unknown confounding factors shows that the relationship between the level of social welfare receipts and the recipient ratio shows a statistically significant inverse U-shape. In addition, sensitivity analysis confirms the robustness of this result. Thus, using these OECD panel data, we find that the results of the empirical analysis are consistent with the model described earlier for the period from 2007 to 2012 for these countries. The relationship between the benefit level and the recipient ratio in this empirical analysis can be explained by the direct and indirect effects of an increase in the benefit level in the theoretical analysis; the direct effect is an increase in the level of benefits, which increases the incentive to take-up benefits. On the other hand, the indirect effect occurs through stigma and can increase the disincentive to take up benefits. Therefore, the positive direct effect dominates the negative indirect effect and the recipient ratio increases when the benefit level is low, the indirect effect dominates the direct effect and the recipient ratio decreases when the benefit level is high.

Several studies have conducted theoretical and/or empirical analysis of the welfare stigma. Moffitt (1983) conducted one of the earlier studies focusing on welfare stigma in economics by analyzing household decision-making regarding whether to take up welfare benefits or supply labor by including the stigma as a kind of monetary cost. Moreover, that paper empirically examined theoretical results using panel study of income dynamics (PSID). Consequently, that author suggested that fixed stigma is statistically significant, but that variable stigma with respect to benefit level is not. Besley and Coate (1992)'s pioneering research analyzed situations wherein stigmas were endogenized. They presented two models of social stigma: statistical discrimination and taxpayer resentment. Their results indicated the occurrence of welfare fraud. As needy types usually chose to take-up welfare benefits, non-take-up of welfare benefits did not manifest in their model. Blumkin et al. (2015) analyzed welfare stigma as a policy tool, which was used to restrain welfare fraud. However, the take-up rate in the United Kingdom was approximately 80 % (Duclos, 1995), while it was approximately 60—67 % in the United States (Blank and Ruggles, 1996), approximately 37 % in Germany (Riphahn, 2001) and 16.3—19.7 % in Japan (Tachibanaki and Urakawa, 2006). Thus, non-take-up welfare did not manifest in their model[1]. One of the few exceptions is Itaya and Kurita (2020). Itaya and Kurita (2020) analyzes both welfare fraud and non-take-up using the replicator dynamics, while this paper analyzes a static model.

The structure of this paper is as follows; the next section presents the theoretical model and comparative static analysis. The third section conducts empirical analysis regarding the relationship between the benefit level and the recipient ratio. The final section concludes this paper.

2 Model

This study develops a model to analyze the interaction between welfare stigma, welfare fraud, and non-take-up. There are two types of an individual, the needy type and the non-needy type. The needy type chooses whether to take up welfare or not, and the non-needy type chooses whether to work or take up welfare. Each individual makes a decision corresponding to the level of stigma cost by taking up welfare. This stigma cost is determined endogenously, and the higher the conditional probability that the recipient is a fraudulent recipient, the higher the stigma cost. The sensitivity to stigma costs is distributed among the needy and non needy types; among the non-needy type, those who are less sensitive take up welfare and those who are more sensitive choose to work. Among the non-needy type, on the other hand, those who are less sensitive choose to take up welfare, while those who are more sensitive choose not to take up. In the equilibrium, the decision of the non-needy type, the decision of the needy type and the level of stigma cost are determined interdependently.

In the comparative static analysis, we show the possibility that the recipient ratio decreases as the benefit level increases.

[1]Hupkau and Maniquet (2018) analyzed the problem of non-take-up of welfare from the perspective of identity economics (Akerlof and Kranton, 2000; Kranton, 2016)

2.1 The basic setting

There are two types of an individual in the economy: the needy type and the non-needy type. A 'needy type' is an individual who cannot work and a 'non-needy type' is defined as an individual who can work if he or she is motivated to do so. We assume that a proportion of needy types in the total population is $\gamma \in (0,1)$. In the economy, needy types are eligible for welfare benefits, and non-needy types are not. That is, 'non-take-up welfare' occurs when the needy type does not choose to take up welfare benefits and 'welfare fraud' is the situation in which the non-needy type decides to take up welfare benefits. To make the notation clear, we denote the needy type as 'type 1' and the non-needy as 'type 2'.

Type 1 individuals have two choices; take-up welfare or not. The utility setting is,

$$\begin{cases} u\left(b, z_1\right) - \phi_1 s\left(p, q, z_1\right) & \text{if taking up welfare,} \\ 0 & \text{otherwise,} \end{cases} \tag{2.1}$$

where s is an index of stigma cost, which is explained later, p is a proportion of recipients to sub-population of type 1, q is a proportion of recipients to sub-population of type 2 and ϕ is the sensitivity to stigma. $u(\cdot,\cdot)$ denotes a material utility, z_i is type i's capability of consumption, and $i = 1, 2$. b is a level of welfare benefit. We assume the following properties: $\forall z_i$, $i = 1, 2$, and income $I = w, b$. For simplicity, we assume that the price of consumption goods is 1.

$$\begin{aligned} &\tfrac{\partial u(I,z_i)}{\partial I} > 0, \\ &\tfrac{\partial u(I,z_i)}{\partial z_i} > 0, \\ &\tfrac{\partial u(I,z_i)}{\partial I \partial z_i} \geq 0. \end{aligned} \tag{2.2}$$

The third property means that capability and consumption are complementary.

Type 2 individuals have two choices: either to take up welfare benefits or work. Type 2's utility setting is as follows:

$$\begin{cases} u\left(b, z_2\right) - \phi_2 s\left(p, q, z_2\right) & \text{if taking up welfare,} \\ u\left(w, z_2\right) - \theta & \text{if working.} \end{cases} \tag{2.3}$$

Here θ is disutility of labor, and w is work income. ϕ_i is uniformly distributed from 0 to $\overline{\phi}$ among type i's sub-population, ϕ_i and ϕ_j are i.i.d, $i, j = 1, 2$, and $i \neq j$. We assume that $z_2 > z_1$: that is, type 2's capability is higher than that of type 1 individuals who cannot work because of time constraints, physical disabilities or mental illness. These constraints can affect consumption. For example, it makes sense that a single-parent household with limited free time will not enjoy consumption from income I as much as a household with two parents.

2.2 The critical level of sensitivity to stigma

To understand a household's decision-making, we consider the critical sensitivity of stigma cost, ϕ_i, as follows:

$$u\left(b, z_1\right) - \hat{\phi}_1 s\left(p, q, z_1\right) = 0, \tag{2.4}$$

$$u\left(b, z_2\right) - \hat{\phi}_2 s\left(p, q; z_2\right) = u\left(w, z_2\right) - \theta. \tag{2.5}$$

Type 1 households, where ϕ_1 is less than or equal to $\hat{\phi}_1$, prefer to take up welfare. Then, all households in which $\phi_1 \in \left[0, \hat{\phi}_1\right]$ choose to take up welfare and all households in which $\phi_1 \in \left(\hat{\phi}_1, \overline{\phi}\right]$ do not. Similarly, type 2 households in which ϕ_2 is less than or equal to $\hat{\phi}_2$ prefer to take up welfare. All households in which $\phi_2 \in \left[0, \hat{\phi}_2\right]$ choose to take-up welfare On the other hand, all households in which $\phi_1 \in \left(\hat{\phi}_1, \overline{\phi}\right]$ choose to work.

The proportion of recipients in type 1, p, is as follows:

$$p = \min\left\{\frac{\hat{\phi}_1}{\overline{\phi}}, 1\right\} = \min\left\{\frac{u\left(b, z_1\right)}{\overline{\phi} s\left(p, q, z_1\right)}, 1\right\}. \tag{2.6}$$

While the proportion of recipients in type 2, q, is as follows:

$$q = \min\left\{\frac{\hat{\phi}_2}{\overline{\phi}}, 1\right\} = \min\left\{\frac{u\left(b, z_2\right) - u\left(w, z_2\right) + \theta}{\overline{\phi} s\left(p, q, z_2\right)}, 1\right\}. \tag{2.7}$$

In the next subsection, we consider the formulation of the stigma cost and the equilibrium in the model.

2.3 Formulation of the stigma cost function

In this subsection, we formulate the stigma cost function. The stigma cost is endogenously determined, and the higher the conditional probability that a recipient is a non-needy type, i.e., fraudulent recipient, the higher the stigma cost. The probability that a recipient is non-needy is given by the following:

$$\Pr(i = 2|\text{Take-up welfare}) = \frac{(1-\gamma)q}{\gamma p + (1-\gamma)q} := \Pi. \tag{2.8}$$

We assume that stigma cost is an increasing function with Π as follows:

$$\begin{aligned} &s = s\left(\Pi(p, q), z_i\right), \\ &\frac{\partial s\left(\Pi(p, q), z_i\right)}{\partial \Pi} > 0, \text{ for } i = 1, 2. \end{aligned} \tag{2.9}$$

This formulation is inspired by the statistical stigma in Besley and Coate (1992) and Blumkin et al. (2015). Setting a stigma occurs as follows. People in society despise 'welfare fraud' (the taking-up of welfare by non-needy type individuals(type 2)). However, it is difficult to identify whether welfare fraud is actually being committed without distinguishing between types 1 and 2. This stems from the idea that, in the world, it is not reprehensible for a truly needy individual to take up welfare, but a negative image is formed of an individual who is not needy taking-up welfare, which causes stigma.

Stigma cost is a function of capability. While Besley and Coate (1992) assumed that stigma cost was the same for all recipients, we differentiate stigma cost by the capabilities of types 1 and 2. We do not assume the sign of $\partial s\left(\Pi, z_i\right)/\partial z_i$. We denote π as the ratio p/q, and then,

$$\Pi = \frac{1}{\gamma p/(1-\gamma)q+1} = \frac{1}{\gamma/(1-\gamma)\pi+1}. \tag{2.10}$$

We can rewrite equation (2.9) as follows:

$$s = s\left(\Pi(p,q), z_i\right) = s\left(\Pi(p/q,1), z_i\right) := s\left(\pi, z_i\right). \tag{2.11}$$

Clearly, we obtain the following:

$$\frac{\partial s\left(\Pi, z_i\right)}{\partial \Pi}\frac{\partial \Pi}{\partial \pi} < 0. \tag{2.12}$$

An equilibrium point corresponds to a solution in the following simultaneous equation:

$$\begin{cases} p = \dfrac{\hat{u}\left(b, z_1\right)}{\overline{\phi} s\left(\pi, z_1\right)}, \\ q = \dfrac{\hat{u}\left(b, z_2\right)}{\overline{\phi} s\left(\pi, z_2\right)}, \\ \pi = \dfrac{p}{q}. \end{cases} \tag{2.13}$$

By substituting the first and the second row equations into the right-hand side of the third row equation of equation (2.13), it is indicated that:

$$\begin{aligned} \pi &= \frac{p(\pi)}{q(\pi)} \\ &= \frac{\hat{u}\left(b, z_1\right)}{\hat{u}\left(b, z_2\right)}\frac{s\left(\pi, z_2\right)}{s\left(\pi, z_1\right)} := M(\pi). \end{aligned} \tag{2.14}$$

Here,

$$\begin{aligned} &\hat{u}\left(b, z_1\right) \equiv u\left(b, z_1\right), \\ &\hat{u}\left(b, z_2\right) \equiv u\left(b, z_2\right) - u\left(w, z_2\right) + \theta, \end{aligned} \tag{2.15}$$

$\hat{u}(b, z_i)$ is the incremental material utility when taking-up welfare. $M(\pi)$ is a mapping from

π to itself. By differentiation, we obtain the following:

$$\begin{aligned}\frac{dM(\pi)}{d\pi} &= \frac{\hat{u}\left(b,z_1\right)}{\hat{u}\left(b,z_2\right)}\left[\frac{\partial s\left(\pi,z_2\right)/\partial\pi}{s\left(\pi,z_1\right)} - \frac{s\left(\pi,z_2\right)}{s\left(\pi,z_1\right)^2}\frac{\partial s\left(\pi,z_1\right)}{\partial\pi}\right] \\ &= \frac{\hat{u}\left(b,z_1\right)}{\hat{u}\left(b,z_2\right)}\frac{s\left(\pi,z_2\right)}{s\left(\pi,z_1\right)}\left[\frac{\partial s\left(\pi,z_2\right)/\partial\pi}{s\left(\pi,z_2\right)} - \frac{\partial s\left(\pi,z_1\right)/\partial\pi}{s\left(\pi,z_1\right)}\right] \\ &= \frac{\partial s\left(\pi,z_2\right)}{\partial\pi}\frac{\pi}{s\left(\pi,z_2\right)} - \frac{\partial s\left(\pi,z_1\right)}{\partial\pi}\frac{\pi}{s\left(\pi,z_1\right)}.\end{aligned} \tag{2.16}$$

Here, we define the elasticity of stigma cost to π:

$$\varepsilon_\pi\left(z_i\right) \equiv -\frac{\partial s\left(\pi,z_i\right)}{\partial\pi}\frac{\pi}{s\left(\pi,z_i\right)}. \tag{2.17}$$

Using this elasticity, we rewrite this as given:

$$\frac{dM(\pi)}{d\pi} = \varepsilon_\pi\left(z_1\right) - \varepsilon_\pi\left(z_2\right). \tag{2.18}$$

Equation (2.18) corresponds to a slope of $M(\pi)$, which is a change of the ratio to itself. Then, if $\varepsilon_\pi\left(z_1\right) - \varepsilon_\pi\left(z_2\right)$ in some domain, the possibility of multiple equilibria exists. The stability condition is

$$\varepsilon_\pi\left(z_1\right) - \varepsilon_\pi\left(z_2\right) < 1. \tag{2.19}$$

We henceforth focus on the equilibrium where the stability condition is retained. The next subsection presents the comparative static analysis focusing on an effect of changes in the benefit level on the recipient ratio in each type and the economy.

2.4 Comparative statics

In this subsection, we conduct comparative statics. We are particularly interested in how a change in benefit level affects equilibrium, and we compare our empirical evidence and theoretical results.

We define the elasticity as follows:

$$\eta_b(z_i) \equiv \frac{\partial \hat{u}(b, z_i)}{\partial b} \frac{b}{\hat{u}(b, z_i)}. \tag{2.20}$$

This is an elasticity of material utility to benefit level. The result is summarized in the following proposition.

Proposition 1

$$\operatorname{sgn}\left[\frac{dp^*}{db}\right] = \operatorname{sgn}\left[\frac{\eta_b(z_1)}{\eta_b(z_2)} - \frac{\varepsilon_{\pi^*}(z_1)}{1+\varepsilon_{\pi^*}(z_2)}\right], \tag{2.21}$$

$$\operatorname{sgn}\left[\frac{dq^*}{db}\right] = \operatorname{sgn}\left[\frac{\eta_b(z_1)}{\eta_b(z_2)} - \frac{1+\varepsilon_{\pi^*}(z_1)}{\varepsilon_{\pi^*}(z_2)}\right], \tag{2.22}$$

$$\operatorname{sgn}\left[\frac{d\pi^*}{db}\right] = \operatorname{sgn}\left[\frac{\eta_b(z_1)}{\eta_b(z_2)} - 1\right]. \tag{2.23}$$

Proof. See appendix. ■

When the ratio $\eta_b(z_1)/\eta_b(z_2)$ is sufficiently low, the equilibrium proportion of recipients of the needy type, p^*, the equilibrium proportion of recipients of the non-needy type, q^*, and their ratio, $\pi^* = p^*/q^*$, decrease according to the level of welfare benefit.

The implication of Proposition 1 is the following. If the non-needy type's elasticity of material utility to benefit level is sufficiently higher than the needy type's, then the impact of increasing recipients of the non-needy type to stigma, which is the direct effect of an increase in benefit level, is stronger than that of the needy type, and the level of stigma cost increases. If this increase in the stigma cost level is sufficiently large, then the indirect effect, the disincentive effect to take up welfare from an increase in stigma, outweighs the direct effect, the incentive effect to take up welfare from an increase in the benefit level, resulting in fewer beneficiaries.

We denote R as a proportion of recipients to total population. Since the size of the population is normalized to 1, R is given as follows:

$$R = \gamma p + (1-\gamma)q. \tag{2.24}$$

An effect of a change in benefit level on R is:

$$\frac{dR^*}{db} = \gamma\frac{dp^*}{db} + (1-\gamma)\frac{dq^*}{db}. \tag{2.25}$$

The sign of an effect of a change in benefit level on the recipient ratio is given in the following proposition.

Proposition 2 *The sign of* $\frac{dR^*}{db}$ *is:*

$$\operatorname{sgn}\frac{dR^*}{db} = \operatorname{sgn}\left[\frac{\eta_b(z_1)}{\eta_b(z_2)} - \frac{1-\gamma+\varepsilon_{\pi^*}(z_1)}{\gamma+\varepsilon_{\pi^*}(z_2)}\right]. \tag{2.26}$$

Proposition 2 reveals the possibility that the recipient ratio decreases as the benefit level increases.

The recipient ratio increases in the benefit level when the ratio of elasticity, $\eta_b(z_1)/\eta_b(z_2)$, is sufficiently low, and vice versa. The mechanism of Proposition 2 is similar to that of Proposition 1 since the effect of a change in benefit level on the recipient ratio is the total effect of adding the effect on the needy type and the effect on the non-needy type.

In this section, we construct a theoretical model that can account for welfare fraud and non-take-up simultaneously; the welfare stigma cost varies with the quality of the recipient, and the decision-making of potential recipients depends on the expectation of the level of stigma cost; the stigma cost is assumed to rise with respect to the conditional probability that the recipient is a fraudulent recipient. This stems from the idea that, in this world, it is not condemnable for a truly needy person to take up welfare, but a negative image is formed about a non-needy person who take up welfare, which becomes a source of stigma. In equilibrium, welfare fraud and non-take-up occur simultaneously. In the comparative static analysis, we show that an increase in the level of benefits can result in a decrease in the recipient ratio for the needy type and the recipient ratio for the non-needy type. Thus, the recipient ratio of the economy as a whole could also be lower with respect to the level of benefits. In the next section, we empirically test the results of this theoretical analysis using OECD panel data.

3 Empirical analysis

This section presents empirical evidence to verify the analysis in Section 2 by exploring the relationship between the recipient ratio and the minimum income benefit level using the OECD panel data.

3.1 Econometric model

The panel data were analyzed to investigate the correlation between the minimum guaranteed income level and social benefit recipients. The decision to employ the panel data to investigate the relationship reflects three motivations. First, a panel data model can have better prediction accuracy than the cross-sectional model and time-series model because it includes more observations than cross-section data and time-series data. Second, it enables researchers to address the issue of endogeneity caused by omitted variable bias. Third, it allows us to include changes in society in the empirical analysis (Greene, 2012). This paper analyzes the relationship between the minimum income benefit level and social benefit recipient ratio based on the baseline model:

$$y_{it} = \mathbf{x}'_{it}\boldsymbol{\beta} + e_{it}, \tag{3.1}$$

where y_{it} is the dependent variable, $\mathbf{x}'_{it}$ is the K-dimensional vector of predictors consisting of the target explanatory variable and the covariates, $\boldsymbol{\beta}$ is the K-dimensional vector of unknown parameters, and e_{it} is the disturbance term, which is distributed as $e_{it} \sim \mathcal{N}(0, \sigma_e^2)$. Furthermore, in equation (3.1), $i = 1, \ldots n$ indicates the index for a country, whereas $t = 1, \ldots, T$

represents the index for time. The OLS estimation of equation (3.1) after pooling the available data is called the pooling estimation.

When we consider the country-specific heterogeneity in the disturbance term of equation (3.1), e_{it} can be decomposed as follows:

$$\begin{aligned} y_{it} &= \mathbf{x}'_{it}\boldsymbol{\beta} + e_{it} \\ e_{it} &= \alpha_i + \nu_{it}, \end{aligned} \tag{3.2}$$

where α_i is the error depending on the country i and $\nu_{it} \sim$ i.i.d. $\mathcal{N}(0, \sigma_\nu^2)$ is the stochastic disturbance term. Equation (3.2) can be considered a one-way error component model (Baltagi, 1984) because it decomposes the disturbance term e_{it} into the error based on the individual heterogeneity and the stochastic error. The model in equation (3.2) can be estimated using a one-way fixed-effect estimator (hereafter referred to as one-way FE) and the one-way random-effect estimator (hereafter refered to as one-way RE). The one-way FE presumes the binary dummy variable for α_i, whereas the one-way RE assumes that the individual effect is randomly determined.

Considering the heterogeneity caused by the individual effect as in equation (3.1), the disturbance term can be further decomposed to incorporate heterogeneity in time:

$$\begin{aligned} y_{it} &= \mathbf{x}'_{it}\boldsymbol{\beta} + e_{it} \\ e_{it} &= \alpha_i + \lambda_t + \nu_{it}, \end{aligned} \tag{3.3}$$

where λ_t is the error depending on the time t. Equation (3.3), a two-way error component model (Baltagi, 1984), decomposes the disturbance term into the error based on the heterogeneity of country i, the error caused by the time, such as economic during shocks, and the stochastic disturbance. As with equation (3.2),the model of equation (3.3) can be estimated by a two-way fixed-effect estimator (hereafter referred to as two-way FE) and a two-way random-effect estimator (hereafter referred to as two-way RE).

This paper estimates the relationship between the minimum income benefit level and social benefit recipients using five estimation methods: pooling, one-way FE, one-way RE, two-way FE, and two-way RE. These estimation methods are assessed via hypothesis testing. We first implement the F-test for pooling versus one-way FE or two-way FE. Second, we perform the Lagrange multiplier test (hereafter, the LM-test) (Honda, 1985) for pooling versus one-way RE or two-way RE. Finally, we conduct a Hausman test (Hausman, 1978) for one-way RE versus one-way FE, two-way RE, and two-way FE. Further information on hypothesis testing in the panel data analysis has been provided by Baltagi (2008).

3.2 Data

This section proposes the details of our dataset used for estimation of the panel data models introduced in Section 3.1. All of the data described below were obtained from OECD.Stat (OECD, 2019).

For the dependent variable, we use the logit-transformed version (`logit_recipient_ratio`) of the recipient ratio (`recipient_ratio`), which is the ratio of social benefit recipients to the total population. Data on the number of social benefit recipients were retrieved from the Social Benefit Recipients Database, and total population data were obtained from Population Statistics.

For the target explanatory variable, we include the minimum guaranteed income `mgincome`, which represents the degree of social benefits in terms of the ratio of the per capita social benefits to the median per capita income. These data can be retrieved from the Adequacy of Guaranteed Minimum Income Benefits. Furthermore, we incorporate the quadratic term `mgincome` (`mgincome_2`) to consider the nonlinear effect of the target explanatory variable.

In order to account for any estimation biases caused by unobserved confounders, we additionally incorporate the following covariates into the vector of predictors:

- `log_gdp_capita`: the natural logarithm of GDP per capita (`gdp_capita`), retrieved from Annual National Accounts. GDP per capita, which reflects the economic situation in each country, is likely to have an immediate impact on the `recipient_ratio`, but there is a relatively delayed impact on `mgincome`.

- `youth_dependency`: ratio of young population (0 to 14 years old) to productive population (15 to 64), retrieved from Population Statistics. This reflects the demographic burden of each country (the ratio of the unproductive population to the productive population). The proportion of younger unproductive population is expected to affect the `recipient_ratio`; it is unlikely to affect `mgincome`.
- `old_dependency`: ratio of old population (over 65 years old) to productive population (15 to 64), retrieved from Population Statistics. The proportion of older unproductive population is expected to affect the `recipient_ratio`; it is unlikely to affect `mgincome`.
- `divorce_rate`: the divorce rate, retrieved from the Family Database. It is a proxy of the household structure, which has an impact on the `recipient_ratio` throughout time. The tighter the time constraints are, the lower the income.
- `unemployment`: the national unemployment rate for the working-age population, retrieved from Labor Force Statistics. It is similar to `log_gdp_capita`, which reflects the economic situation in each country.
- `population_growth`: the population growth, retrieved from Population Statistics and calculated by the authors. This could be a confounding factor that positively affects both `recipient_ratio` and `mgincome`. This is because `recipient_ratio` is calculated as the ratio of recipients to the population, while `mgincome` is likely to be affected by population growth through economic growth (Brueckner and Schwandt, 2015).

The panel dataset includes a date for the aforementioned variables. After reducing some missing series in the sample that were not randomly missing, we obtain panel data for $n = 25$ countries covering the time frame from 2007 to 2012. This paper conducts the empirical analysis using the panel data with the number of observations $nT = N = 150$.

Let us simply examine the differences in `mgincome` by country and year. `mgincome`, one of the levels of social welfare, represents the share of social welfare benefits in median disposable income. In order to examine each of those factors that determine `mgincome`, the relationship between the median disposable income and the amount of benefits is shown as Figure 1. The median income for each year in each country was obtained from the Income Distribution Database of OECD.stat, and the social welfare benefits were calculated using the median disposable income as described above. Units for both median social welfare benefits and income are converted to US dollars for each year. The solid line is a simple regression of these data. The scatterplot with the addition of this regression curve simply appears to show a positive linear relationship of benefits to the median income. Here, this study confirms institutional changes in those social welfare policies over the period of the samples using OECD country policy descriptions (OECD, 2020) for those countries (Denmark, Spain, and Iceland) that have country-year observations with residuals defined by this regression curve above the 95th percentile in the sample. First, there was a social welfare policy change in Denmark regarding the requirements for taking-up welfare in 2008, when the obligation for family members was relaxed to allow spouses who could not work to take up welfare benefits as long as they had performed 300 hours of regular work within the previous two years. In Spain and Iceland, no institutional changes in social welfare could be identified within the sample period. Institutional changes such as those that have taken place in Denmark could occur in other countries as well. This country-dependent heterogeneity of these institutional changes is explained by the error-component model described in Section 3.1.

3.3 Result

This section presents the result of the empirical analysis investigating the relationship between the minimum guaranteed income level and the ratio of the number of recipients.

Table 1 presents the descriptive statistics of pooled panel data. This table demonstrates the large inequality between the minimum and maximum recipient ratio (minimum: 0.001, maximum: 0.037). Furthermore, the maximum of `mgincome` in Table 1 indicates that countries tend to guarantee almost 60% of the median per capita income through social benefit programs, although the median and mean of the guaranteed minimum income is approximately 40%.

Examining the descriptive statistics by country, Tables 2 and 3 indicate the necessity of adjustment by covariates or dealing with country-based heterogeneity when we assume that the minimum income benefit level is the determinant factor influencing benefit recipients/ total population ratio. For example, Canada and the Slovak Republic have the same maximum mean of recipient ratio (0.034); however, their mean minimum guaranteed income levels differ (Canada: 0.368, Slovak Republic: 0.238).

Table 4 presents the descriptive statistics by year. Although no large difference in means and medians can be found in this table, the standard deviation of the minimum guaranteed income level includes a relatively large outlier in 2012 (0.89). This motivates us to include time-specific heterogeneity in our model by estimating the two-way error component model.

Before proceeding to regression analysis, let us discuss the simple correlation between benefit level and recipient ratio. Figure 2 presents the scatterplot of the observed couples (`mgincome`, `recipient_ratio`). Even though the figure depicts the roughly convex relationship of two variables of interest, possible confounders might lead to a spurious correlation among them. We thus discuss a regression analysis taking into account other factors, which may affect both of these target variables, and unobserved heterogeneity pertaining to country-specific factors and time-specific factors.

As the main findings in this empirical evidence, Table 5 shows the estimation results of panel data regression models based on the data introduced in Section 3.2. Each row corresponds to an explanatory variable, and each column corresponds to an estimation method. The standard errors of the estimated coefficients are estimated using the heteroscedasticity and autocorrelation consistent estimator (hereafter referred to as the HAC estimator) of Arellano (1987). The bottom part of this table provides the results of the hypothesis testing carried out for model evaluation.

Regarding the hypothesis testing concerning the pooling estimation, both one-way FE and two-way FE are accepted at 1% statistical significance according to the F-test results. LM-tests for the random-effect estimators reject the pooling estimation at 1% significance but accept the one-way RE and two-way RE at the same level of significance. In the comparison of fixed-effect estimators and random-effect estimators, Hausman tests do not reject either one-way RE or two-way RE. Furthermore, neither of the fixed-effect estimators are accepted.

Examining the estimated coefficients by pooling estimation, `mgincome` has a significantly positive effect on the recipient ratio, and its quadratic term has a significantly negative effect on the recipient ratio. This suggests that the minimum guaranteed income level has an upper convex effect on recipients/population ratio. However, the results of the F-test, which compares the pooling estimation with the fixed-effect estimators, and of the LM-test, which compares the pooling estimation with the random-effect estimators, highlight the necessity to account for heterogeneity in a country or in both a country and with time.

The Hausman test results in Table 5 suggest that the correlation between the explanatory variables and country effect or between the explanatory variables and both country effect and time effect is not statistically significant, i.e., the correlation between $\mathbf{x}_{it}$ and α_i or $\mathbf{x}_{it}$ and both α_i and λ_t is not statistically significant. Therefore, the random-effect estimator, which assumes no correlation between the explanatory variables and decomposed effects such as α_i and λ_t, is the most preferable method according to the hypothesis test results. In the estimation result of one-way RE considering country-specific heterogeneity, the minimum guaranteed income level has an upper convex effect on recipients/population ratio as well as the pooling estimation. This relationship is similar to the one found in the estimation of the two-way error component models.

Figure 3 presents the fitted curve of one-way RE with the scatter plot of the couples of observations (`mgincome`, `logit_recipient_ratio`). As we discussed, the one-way RE curve indeed visually indicates the upper convex relationship between the benefit level and the recipient ratio.

The relationship between the level of social welfare and the recipient ratio shown by this empirical analysis, given the background of the theoretical analysis, is that according to Proposition 2, an increase in the level of benefits has both direct and indirect effects. The direct effect is that an increase in the level of benefits raises the material utility of taking-up welfare and increases the incentive of taking-up it. On the other hand, the indirect effect shows a negative sign when the rate of increase in non-needy type recipients is greater than the rate of increase in needy type recipients when the benefit level increases, which produces a disincentive effect of taking-up welfare. When the indirect effect is negative and its magnitude is large, the effect dominates the direct effect and the total effect is thus negative. Combining the inverse U-shaped relationship and the theoretical mechanism of the empirical analysis of `mgincome` and `logit_recipient_ratio`, it can be said that when the benefit level is low, the direct effect dominates the indirect effect, or the indirect effect is also positive. On the other hand, when the benefit level is somewhat higher, the indirect effect is negative, which further dominates the direct effect and the recipient ratio thus decreases.

Figure 4 includes two categories of members defined by an estimated maximum value of recipient ratio. Each member is shown in Tables 6 and 7. 'group_1', whose members have less `mgincome` than the threshold, and a benefit level corresponding to an estimated maximum of `logit_recipient_ratio` by one-way RE, includes Austria, Canada and Spain. On the other hand, 'group_2', whose members have more `mgincome` than the benefit level corresponding to an estimated maximum of `logit_recipient_ratio`, includes Netherlands, Denmark and Germany.

For example, Figure 4 shows that Spain, a 'group_1' country, had a low level of social welfare benefits and a low recipient ratio for the period from 2007 to 2012. Moreover, the recipient ratio is the highest for countries with high benefit levels, such as France, for the period from 2007 to 2012. Therefore, it can be determined that there is a positive relationship between the benefit level and the recipient ratio in 'group_1'. On the other hand, the recipient ratio has started to decrease in the situation where the benefit level increased from 2007 to

2012 in Switzerland and Australia, which are 'group_2' countries that are above the threshold of `mgincome` defined in our estimated maximum recipient ratio by one-way RE. In addition, if we consider the countries with higher benefit levels than those in Switzerland and Australia, we can observe that Germany has a higher benefit level and a much lower recipient ratio from 2007 to 2012. Therefore, it can be determined that the benefit level and recipient ratio are negatively related in 'group_2'.

To confirm the robustness of the estimated results obtained so far, we perform a sensitivity analysis by excluding covariates. Table 8 displays the results of the one-way RE estimation by adding the covariates one by one. The reason for choosing one-way RE as the estimator here is that it is the most statistically significant, as a result of the hypothesis testing for each estimator using the full model described above. As this Table shows, the coefficient of `mgincome` is positive in all cases where covariates are lacking, and the squared term of `mgincome` exhibits a significantly negative coefficient. All of the estimation results in Table 8 show a relationship that is consistent with the results that have been estimated by the full model. The sensitivity analysis therefore strengthens the robust inverse U-shaped relationship between the level of social welfare benefits and the recipient ratio which has been estimated so far.

In this section, an empirical analysis is conducted to verify the results of the theoretical analysis in the previous section using OECD panel data for the period from 2007 to 2012. The results of this empirical analysis show that the relationship between the benefit level and the recipient ratio in a given country is exhibited by an inverse U-shape, and the robustness of this result is further confirmed by a sensitivity analysis. The results of these empirical analyses reinforce the counterintuitive theoretical consequence that, under *ceteris-paribus*, an increase in benefit levels leads to a decrease in the recipient ratio.

4 Conclusion

This study contributed with the respect to the following points: first, we constructed the model in which non-take-up and welfare fraud coexist in equilibrium, and showed that a comparative statistic analysis reveals the possibility that the recipient ratio decreases as the benefit level increases. Second, in the empirical analysis using the macro panel data, we find that this association is observed and that the benefit level and the recipient ratio exhibit an inverse U-shaped relationship. The results of this empirical analysis supported the counterintuitive theoretical result that an increase in the benefit level leads to a lower the recipient ratio when other conditions are held constant.

In this paper, we consider only the discrete decision of whether or not to participate in the labor market. Labor supply decisions after labor market participation are continuous, and both intensive and extensive margin are important in considering welfare benefit programs. Saez (2002) analyzes optimal income transfers in light of both of them. Future work introduces an endogenous stigma into the framework of Saez (2002) to analyze a more realistic model and present practical policy implications.

Although this paper and Besley and Coate (1992) analyze static models of welfare stigma, we present the following questions. How do welfare stigma and behavior of potential recipients change in long-term? How do the dynamics of welfare stigma and potential recipients' behavior change during the process of adjustment to equilibrium? Itaya and Kurita (2020) attempts to investigate such questions using the replicator dynamics.

Acknowledgment

Earlier version of the paper have been presented at the Spring Meeting of the Japan Association for Applied Economics, June, 2019. We wish to thank Kimiko Terai and seminar participants for their useful comments. The first author gratefully acknowledges the financial support provided by the Grant-in-Aid for Scientific Research from the Japan Society for the

Promotion of Science (JSPS KAKENHI Grant Number JP19K23194 and JP20K13486).

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Appendix

Proof of Proposition 1. Equilibrium equations are as follows:

$$\begin{cases} p = \dfrac{\hat{u}(b, z_1)}{\overline{\phi} s(\pi, z_1)}, \\ q = \dfrac{\hat{u}(b, z_2)}{\overline{\phi} s(\pi, z_2)}, \\ \pi = \dfrac{p}{q}. \end{cases}$$

By logarithmic transformation, we obtain the following:

$$\begin{cases} \ln p = \ln \hat{u}(b, z_1) - \ln s(\pi, z_1) - \ln \overline{\phi}, \\ \ln q = \ln \hat{u}(b, z_2) - \ln s(\pi, z_2) - \ln \overline{\phi}, \\ \ln \pi = \ln p - \ln q. \end{cases}$$

By totally differentiating and setting $d\theta = dw = d\overline{\phi} = dz_1 = dz_2 = d\gamma = 0$,

$$\begin{cases} \dfrac{dp}{p} = \dfrac{\partial \hat{u}(b, z_1)/\partial b}{\hat{u}(b, z_1)} db - \dfrac{\partial s(\pi, z_1)/\partial \pi}{s(\pi, z_1)} d\pi, \\ \dfrac{dq}{q} = \dfrac{\partial \hat{u}(b, z_2)/\partial b}{\hat{u}(b, z_2)} db - \dfrac{\partial s(\pi, z_2)/\partial \pi}{s(\pi, z_2)} d\pi, \\ \dfrac{d\pi}{\pi} = \dfrac{dp}{p} - \dfrac{dq}{q}. \end{cases}$$

$$\Longleftrightarrow$$

$$\begin{cases} \dfrac{dp}{p} = \dfrac{\partial \hat{a}(b, z_1)}{\partial b} \dfrac{b}{\hat{u}(b, z_1)} \dfrac{db}{b} - \dfrac{\partial s(\pi, z_1)}{\partial \pi} \dfrac{\pi}{s(\pi, z_1)} \dfrac{d\pi}{\pi}, \\ \dfrac{dq}{q} = \dfrac{\partial \hat{a}(b, z_2)}{\partial b} \dfrac{b}{\hat{u}(b, z_2)} \dfrac{db}{b} - \dfrac{\partial s(\pi, z_2)}{\partial \pi} \dfrac{\pi}{s(\pi, z_2)} \dfrac{d\pi}{\pi}, \\ \dfrac{d\pi}{\pi} = \dfrac{dp}{p} - \dfrac{dq}{q}. \end{cases}$$

$$\Longleftrightarrow$$

$$\begin{cases} \dfrac{dp}{p} = \eta_b(z_1) \dfrac{db}{b} + \varepsilon_\pi(z_1) \dfrac{d\pi}{\pi}, \\ \dfrac{dq}{q} = \eta_b(z_2) \dfrac{db}{b} + \varepsilon_\pi(z_2) \dfrac{d\pi}{\pi}, \\ \dfrac{d\pi}{\pi} = \dfrac{dp}{p} - \dfrac{dq}{q}. \end{cases}$$

A matrix representation is given below:

$$\begin{bmatrix} 1 & 0 & -\varepsilon_{\pi}(z_1) \\ 0 & 1 & -\varepsilon_{\pi}(z_2) \\ 1 & -1 & -1 \end{bmatrix} \begin{bmatrix} \frac{dp/p}{db/b} \\ \frac{dq/q}{db/b} \\ \frac{d\pi/\pi}{db/b} \end{bmatrix} = \begin{bmatrix} \eta_b(z_1) \\ \eta_b(z_2) \\ 0 \end{bmatrix}.$$

By Cramer's rule, solutions are given as follows:

$$\begin{aligned} \frac{dp/p}{db/b} &= \frac{-\eta_b(z_1)\left[1+\varepsilon_{\pi}(z_2)\right] + \eta_b(z_2)\,\varepsilon_{\pi}(z_1)}{\varepsilon_{\pi}(z_1) - \left[1+\varepsilon_{\pi}(z_2)\right]}, \\ \frac{dq/q}{db/b} &= \frac{\eta_b(z_2)\left[1+\varepsilon_{\pi}(z_1)\right] - \eta_b(z_1)\,\varepsilon_{\pi}(z_2)}{\varepsilon_{\pi}(z_1) - \left[1+\varepsilon_{\pi}(z_2)\right]}, \\ \frac{d\pi/\pi}{db/b} &= \frac{-\eta_b(z_1) + \eta_b(z_2)}{\varepsilon_{\pi}(z_1) - \left[1+\varepsilon_{\pi}(z_2)\right]}. \end{aligned}$$

Since the stability condition is $\varepsilon_{\pi^*}(z_1) - \varepsilon_{\pi^*}(z_2) < 1$, the denominator, $\varepsilon_{\pi}(z_1) - [1+\varepsilon_{\pi}(z_2)]$, is negative.

Therefore, the result of comparative statics regarding a change in benefit level is given as follows:

$$\begin{aligned} \operatorname{sgn}\left[\frac{dp^*}{db}\right] &= \operatorname{sgn}\left[\frac{\eta_b(z_1)}{\eta_b(z_2)} - \frac{\varepsilon_{\pi^*}(z_1)}{1+\varepsilon_{\pi^*}(z_2)}\right], \\ \operatorname{sgn}\left[\frac{dq^*}{db}\right] &= \operatorname{sgn}\left[\frac{\eta_b(z_1)}{\eta_b(z_2)} - \frac{1+\varepsilon_{\pi^*}(z_1)}{\varepsilon_{\pi^*}(z_2)}\right], \\ \operatorname{sgn}\left[\frac{d\pi^*}{db}\right] &= \operatorname{sgn}\left[\frac{\eta_b(z_1)}{\eta_b(z_2)} - 1\right]. \end{aligned}$$

■

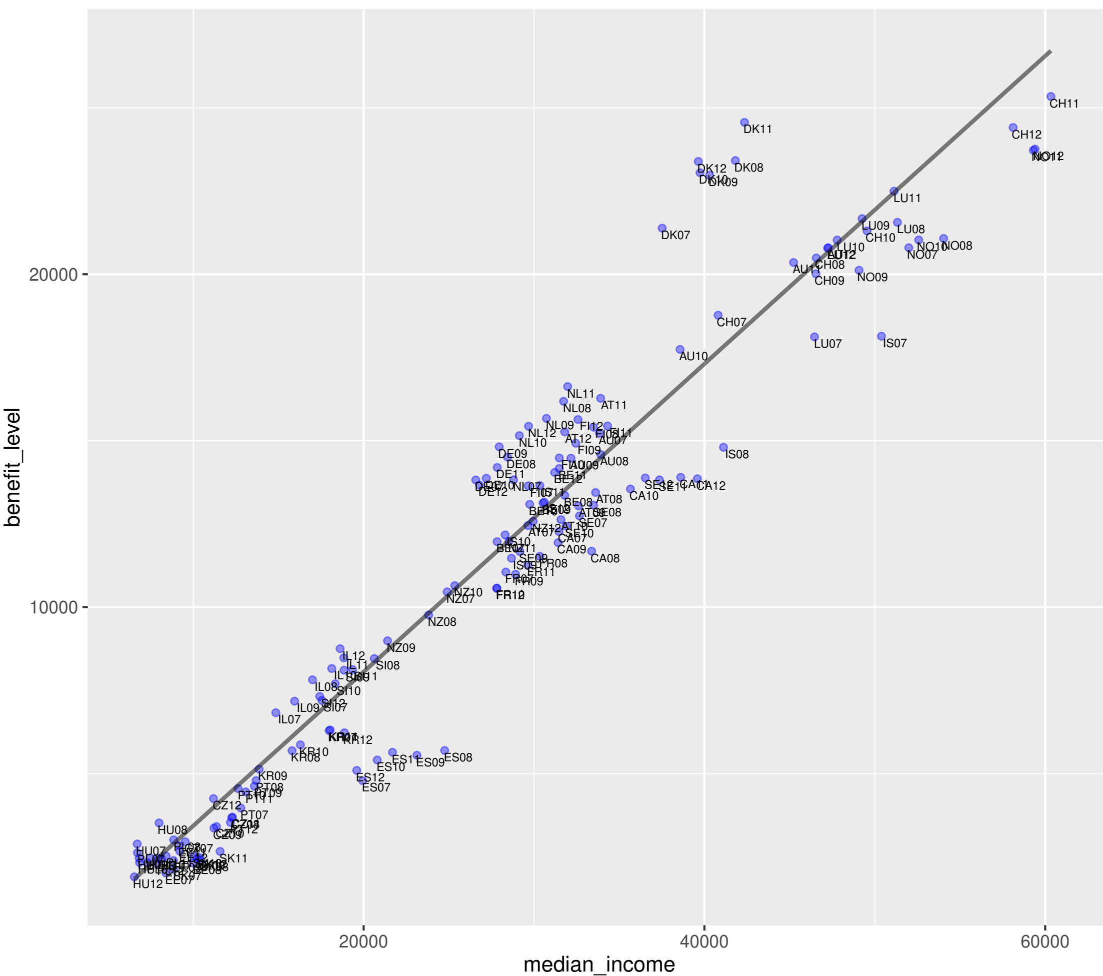

Figure 1: Relationship between the median income and benefit level

Notes: Strings accompanied by points indicate the attribute of observation, which combines the ISO 3166-1 alpha-2 code of countries shown in the table below with the last 2 digits of the observation year. All numerical units are converted to US dollars for the corresponding year.

country	abbreviation	country	abbreviation	country	abbreviation	country	abbreviation
Australia	AU	Finland	FI	Luxembourg	LU	Slovenia	SI
Austria	AT	France	FR	Netherlands	NL	Spain	ES
Belgium	BE	Germany	DE	New Zealand	NZ	Sweden	SE
Canada	CA	Hungary	HU	Norway	NO	Switzerland	CH
Czech Republic	CZ	Iceland	IS	Poland	PL		
Denmark	DK	Israel	IL	Portugal	PT		
Estonia	EE	Korea	KR	Slovak Republic	SK		

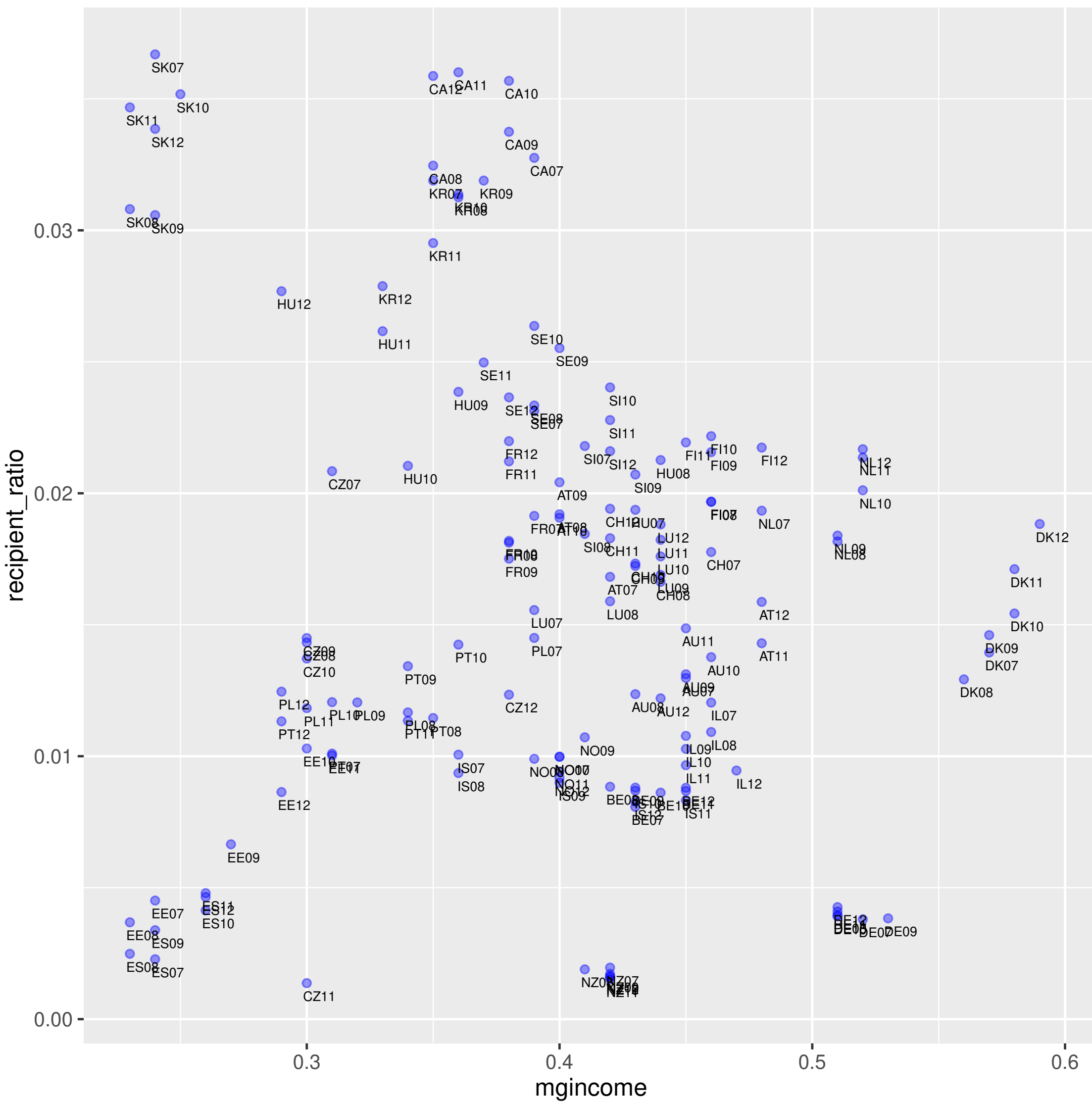

Figure 2: Simple relationship between the recipient ratio and benefit level

Notes: Strings accompanied by points indicate the attribute of observation, which combines the ISO 3166-1 alpha-2 code of countries shown in the table below with the last 2 digits of the observation year.

country	abbreviation	country	abbreviation	country	abbreviation	country	abbreviation
Australia	AU	Finland	FI	Luxembourg	LU	Slovenia	SI
Austria	AT	France	FR	Netherlands	NL	Spain	ES
Belgium	BE	Germany	DE	New Zealand	NZ	Sweden	SE
Canada	CA	Hungary	HU	Norway	NO	Switzerland	CH
Czech Republic	CZ	Iceland	IS	Poland	PL		
Denmark	DK	Israel	IL	Portugal	PT		
Estonia	EE	Korea	KR	Slovak Republic	SK		

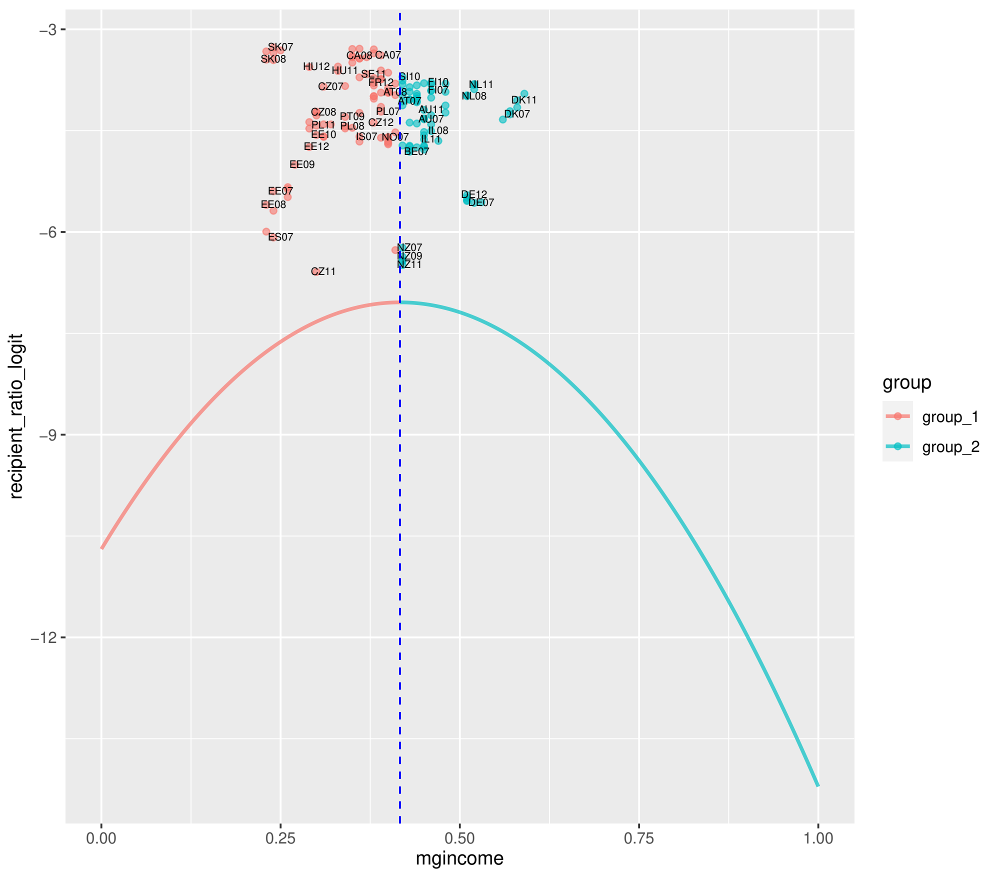

Figure 3: Fitted curve of one-way RE and scatterplot between the recipient ratio and benefit level

Notes: Strings accompanied by points indicate the attribute of observation, which combines the ISO 3166-1 alpha-2 code of countries shown in the table below with the last 2 digits of the observation year. The dashed blue line indicates a location of `mgincome` which corresponds to an estimated maximum of `recipient_ratio_logit` obtained by the fitted curve of one-way RE. 'group_1' and 'group_2' are defined by the location based on the dashed blue line. If an observed value of `mgincome` is less than the dashed blue line, it is categorized as 'group_1'; otherwise, it is categorized as 'group_2'.

country	abbreviation	country	abbreviation	country	abbreviation	country	abbreviation
Australia	AU	Finland	FI	Luxembourg	LU	Slovenia	SI
Austria	AT	France	FR	Netherlands	NL	Spain	ES
Belgium	BE	Germany	DE	New Zealand	NZ	Sweden	SE
Canada	CA	Hungary	HU	Norway	NO	Switzerland	CH
Czech Republic	CZ	Iceland	IS	Poland	PL		
Denmark	DK	Israel	IL	Portugal	PT		
Estonia	EE	Korea	KR	Slovak Republic	SK		

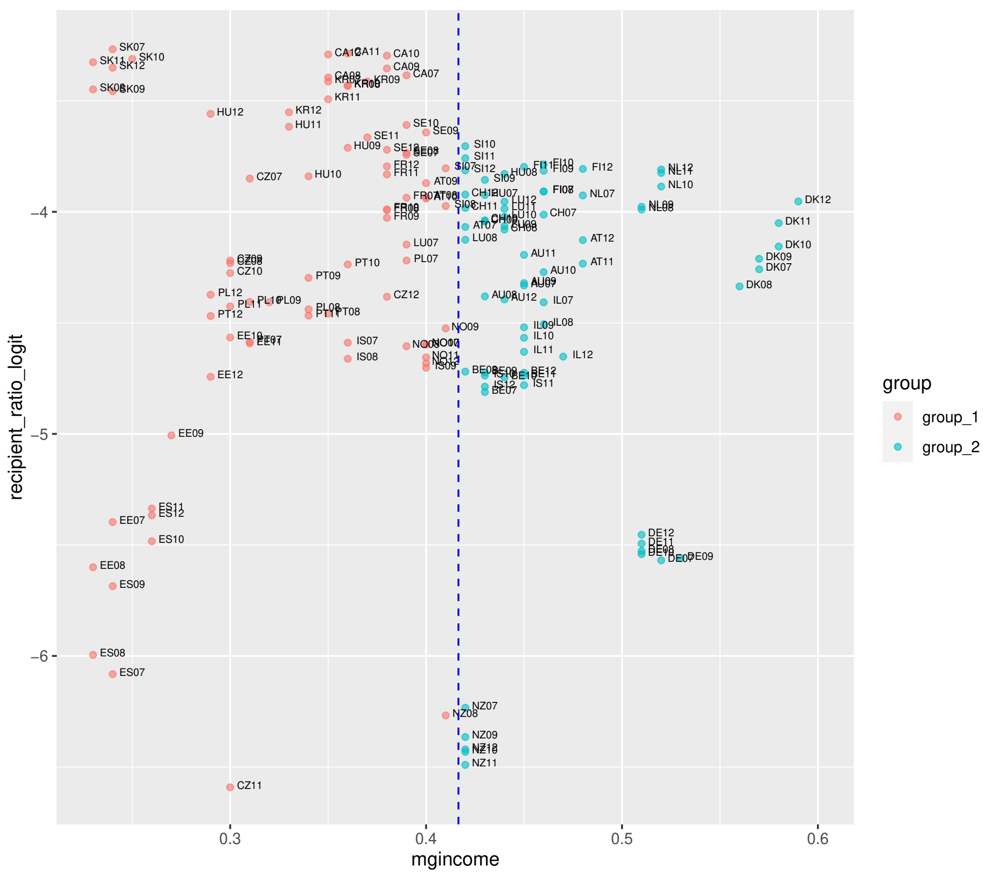

Figure 4: Scatterplot between the recipient ratio and benefit level, grouped

Notes: Strings accompanied by points indicate the attribute of observation, which combines the ISO 3166-1 alpha-2 code of countries shown in the table below with the last 2 digits of the observation year. The dashed blue line indicates a location of `mgincome` which corresponds to an estimated maximum of `recipient_ratio_logit` obtained by the fitted curve of one-way RE. 'group_1' and 'group_2' are defined by the location based on the dashed blue line. If an observed value of `mgincome` is less than the dashed blue line, it is categorized as 'group_1'; otherwise, it is categorized as 'group_2'.

country	abbreviation	country	abbreviation	country	abbreviation	country	abbreviation
Australia	AU	Finland	FI	Luxembourg	LU	Slovenia	SI
Austria	AT	France	FR	Netherlands	NL	Spain	ES
Belgium	BE	Germany	DE	New Zealand	NZ	Sweden	SE
Canada	CA	Hungary	HU	Norway	NO	Switzerland	CH
Czech Republic	CZ	Iceland	IS	Poland	PL		
Denmark	DK	Israel	IL	Portugal	PT		
Estonia	EE	Korea	KR	Slovak Republic	SK		

Table 1: Descriptive statistics of OECD panel data: whole data

	Mean	Median	Standard Deviation	Min	Max
`recipient_ratio`	0.016	0.015	0.009	0.001	0.037
`logit_recipient_ratio`	-4.327	-4.175	0.753	-6.591	-3.268
`mgincome`	0.397	0.400	0.082	0.230	0.590
`mgincome_2`	0.164	0.160	0.065	0.053	0.348
`gdp_capita`	37704.939	37699.559	14081.170	16788.433	91814.013
`log_gdp_capita`	10.479	10.537	0.335	9.728	11.428
`youth_dependency`	0.254	0.241	0.053	0.199	0.459
`old_dependency`	0.229	0.238	0.040	0.138	0.314
`divorce_rate`	0.002	0.002	0.000	0.001	0.003
`unemployment`	0.074	0.072	0.037	0.023	0.249
`population_growth`	0.006	0.005	0.007	-0.009	0.025

Notes: $T = 6, n = 25, N = 150$.

Table 2: Descriptive statistics of OECD panel data: by country (1)

country	recipient_ratio	logit_recipient_ratio	mgincome	mgincome_2	gdp_capita	log_gdp_capita
			Mean (Standard Deviation)			
Australia	0.013 (0.001)	-4.315 (0.074)	0.447 (0.010)	0.200 (0.009)	40852.112 (2156.481)	10.617 (0.053)
Austria	0.018 (0.002)	-4.029 (0.138)	0.430 (0.039)	0.186 (0.035)	42435.028 (2584.710)	10.654 (0.060)
Belgium	0.009 (0.000)	-4.744 (0.035)	0.437 (0.012)	0.191 (0.011)	39517.464 (2220.265)	10.583 (0.056)
Canada	0.034 (0.002)	-3.335 (0.049)	0.368 (0.017)	0.136 (0.013)	40428.026 (1271.527)	10.607 (0.031)
Czech Republic	0.013 (0.006)	-4.592 (0.996)	0.315 (0.032)	0.100 (0.022)	27776.316 (1070.706)	10.231 (0.039)
Denmark	0.015 (0.002)	-4.161 (0.140)	0.575 (0.010)	0.331 (0.012)	42137.252 (2322.734)	10.647 (0.055)
Estonia	0.007 (0.003)	-4.984 (0.433)	0.273 (0.033)	0.076 (0.018)	22846.807 (2032.578)	10.033 (0.088)
Finland	0.021 (0.001)	-3.837 (0.056)	0.462 (0.010)	0.213 (0.009)	39257.144 (1350.605)	10.577 (0.034)
France	0.019 (0.002)	-3.929 (0.094)	0.382 (0.004)	0.146 (0.003)	35822.205 (1475.914)	10.486 (0.041)
Germany	0.004 (0.000)	-5.525 (0.044)	0.515 (0.008)	0.265 (0.009)	39925.940 (2678.832)	10.593 (0.066)
Hungary	0.023 (0.003)	-3.747 (0.142)	0.365 (0.059)	0.136 (0.044)	21298.496 (1512.043)	9.964 (0.072)
Iceland	0.009 (0.001)	-4.710 (0.076)	0.405 (0.038)	0.165 (0.031)	41380.192 (1215.725)	10.630 (0.029)
Israel	0.011 (0.001)	-4.547 (0.090)	0.457 (0.008)	0.209 (0.007)	28872.669 (1899.220)	10.269 (0.065)
Korea	0.031 (0.002)	-3.456 (0.055)	0.353 (0.014)	0.125 (0.010)	29748.950 (1733.041)	10.299 (0.058)
Luxembourg	0.017 (0.001)	-4.050 (0.077)	0.428 (0.020)	0.184 (0.017)	86918.694 (3971.080)	11.372 (0.045)
Netherlands	0.020 (0.001)	-3.902 (0.076)	0.510 (0.015)	0.260 (0.015)	45641.618 (1321.341)	10.728 (0.029)
New Zealand	0.002 (0.000)	-6.368 (0.100)	0.418 (0.004)	0.175 (0.003)	30845.995 (1511.117)	10.336 (0.049)
Norway	0.010 (0.001)	-4.610 (0.054)	0.400 (0.006)	0.160 (0.005)	59776.358 (3956.631)	10.997 (0.066)
Poland	0.012 (0.001)	-4.378 (0.081)	0.325 (0.036)	0.107 (0.025)	20207.247 (2579.601)	9.907 (0.129)
Portugal	0.012 (0.002)	-4.419 (0.128)	0.332 (0.026)	0.111 (0.017)	26558.193 (521.970)	10.187 (0.020)
Slovak Republic	0.034 (0.002)	-3.360 (0.076)	0.238 (0.008)	0.057 (0.004)	24142.536 (2038.476)	10.089 (0.086)
Slovenia	0.022 (0.002)	-3.818 (0.092)	0.418 (0.008)	0.175 (0.006)	28351.080 (880.111)	10.252 (0.031)
Spain	0.004 (0.001)	-5.658 (0.320)	0.248 (0.013)	0.062 (0.007)	32403.199 (568.189)	10.386 (0.017)
Sweden	0.024 (0.001)	-3.686 (0.055)	0.387 (0.010)	0.150 (0.008)	42080.770 (1911.048)	10.646 (0.045)
Switzerland	0.018 (0.001)	-4.013 (0.055)	0.433 (0.015)	0.188 (0.013)	53399.177 (3100.762)	10.884 (0.058)

Notes: $T = 6, n = 25, N = 150$Numbers in parentheses represent the standard deviation.

Table 3: Descriptive statistics of OECD panel data: by country (2)

country	youth_dependency	old_dependency	divorce_rate	unemployment	population_growth
Mean (Standard Deviation)					
Australia	0.284 (0.002)	0.201 (0.007)	0.002 (0.000)	0.050 (0.005)	0.017 (0.003)
Austria	0.222 (0.006)	0.259 (0.005)	0.002 (0.000)	0.048 (0.004)	0.003 (0.001)
Belgium	0.257 (0.001)	0.261 (0.003)	0.003 (0.000)	0.076 (0.005)	0.009 (0.002)
Canada	0.239 (0.004)	0.203 (0.008)	0.002 (0.000)	0.073 (0.010)	0.011 (0.001)
Czech Republic	0.205 (0.006)	0.218 (0.014)	0.003 (0.000)	0.063 (0.011)	0.004 (0.004)
Denmark	0.276 (0.004)	0.251 (0.014)	0.003 (0.000)	0.061 (0.020)	0.005 (0.001)
Estonia	0.226 (0.006)	0.259 (0.005)	0.002 (0.000)	0.107 (0.048)	-0.002 (0.001)
Finland	0.252 (0.002)	0.261 (0.014)	0.002 (0.000)	0.076 (0.008)	0.005 (0.000)
France	0.284 (0.003)	0.261 (0.007)	0.002 (0.000)	0.085 (0.009)	0.005 (0.000)
Germany	0.205 (0.002)	0.310 (0.005)	0.002 (0.000)	0.071 (0.012)	-0.004 (0.003)
Hungary	0.215 (0.003)	0.241 (0.006)	0.002 (0.000)	0.098 (0.017)	-0.003 (0.001)
Iceland	0.311 (0.003)	0.179 (0.008)	0.002 (0.000)	0.056 (0.024)	0.008 (0.013)
Israel	0.454 (0.005)	0.160 (0.004)	0.002 (0.000)	0.083 (0.011)	0.019 (0.002)
Korea	0.227 (0.016)	0.149 (0.009)	0.002 (0.000)	0.035 (0.002)	0.006 (0.001)
Luxembourg	0.259 (0.008)	0.204 (0.002)	0.002 (0.000)	0.048 (0.005)	0.019 (0.003)
Netherlands	0.263 (0.003)	0.230 (0.012)	0.002 (0.000)	0.041 (0.008)	0.004 (0.001)
New Zealand	0.316 (0.001)	0.195 (0.008)	0.002 (0.000)	0.058 (0.014)	0.009 (0.002)
Norway	0.285 (0.004)	0.226 (0.006)	0.002 (0.000)	0.031 (0.004)	0.012 (0.001)
Poland	0.215 (0.003)	0.191 (0.003)	0.002 (0.000)	0.092 (0.012)	0.002 (0.004)
Portugal	0.230 (0.004)	0.277 (0.010)	0.002 (0.000)	0.113 (0.032)	-0.000 (0.002)
Slovak Republic	0.217 (0.004)	0.173 (0.005)	0.002 (0.000)	0.125 (0.019)	0.001 (0.000)
Slovenia	0.203 (0.004)	0.238 (0.006)	0.001 (0.000)	0.067 (0.018)	0.004 (0.003)
Spain	0.218 (0.005)	0.247 (0.008)	0.002 (0.000)	0.173 (0.063)	0.009 (0.007)
Sweden	0.257 (0.003)	0.279 (0.012)	0.002 (0.000)	0.076 (0.011)	0.008 (0.001)
Switzerland	0.220 (0.007)	0.252 (0.011)	0.002 (0.000)	0.042 (0.006)	0.009 (0.005)

Notes: $T = 6, n = 25, N = 150$Numbers in parentheses represent the standard deviation.

Table 4: Descriptive statistics of OECD panel data: by year

year	recipient_ratio	logit_recipient_ratio	mgincome	mgincome_2	gdp_capita	log_gdp_capita	youth_dependency	old_dependency	divorce_rate	unemployment	population_growth
					Mean						
2007	0.016	-4.339	0.396	0.164	35645.300	10.419	0.257	0.221	0.002	0.060	0.007
2008	0.015	-4.383	0.391	0.160	37381.672	10.468	0.255	0.223	0.002	0.057	0.008
2009	0.016	-4.311	0.397	0.164	36290.570	10.443	0.253	0.226	0.002	0.078	0.007
2010	0.017	-4.275	0.400	0.166	37469.973	10.476	0.252	0.230	0.002	0.084	0.006
2011	0.016	-4.370	0.399	0.166	39355.518	10.524	0.252	0.234	0.002	0.081	0.005
2012	0.016	-4.284	0.398	0.166	40086.599	10.543	0.252	0.240	0.002	0.083	0.005
					Median						
2007	0.016	-4.147	0.400	0.160	36871.534	10.515	0.249	0.229	0.002	0.054	0.005
2008	0.014	-4.231	0.400	0.160	38133.413	10.549	0.242	0.234	0.002	0.056	0.007
2009	0.015	-4.212	0.400	0.160	37695.802	10.537	0.240	0.237	0.002	0.078	0.005
2010	0.015	-4.156	0.400	0.160	38737.069	10.565	0.237	0.239	0.002	0.077	0.005
2011	0.015	-4.194	0.420	0.176	40683.337	10.614	0.236	0.240	0.002	0.072	0.004
2012	0.016	-4.127	0.420	0.176	40619.937	10.612	0.236	0.248	0.002	0.074	0.004
					Standard Deviation						
2007	0.009	0.775	0.082	0.064	13813.492	0.353	0.054	0.039	0.000	0.024	0.007
2008	0.008	0.758	0.084	0.064	14436.887	0.348	0.054	0.040	0.000	0.022	0.007
2009	0.009	0.731	0.082	0.065	13382.286	0.336	0.053	0.041	0.000	0.033	0.007
2010	0.009	0.728	0.080	0.065	13804.461	0.330	0.053	0.041	0.000	0.040	0.006
2011	0.010	0.865	0.084	0.068	14869.727	0.330	0.053	0.041	0.000	0.040	0.007
2012	0.009	0.726	0.089	0.071	15019.149	0.329	0.054	0.042	0.000	0.046	0.007

Notes: $T = 6, n = 25, N = 150$.

Table 5: Results of empirical analysis using OECD panel data

	Dependent variable:				
	logit_recipient_ratio				
	Pooling	one-way FE	two-way FE	one-way RE	two-way RE
mgincome	15.434**	18.021***	19.430***	17.534***	19.006***
	(6.382)	(6.737)	(7.076)	(6.704)	(6.843)
mgincome_2	−16.573**	−21.915***	−23.710***	−21.050**	−22.761***
	(7.593)	(7.800)	(8.399)	(8.198)	(8.512)
log_gdp_capita	0.252	0.492	0.332	0.423	0.352
	(0.264)	(0.394)	(0.570)	(0.261)	(0.295)
unemployment	2.736	5.417***	5.842***	5.250***	5.602***
	(2.387)	(1.654)	(2.019)	(1.375)	(1.775)
youth_dependency	−6.370***	−4.024	−5.626	−5.208	−6.160
	(1.624)	(7.033)	(7.782)	(3.685)	(4.189)
old_dependency	−8.012***	−4.283	−8.213	−5.069	−7.638
	(2.192)	(5.286)	(8.324)	(3.977)	(5.348)
divorce_rate	81.888	244.345	281.102	204.770	255.144
	(172.752)	(210.052)	(216.581)	(186.280)	(191.322)
population_growth	−4.079	12.090*	12.621*	10.512	11.681
	(13.483)	(7.213)	(7.048)	(8.717)	(8.643)
Constant	−7.279**			−10.693***	−9.555***
	(2.932)			(3.323)	(3.354)
R^2	0.163	0.233	0.246	0.214	0.251
Adjusted R^2	0.116	0.023	−0.003	0.170	0.179
F-test (vs. pooling)		57.200 ***	47.991***		
F-test (vs. one-way FE)			1.219		
LM-test (vs. pooling)				17.294***	11.119***
Hausman-test (vs. random effect)		1.424	0.950		

Notes: Numbers in parentheses represent standard error calculated by HAC (Arellano, 1987) estimator. Above *,** ,*** indicate statistical significance at 10%, 5%, 1%, respectively.

Table 6: 'group_1' countries less than an estimated maximum of `recipient_ratio_logit` by one-way RE

group_1					
country	year	name_year	country	year	name_year
Austria	2008	AT08	Luxembourg	2007	LU07
Austria	2009	AT09	New Zealand	2008	NZ08
Austria	2010	AT10	Norway	2007	NO07
Canada	2007	CA07	Norway	2008	NO08
Canada	2008	CA08	Norway	2009	NO09
Canada	2009	CA09	Norway	2010	NO10
Canada	2010	CA10	Norway	2011	NO11
Canada	2011	CA11	Norway	2012	NO12
Canada	2012	CA12	Poland	2007	PL07
Czech Republic	2007	CZ07	Poland	2008	PL08
Czech Republic	2008	CZ08	Poland	2009	PL09
Czech Republic	2009	CZ09	Poland	2010	PL10
Czech Republic	2010	CZ10	Poland	2011	PL11
Czech Republic	2011	CZ11	Poland	2012	PL12
Czech Republic	2012	CZ12	Portugal	2007	PT07
Estonia	2007	EE07	Portugal	2008	PT08
Estonia	2008	EE08	Portugal	2009	PT09
Estonia	2009	EE09	Portugal	2010	PT10
Estonia	2010	EE10	Portugal	2011	PT11
Estonia	2011	EE11	Portugal	2012	PT12
Estonia	2012	EE12	Slovak Republic	2007	SK07
France	2007	FR07	Slovak Republic	2008	SK08
France	2008	FR08	Slovak Republic	2009	SK09
France	2009	FR09	Slovak Republic	2010	SK10
France	2010	FR10	Slovak Republic	2011	SK11
France	2011	FR11	Slovak Republic	2012	SK12
France	2012	FR12	Slovenia	2007	SI07
Hungary	2009	HU09	Slovenia	2008	SI08
Hungary	2010	HU10	Spain	2007	ES07
Hungary	2011	HU11	Spain	2008	ES08
Hungary	2012	HU12	Spain	2009	ES09
Iceland	2007	IS07	Spain	2010	ES10
Iceland	2008	IS08	Spain	2011	ES11
Iceland	2009	IS09	Spain	2012	ES12
Korea	2007	KR07	Sweden	2007	SE07
Korea	2008	KR08	Sweden	2008	SE08
Korea	2009	KR09	Sweden	2009	SE09
Korea	2010	KR10	Sweden	2010	SE10
Korea	2011	KR11	Sweden	2011	SE11
Korea	2012	KR12	Sweden	2012	SE12

Notes: 'group_1' defined by countries with the value of `recipient_ratio_logit` which is less than an estimated maximum of `recipient_ratio_logit` by one-way RE. Column 'name_year' indicates ISO 3166-1 alpha-2 code of countries with the last two digits of the year.

Table 7: 'group_2' countries less than an estimated maximum of `recipient_ratio_logit` by one-way RE

group_2					
country	year	name_year	country	year	name_year
Australia	2007	AU07	Israel	2009	IL09
Australia	2008	AU08	Israel	2010	IL10
Australia	2009	AU09	Israel	2011	IL11
Australia	2010	AU10	Israel	2012	IL12
Australia	2011	AU11	Luxembourg	2008	LU08
Australia	2012	AU12	Luxembourg	2009	LU09
Austria	2007	AT07	Luxembourg	2010	LU10
Austria	2011	AT11	Luxembourg	2011	LU11
Austria	2012	AT12	Luxembourg	2012	LU12
Belgium	2007	BE07	Netherlands	2007	NL07
Belgium	2008	BE08	Netherlands	2008	NL08
Belgium	2009	BE09	Netherlands	2009	NL09
Belgium	2010	BE10	Netherlands	2010	NL10
Belgium	2011	BE11	Netherlands	2011	NL11
Belgium	2012	BE12	Netherlands	2012	NL12
Denmark	2007	DK07	New Zealand	2007	NZ07
Denmark	2008	DK08	New Zealand	2009	NZ09
Denmark	2009	DK09	New Zealand	2010	NZ10
Denmark	2010	DK10	New Zealand	2011	NZ11
Denmark	2011	DK11	New Zealand	2012	NZ12
Denmark	2012	DK12	Slovenia	2009	SI09
Finland	2007	FI07	Slovenia	2010	SI10
Finland	2008	FI08	Slovenia	2011	SI11
Finland	2009	FI09	Slovenia	2012	SI12
Finland	2010	FI10	Switzerland	2007	CH07
Finland	2011	FI11	Switzerland	2008	CH08
Finland	2012	FI12	Switzerland	2009	CH09
Germany	2007	DE07	Switzerland	2010	CH10
Germany	2008	DE08	Switzerland	2011	CH11
Germany	2009	DE09	Switzerland	2012	CH12
Germany	2010	DE10			
Germany	2011	DE11			
Germany	2012	DE12			
Hungary	2007	HU07			
Hungary	2008	HU08			
Iceland	2010	IS10			
Iceland	2011	IS11			
Iceland	2012	IS12			
Israel	2007	IL07			
Israel	2008	IL08			

Notes: 'group_2' defined by countries with the value of `recipient_ratio_logit` which is more than an estimated maximum of `recipient_ratio_logit` by one-way RE. Column 'name_year' indicates ISO 3166-1 alpha-2 code of countries with the last two digits of the year.

Table 8: Results of empirical analysis using OECD panel data: Sensitivity analysis

	Dependent variable:					
	`logit_recipient_ratio`					
	(1)	(2)	(3)	(4)	(5)	(6)
`mgincome`	18.939**	19.186**	16.213**	18.320**	16.694**	17.301**
	(9.435)	(9.375)	(7.005)	(7.447)	(7.068)	(7.034)
`mgincome_2`	−23.707**	−24.034**	−20.404**	−22.777**	−20.186**	−20.831**
	(11.871)	(11.807)	(8.935)	(9.430)	(9.048)	(8.722)
`log_gdp_capita`		0.084	0.067	0.033	0.367*	0.518*
		(0.272)	(0.275)	(0.300)	(0.214)	(0.278)
`unemployment`			2.942***	2.879***	4.113***	4.730***
			(0.733)	(0.768)	(0.740)	(1.086)
`youth_dependency`				−3.903	−5.660	−5.629
				(3.077)	(3.985)	(3.953)
`old_dependency`					−6.206	−6.518
					(4.810)	(4.823)
`divorce_rate`						206.935
						(187.571)
`population_growth`						
Constant	−7.950***	−8.873**	−8.333**	−7.431*	−8.931***	−11.083***
	(1.877)	(3.586)	(3.439)	(3.869)	(3.016)	(3.277)
Observations	150	150	150	150	150	150
R^2	0.081	0.082	0.138	0.153	0.184	0.196
Adjusted R^2	0.069	0.064	0.114	0.124	0.150	0.156

Notes: Numbers in parentheses represent standard error calculated by HAC (Arellano, 1987) estimator. Above *,** ,*** indicate statistical significance at $10\%, 5\%, 1\%$, respectively.