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Doctor of Philosophy

The impact of reciprocity on workers' support for universal basic income policy; Green Bonds and Corporate ESG Performance

The Graduate School
of the University of Ulsan

Department of Economics
Li Ziwei

The impact of reciprocity on workers' support for universal basic income policy; Green Bonds and Corporate ESG Performance

Supervisor: 유동우(Yoo, Dongwoo)

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Li Ziwei

Department of Economics
University of Ulsan, Korea

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The impact of reciprocity on workers' support for universal basic income policy; Green Bonds and Corporate ESG Performance

This certifies that the dissertation thesis of

Li Ziwei is approved.

Committee Chair Dr.
DooSeok Jang

Committee Member Dr.
Cheal Kwon Cho

Committee Member Dr.
Ryu Sangyun

Committee Member Dr.
Dongwoo Yoo

Committee Member Dr.
Kweyang Rhee

Department of Economics

Ulsan, Korea

August 2023

Abstract

This dissertation consists of two chapters. The first chapter's context is about the impact of reciprocity on workers' support for universal basic income policy. The second is to study the Green Bonds Improve Corporate ESG Performance using Chinese listed company data.

The chapter 1 shows that how the reciprocity affects the negotiation of universal basic income (UBI) between poor and the work representatives. This chapter builds a normal form game between workers and the poor to investigate the impact of reciprocity on Universal Basic Income (UBI) policies. We find that under the rational economic man assumption, the two sides are unable to reach a consistent equilibrium on UBI policy that satisfies both sides. In contrast, reciprocity can lead workers and the poor to agree on UBI policy options. Second, if both sides are selfish, the result will be that social welfare is lower than it would be under a positive reciprocal equilibrium. And a negative reciprocal equilibrium is more destructive to social welfare than selfishness. Finally, to solve a consistent reciprocal equilibrium, we find the Reciprocal Equilibrium Condition (REC) of the two-player reciprocal normal form game, and when the condition is satisfied, we can always find a consistent reciprocal equilibrium.

Chapter 2 uses data from Chinese listed companies and finds that the issuance of green bonds significantly improves corporate ESG performance. This effect is more significant in firms with younger managers or fewer financing constraints than the others. We also find that green bonds improve ESG performance by increasing

financing size. Robustness is tested using multiple control variables and ologit method, and the findings are robust. The findings of we provide policymakers with an effective tool to help improve corporate ESG performance through green bonds.

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Chapter 1. The impact of reciprocity on workers' support for universal basic income policy

1.1 Introduction

Currently, countries around the world are facing the social problems of income inequality. According to the Credit Suisse Research Institute, Global Wealth Databook (2021,2022), wealth inequality has generally increased since the onset of the new epidemic. For the second consecutive year, the wealth share of the top 1% of the world's population has increased from 43.9% in 2019 to 45.6% in 2021. Inequality has increased as the value of financial assets has soared during the new pneumonia pandemic. By the end of 2021, the bottom 50% of adults account for less than 1% of global wealth. However, the wealthiest 10% of the poor account for 82% of global wealth. Global wealth inequality has worsened.

While income tax is one method to alleviate inequality, it was yet to be as effective as was expected in reducing inequality. Other methods are needed to complement it (Mirrlees, 1971). Universal Basic Income (UBI) as a redistributive tool is one method to mitigate income inequality and has gained significant attention worldwide. Unlike traditional redistribution, UBI policy unconditionally provides all people an equal amount of basic income, regardless of whether they are poor or rich. However, it may not be welcomed by all citizens. The UBI policy has raised a few concerns. They fear that it will lead to a reduction in the motivation of labor in society. UBI policy is generally funded by redistributing revenue through the imposition of income tax

(Hanna & Olken, 2018). If the reward for work is reduced relative to the welfare benefits, then there may be some people dropping out of the labor market. Furthermore, a high level of taxation and redistribution may shift labor supply from high productivity activities to low productivity jobs or unemployment(Saez, 2002) and reduce labor supply(Alesina & Angeletos, 2005).

In China, the government first proposed to revise the income tax system before revising the personal income tax rates. Then, the government will invite typical representatives of relevant interest groups as well as professionals to listen to their opinions and suggestions on the policy. The government will then make amendments to the proposal based on these opinions and taking into account the actual situation. Eventually, the National People's Congress votes on the amended proposal and formally issues it. While UBI is good for alleviating inequality, the UBI policy maybe reduce the income of some workers and thus demotivate them to work. In the case of the poor and the workers, two groups with seemingly conflicting interests. The workers want the lowest possible tax rate, while the poor may wish for the highest possible tax rate. This leads us to ask a natural question. Can reciprocal agents resolve differences in UBI policy through gaming?

Most of the traditional studies on redistribution in the past have been conducted under the assumption of rational economic man. These studies have assumed that agents are selfish and self-interested and have rarely considered some psychological aspects of human behavior. However, much research in psychology proves that people are not entirely selfish and self-interested. They also have non-selfish or mutual help behaviors

such as cooperation and reciprocity. They will behave equally well towards each other's kind intentions and, conversely, behave in a hostile manner towards each other's hostile behavior. In the field of economics, there have been many economic experiments demonstrating that people have a reciprocal aspect, such as the ultimatums game(Camerer & Thaler, 1995; Cameron, 1999; Roth et al., 1991), gift exchange game (Falk et al., 2003; HOFFMAN et al., 1998), trust game(Cox, 2009; Fahr & Irlenbusch, 2000), dictatorship game(Andreoni & Miller, 1993; Camerer & Thaler, 1995; Forsythe et al., 1994), and other experiments have demonstrated that realistic agent has the property of reciprocity.

Rabin (1993) developed a motivation-based fairness game model. Fehr and Schmidt (1999) also developed a fairness (FS) model. The former focuses on the criterion of fairness, where the agent considers the other player to be kind to him/her if he/she is paid more than his/her psychological expectation criterion, otherwise, he/she is unkind. Dufwenberg and Kirchsteiger (2004) expand on Rabin's fairness model by introducing the concept of reciprocal equilibrium and developing a sequential reciprocity model. There have been some studies on fairness theory on redistribution. These studies applied the FS model to study the impact of income inequality aversion on redistribution(Jang & Atkinson, 2020; Murray et al., 2018). On the other hand, Dufwenberg's theory of reciprocity has also been applied to research in the field of economics. For example, Dufwenberg and Patel (2017) explore the impact of reciprocity on coordination and participation in the private provision of public goods. Under the assumption that agents are reciprocal, Dufwenberg et al. (2022) study the

effect of market interactions on subsequent altruistic behavior is investigated. Hahn (2009) studies the impact of reciprocal behaviour on voting behaviour in a two-party political system. So far, little literature studies redistribution from the perspective of the reciprocity factor. Therefore, this paper uses Dufwenberg's theory of reciprocity and UBI policy to conduct research that complements this aspect of the study.

Meltzer and Richard (1981) built a two-stage model in which citizens choose the preferred income tax rate in the first stage, and voters also workers choose labor time in the second stage. The FS model argues that people seek equality in distributional outcomes. The utility of inequality aversion arises from the difference between one's own income and that of others. Negative utility arises based on pity when the income of others is lower than one's own. Negative utility based on envy arises when the income of others is higher than one's own income. Murray et al. (2018) based on this model combined with the FS model, studied the impact of inequality aversion on redistribution. In this paper, we argue that redistributive policies are primarily generated by the negotiations and choices made by the relevant interest groups, and that redistributive policies are then made by the government according to their preferences. Reciprocity plays a critical role in the negotiation process to facilitate successful negotiations between the two sides. In this way, reciprocity affects the equilibrium between interest groups regarding the choice of redistributive tax rates. To demonstrate this, we attempt to create a two-players reciprocal negotiation game on UBI policy between the poor and workers, and examine whether it can help achieve a mutually agreed UBI policy from a reciprocal bargaining perspective. This paper conducts research based on

reciprocity theory and contributed to the literature in the field of redistribution and UBI policy.

Generally, most negotiations take place between group representatives, and it is common to negotiate with two sides. In negotiation, reciprocity can help represetative to reach a satisfactory agreement(Komorita & Parks, 1998). Therefore, we take Meltzer and Richard (1981) and Dufwenberg and Kirchsteiger (2004) reciprocity models to construct a reciprocal utility model. And use this model to study the impact of reciprocity on redistribution in a two-players negotiation normal form game between the poor and workers. First of all, we apply Dufwenberg's reciprocity model by proposing a reciprocal equilibrium condition, which we show will always lead to a reciprocal equilibrium in which both parties reach a mutually agreeable solution in a two-players normal form game, as long as the conditions are satisfied. This somewhat simplifies the reciprocity model's application to two-party negotiation game. After that, we use the reciprocity model to explore whether workers and the poor can reach a mutually agreeable solution to the formulation of UBI policy through reciprocal negotiations. In our model, the poor and workers can reach a consistent reciprocal equilibrium on UBI policy options. However, this equilibrium could be a positive reciprocal equilibrium or a negative reciprocal equilibrium. Finally, by comparing total social welfare in reciprocal and selfish equilibria, we observe that the positive consistent reciprocal equilibrium performs better in promoting social welfare, creating more total social welfare than the selfish and negative consistent reciprocal equilibria.

The article is structured as follows: In the next section, we introduce the research

hypotheses and the model assumptions. In Section 3, we introduce Dufwenberg's reciprocity model and develop the reciprocity model for this article. In Section 4, we present the reciprocal equilibrium conditions and use it to analyze the results of comparing non-reciprocal and reciprocal equilibrium. Besides, we discuss the robustness. In Section 5, the full text is a conclusion. The main proof procedure is placed in the appendix.

1.2 Basic model

Let us assume that there are n citizens in a society, n_1 of whom belong to the group of the poor and n_2 to the group of workers involved in labor. All citizens' material payoff or consumption constraint derives from labor income and UBI. The UBI derives from the government granting the entire citizens an undifferentiated and equal amount of income. It derives from the personal income tax levied by the government so that UBI is $g = \frac{\sum_{\forall i} t y_i}{n}$. After that, pre-tax labor income is $y_i = s_i l_i$, which is determined by the skill level of the worker $s_i \in (0,1]$ and the labor time $l_i \in [0,1]$. Saez (2002) argues that when benefits are too high relative to labor income, it causes workers to leave the labor market. Therefore, we assume the UBI is less then y_i, otherwise the citizen will quit the labor market and become a citizen without labor income. Besides, post-tax income depends on the redistributive tax rate or the personal income tax rate t. However, citizens' participation in labor incurs a labor cost with negative utility, which makes them earn income while making the individual's utility decrease when they participate in labor. Moreover, this negative utility has the effect of

accelerating the reduction of individual utility as the labor time increases. In other words, the marginal cost of individual workers increases as the labor time increases. Therefore, we assume the labor cost function is a convex function. Another aspect is that the mathematical reciprocity models are difficult to derive and will make the study difficult even in simple cases. To solve this problem, we assume that the cost function is quadratic. In all, we suppose the cost function of worker i is $C(l_i) = \frac{l_i^2}{2}$. Thus, the individual's utility function consists of their post-tax labor income, UBI, and labor cost, and we assume that each individual utility function is as follow:

$$u_i = (1-t)s_i l_i + g(t; \boldsymbol{s}) - C(l_i)$$

Everyone seeks to maximize his or her individual utility, but in general, citizens cannot change their labor skills. They can only choose their optimal labor time according to the tax rate.

1.2.1 Sequence of actions

We consider a two-stage game model. In the first stage, we allow one representative of the poor and one representative of the workers to negotiate and choose a tax rate t as the amount of UBI to be awarded. Since the redistributive tax rate t determines UBI, we are able to describe it as the income tax rate. We can replace the UBI selection problem with a redistributive tax rate t choosing problem. In the first stage, the representatives of both parties choose their prefered redistributive tax rate t. In the second stage, after the redistributive tax rate t is chosen, workers choose their optimal labor time according to the utility function. Each citizen in these action sequences,

including the representative, is familiar with this operation. At the same time, the chosen represetative follows the principle of maximizing individual utility when choosing their preferred tax rate t.

We use backward induction to solve this problem. Firstly, we let each citizen choose his optimal labor time supply l_i. Since workers choose their optimal labor time based on the tax rate, we can look at this as $l_i(t)$. Thus, they choose the optimal labor time to maximize individual utility. The representatives of both parties then choose their preferred tax rate to maximize individual utility. In effect, the problem under study can be transformed into a two-players normal form game.

1.2.2 Utility functions of representative

Given the skill level $\boldsymbol{s}$ and tax rate t, each citizen will choose the optimal labor time l_i, By FOC we can find the individual's optimal labor time:

$$l_i^*(t) = (1-t)s_i$$

Therefore, our pre-tax income and UBI can be as follow:

$$y_i = (1-t)s_i^2$$

$$g(t;s) = \frac{1}{n}\sum_{\forall j} ty_j = t(1-t)\bar{s}^2$$

Where $\bar{s}^2 = \frac{1}{n}\sum_{\forall i} s_i^2$

The individual utility function is then as follow:

$$w_i = u_i(l_i^*) = \frac{(1-t)^2 s_i^2}{2} + g(t;\boldsymbol{s})$$

Some literatures suggest that since people rarely observe actual earning capacity, they usually judge their earning capacity based on their income (Mirrlees, 1971).

Therefore, we classify citizens who have no labor income as a group of the poor. This segment of the poor has no labor income but receives UBI from the government as income. Then, we divide the utility function of citizens into two parts, the utility functions of the poor (u) and the workers (l) as follow:

$$w_u(t;s) = g(t;s) = t(1-t)\bar{s}^2$$

$$w_l(t;s) = \frac{1}{2}(1-t)^2 s_j^2 + g(t;s)$$

$$= \frac{1}{2}(1-t)[(1-t)s_i^2 + 2t\bar{s}^2]$$

In formulating a particular policy, the Chinese government usually chooses a representative who can represent the interests of their group. The government will then listen to their demands or preferences and design a policy proposal. Finally, the government will collect the views of both sides, modify the proposal and issue the policy. We denote α_l and $1-\alpha_l$ as the weight of the poor and the worker representative, respectively. Therefore, the final redistributive tax rate is $t = \alpha_l t_l + (1-\alpha_l)t_u$. We suppose the government gives two sides with the same weight.

In this game, the government will choose a representative for the poor and worker groups to negotiate. The subscripts u and l are to denote the representatives chosen by the poor and the workers, respectively. The issue of how to appoint representatives is discussed in two parts. Whichever person the government chooses as representative u, it does not make a significant difference to the poor group. Because their income situation is essentially the same. They have no labor income, only income from redistribution. Therefore, any citizen within a poor group acting as a represetative u essentially represents the interests of his or her group. However, this is different when

selecting representative l. Since there is a wide variation in workers' income, when selecting a representative l, the government usually focuses on choosing a representative who represents the interests of most of the group as far as possible. Generally, in practice, most policymakers habitually adopt averages as the basis for decision-making. This is also the case in China. Chinese administration and policy making is usually based on averages. Therefore, we assume the government chooses average-income workers as a representative of worker group. Therefore, we conclude $y_l = (1-t)s_l^2 = (1-t)\bar{s}^2 = \bar{y}$ or $s_l^2 = \bar{s}^2$.

Then the utility functions represented by the poor and the workers are as follows:

$$w_u = g(t,s) = t\bar{y} = t(1-t)\bar{s}^2$$

$$w_l = (1-t)\bar{y} + g(t) - \frac{l_i^2}{2} = \frac{1}{2}(1-t^2)\bar{s}^2$$

Total welfare of poor and working groups:

$$sw_u = n_1 t(1-t)\bar{s}^2$$

$$sw_l = \frac{1}{2}(1-t)^2 \sum_{j=n_1+1}^{n} s_j^2 + n_2 t(1-t)\bar{s}^2$$

1.2.3 Selfish equilibrium

Under the rational economic man assumption, the representatives care about their own income or material payoff. They are selfish and do not concern themselves with the interests of others. We can deduce the selfish equilibrium in Proposition 1.

Proposition 1*: If both representatives are selfish, the poor representative will always*

strategically choose $t_u = \frac{1}{2(1-\alpha_l)}$*, and the worker representative will choose* $t_l = 0$*. The profile* $(t_l = 0, t_u = \frac{1}{2(1-\alpha_l)})$ *is the equilibrium and the final redistributive tax rate* $t = \frac{1}{2}$*.*

The poor representative derives $\frac{\partial w_u(t)}{\partial t} = (1-2t)\bar{s}^2$, which gives $t = \frac{1}{2}$, maximizing individual utility. On the other hand, the worker representative's preference for the tax rate can be derived from the partial derivative of income $\frac{\partial w_l(t)}{\partial t} = -t\bar{s}^2$, whereby we know that $t = 0$ maximizes individual utility. According to the rule of tax rate determination, the worker representative expects to end up with a tax rate is as close to 0 as possible, then $t_l = 0$ is the optimal choice for the worker representative. The poor representative expects that the worker representative will always choose $t_l = 0$, and to ensure that their own interests are maximized then, they will strategically choose $t_u = \frac{1}{2(1-\alpha_l)}$, so the profile $(t_l = 0, t_u = \frac{1}{2(1-\alpha_l)})$ is equilibrium and the redistributive tax rate is $t = \frac{1}{2}$, while UBI is $g\left(t = \frac{1}{2}\right)$. We can see that it is not possible to make $t_l = t_u$ an equilibrium.

If both representatives are selfish, the worker representative wants to keep all his labor income rather than have it cut by a tax. He always wants no taxation and, therefore, always chooses $t_l = 0$ as his only optimal choice strategy. On the other hand, then the poor representative always wants to get the most UBI support. However, if the tax rate is too high, it will discourage workers from participating in labor and lead to a reduction in l, which will result in less UBI being received. To get the most UBI for himself, the poor representative will find a way to end up with a tax rate as close as possible to $t = \frac{1}{2}$. Therefore, he will choose $t_u = \frac{1}{2(1-\alpha_l)}$. This results in a selfish

equilibrium combination $(t_l = 0, t_u = \frac{1}{2(1-\alpha_l)})$.

1.3 Reciprocity model

The theory of reciprocity was developed from the theory of fairness, in which people usually give kindness to those who are kind, and unkindness will go to those who are unkind (Dufwenberg & Kirchsteiger, 2004; Falk & Fischbacher, 2006; Rabin, 1993). Rabin (1993) quantified the emotion of fairness by modeling it and applying it to the psychological game of normal form game to study game between firms and customers and firms and employees. Dufwenberg and Kirchsteiger (2004) extended this model with a belief-based reciprocity model and a reciprocity theory for sequential game. The mathematical model is as follows.

$$
\begin{aligned}
&U_i\left(a_i(h), \left(b_{ij}(h), \left(c_{ijk}(h)\right)_{k\neq j}\right)_{j\neq i}\right) \\
&= \pi_i\left(a_i(h), \left(b_{ij}(h)\right)_{j\neq i}\right) \\
&+ \sum_{j\in N\setminus\{\mathrm{i}\}} \left(Y_{ij}\cdot \kappa_{ij}\left(a_i(h), \left(b_{ij}(h)\right)_{j\neq i}\right)\cdot \lambda_{iji}\left(b_{ij}(h), \left(c_{ijk}(h)\right)_{k\neq j}\right)\right),
\end{aligned}
$$

The model considers the player's utility function as consisting of two components: material payoff and the utility from reciprocity. where a_i is player i's strategy, b_{ij} is a first-order belief that player i believes the strategy chosen by player j, and c_{ijk} is a second-order belief that player i believes that what strategy is player j believes player k chooses. Y_{ij} denotes player i's reciprocal sensitivity to player j. κ_{ij} measures how kind is player i to player j at the node h. λ_{iji} measures i believe how kind is player j to him. κ_{ij} and λ_{iji} are then described by the follows:

$$
\kappa_{ij}\left(a_i(h), \left(b_{ij}(h)\right)_{k\neq i}\right) := \pi_j\left(a_i(h), \left(b_{ij}(h)\right)_{k\neq i}\right) - \pi_j^{e_i}\left(\left(b_{ij}(h)\right)_{k\neq i}\right)
$$

$$\lambda_{iji}\left(b_{ij}(h),\left(c_{ijk}(h)\right)_{k\neq j}\right):=\pi_i\left(b_{ij}(h),\left(c_{ijk}(h)\right)_{k\neq j}\right)-\pi_i^{e_j}\left(\left(c_{ijk}(h)\right)_{k\neq j}\right)$$

where $\pi_j^{e_i}((b_{ik}(h))_{k\neq i})=\frac{1}{2}\cdot\left[max\left\{\pi_j\left(a_i,\left(b_{ij}\right)_{j\neq i}\right)\mid a_i\in A_i\right\}+min\left\{\pi_j\left(a_i,\left(b_{ij}\right)_{j\neq i}\right)\mid a_i\in E_i\right\}\right]$. $\pi_j^{e_i}((b_{ik}(h))_{k\neq i})$ is equitable payoff or equitable payoff. It measures the kindness or unkindness shown by the other player. It is worth noting that when computing the minimum material payoff $min\left\{\pi_j\left(a_i,\left(b_{ij}\right)_{j\neq i}\right)\mid a_i\in E_i\right\}$, the strategy a_i chosen by the player i must be efficient. A strategy a_i is defined as efficient if another strategy a_i' does not exist such that the material payoff of all players is strictly improved. For example, when calculating the minimum material payoff for player i to player j, strategy a_i cannot reduce the material payoff of two players at the same time. Otherwise, it would be considered an inefficient strategy. a_i has to ensure that player j's material payoff is reduced while ensuring that player $i's$ own material payoff is at least not reduced.

In addition, Dufwenberg and Kirchsteiger (2004) defined a sequential reciprocity equilibrium.

Definition 1. *The profile* $a^*=(a_i^*)_{i\in N}$ *is a sequential reciprocity equilibrium (SRE) if for all* $i\in N$ *and for each history* $h\in H$ *it holds that.*

(1) $a_i^*(h)\in\underset{a_i\in A_i(h,a^*)}{\operatorname{argmax}}U_i\left(a_i,\left(b_{ij}(h),\left(c_{ijk}(h)\right)_{k\neq j}\right)_{j\neq i}\right)$,

(2) $b_{ij}=a_j^*$ for all $j\neq i$

(3) $c_{ijk}=a_k^*$ for all $j\neq i,k\neq j$.

Regarding reciprocity theory, Falk and Fischbacher (2006) also propose positive

and negative reciprocity, and some scholars have addressed the concept of positive reciprocity in their research. In reciprocal game, there is both mutual help and mutual harm. We classify two types of equilibrium in reciprocal game, namely the positive and negative reciprocity equilibrium, based on the condition that the sequential reciprocity equilibrium is satisfied. The equilibrium in which the player chooses a strategy profile (t_u, t_l) that is friendly to both players is called the positive reciprocity equilibrium, while the opposite is called the negative reciprocity equilibrium. In this paper, the equilibrium in which players choose the same strategy is named a consistent reciprocity equilibrium.

The reciprocal equilibrium in the case where κ_{ij}, κ_{ji}, λ_{jij} and λ_{iji} are positive simultaneously comes to be defined as the positive reciprocity equilibrium. In economic terms, if all four variables are positive simultaneously, this means that player i and player j both consider the other player to be friendly to them and adopt strategies that are friendly to the other player. Similarly, if all four variables are negative at the same time, the reciprocity equilibrium is characterized as a negative reciprocity equilibrium.

Since this paper is based on the normal form game, we will not consider the node h variables of the sequential game. Thus far, we have constructed reciprocal utility functions for the representatives of the poor and the representatives of the workers based on the reciprocity theory model as follows:

$$U_u(a_u, b_{ul}, c_{ulu}) = w_u(a_u, b_{ul}) + Y_{ul} \cdot \kappa_{ul}(a_u, b_{ul}) \cdot \lambda_{ulu}(b_{ul}, c_{ulu})$$

$$U_l(a_l, b_{lu}, c_{lul}) = w_l(a_l, b_{lu}) + Y_{lu} \cdot \kappa_{lu}(a_l, b_{lu}) \cdot \lambda_{lul}(b_{lu}, c_{lul})$$

where Y_{ul} and Y_{lu} are the reciprocal sensitivity coefficients of the poor and

worker representatives to the other party, respectively, κ_{ul} and κ_{lu} are the friendliness of the poor and worker representatives to the other party, respectively, as well as λ_{ulu} and λ_{lul} measure the friendliness of the poor and worker representatives to themselves as perceived by the other party, respectively.

1.4 Result

The reciprocity can have an impact on a representative's choice of strategy. If one party proposes a tax rate that infringes on the interests of the other party, it will invite retaliation from the other party, making the actual return to the other party potentially lower than the return expected from the tax rate proposed by the other party. Conversely, one may receive an additional return from the other party. We will then explore what equilibrium outcomes differ for the UBI choice under the assumptions of an rational economic agent and the assumption of reciprocity.

We explore what happens to the equilibrium under the reciprocity assumption. Before exploring reciprocal equilibria, we suggest reciprocal equilibrium conditions (REC) for solving two-players normal form game.

Remark 1: In a two-players normal form game, reciprocal equilibrium and consist reciprocal equilibrium exist if the reciprocal equilibrium conditions are satisfied:

(i) In a game where both players choose to jointly influence the actual strategy, meaning that $a = a(a_i, a_j)$ and $a(a_i, a_j)$is continuously derivable with respect to a_i and a_j;

(ii) The reciprocal utility function of each player i is a quadratic continuous concave

function of strategy a_i;

(iii) $Y_{ij}Y_{ji} = \frac{1}{\lambda_{iji}\lambda_{jij}}$.

In the following, we use the reciprocal equilibrium condition to demonstrate that reciprocity can lead to a reciprocal equilibrium in UBI policy between representatives of both parties.

Proposition 2: *All profiles* (t_l, t_u) *for* $t_l + t_u = \frac{2}{2+Y_{ul}\lambda_{ulu}}$ *is positive(negative) reciprocal equilibrium if the reciprocal equilibrium condition is satisfied and* $\lambda > 0$ $(0 > \lambda_{lul} > -\frac{1}{2Y_{lu}}$ and $0 > \lambda_{ulu} > -\frac{2}{Y_{ul}})$. *In particular, profiles* (t_l, t_u) *is a positive(negative) consistent reciprocal equilibrium if satisfies* $t_l = t_u = \frac{1}{2+Y_{ul}\lambda_{ulu}}$.

Under the rational economic man assumption, the equilibrium of the strategy profile between the representative of the poor and the representative of the workers is $(t_l = 0, t_u = \frac{1}{2(1-\alpha_l)})$. However, with the influence of reciprocity, representatives from both sides can agree on preferences for UBI policy. Fortunately, it is possible for both sides' representatives to agree on a reciprocal equilibrium on tax rate that will allow the parties to overcome their divergence.

Although the representatives can reach a consistent reciprocal equilibrium, this is not always favorable. It is worth noting that a positive consistent equilibrium can be achieved when $\lambda > 0$, while a negative consistent equilibrium is possible when $\lambda < 0$. Representatives would like to achieve a constructive reciprocal equilibrium rather than a destructive one in any negotiation. In order to avoid a negative reciprocal

equilibrium, representatives of both sides should choose tax rate to make the other side believe that the tax rate he/she chooses is a kind rather than an unkind one. Conversely, if one side convinces the other side that the tax rate he chose is kind, this can result in retaliation from the other side. Thus, it is easy to end up with a negative reciprocal equilibrium.

Mutual harm is not beneficial to either side and the society, while mutual benefit makes both better. The Proposition 3 illustrates exactly this point.

Proposition 3*: The total social welfare resulting from a positive consistent reciprocal equilibrium is greater than that resulting from a rational economic man equilibrium. And the negative consistent reciprocal equilibrium is harmful for the total social welfare.*

Total social welfare consists of a function of the individual utility of all people. A positive consistent reciprocal equilibrium makes total social welfare greater than total social welfare in a selfish equilibrium as well as in a negative consistent reciprocal equilibrium. This is because both sides are able to make each other feel that their tax rate choices release kind signals. In this situation, where one person gives up a step, it allows the final tax rate to reach an equilibrium $t < \frac{1}{2}$. However, the point of concern is that a negative consistent reciprocal equilibrium makes total social welfare lower than that in a positive consistent reciprocal equilibrium and a selfish equilibrium.

We test the robustness of the reciprocal equilibrium condition under a progressive

tax system. The government imposes an additional tax rate when residents' incomes are above a certain income level.

Corollary 1*: In terms of material payoff, a negative consistent reciprocal equilibrium results in a lose-lose situation, a positive consistent reciprocal equilibrium is more favorable to workers, and a selfish equilibrium is more favorable to the poor.*

Proposition 4. *In the context of progressive taxation, if the reciprocal equilibrium condition is satisfied, there is a consistent reciprocal equilibrium with* $t_u = t_l$.

In the context of progressive taxation, we can still prove a consistent reciprocal equilibrium such as $t_u = t_l$ if the reciprocal equilibrium condition is satisfied. Even though it is possible for workers' representatives to be at different applicable tax rates, this does not prevent workers from forming a consistent positive reciprocal equilibrium with the poor.

1.5 Conclusion

We explore the influence of reciprocity on the poor and workers in the game of UBI policy choices. This paper gives us 3 insights. Firstly, reciprocal equilibria will lead to different outcomes than selfish equilibrium bands. The selfish equilibrium fails to bring the poor and worker to a consistent equilibrium on UBI policy. In contrast, under the influence of reciprocity, the poor and the worker choose kind strategies,

which can then lead to a consistent equilibrium on UBI policy. Secondly, the selfish strategy that considers only the maximization of material payoff will reduce the total welfare of society. However, this does not mean that reciprocal equilibria always lead to socially beneficial outcomes. The negative consistent reciprocal equilibrium is destructive to social welfare, and the positive consistent reciprocal equilibrium brings more welfare to society. Finally, the government, a policy and decision maker, can lead both sides to achieve a constructive and consistent reciprocal equilibrium by avoiding negative reciprocal equilibria. By incorporating the impact of reciprocity into the policy-making process, governments are more likely to develop a mutually satisfactory UBI policy. And it will be a policy that is beneficial to society. Moreover, if the government wants to implement a UBI policy successfully, it may be a better strategy to reduce resistance to the policy and lead both sides to negotiate more on the basis of reciprocity rather than selfishness.

Chapter 2. Do Green Bonds Improve Corporate ESG Performance?

2.1 Introduction

Since 2000, the global economy has entered a historical phase of rapid development. However, economic development has brought problems with it. Various energy-intensive commodities such as cars and heaters have continued to emerge and become famous. Manufacturing industries are rapidly emerging in developing countries, leading to a rapid increase in demand for fossil and electric energy from raw production agents and consumers. In addition, expanding the production capacity of some heavily polluting enterprises has made it increasingly challenging to control pollution. Since 2000, China's oil consumption has proliferated from 221 million tonnes in 2005 to 718 million tonnes in 2021, an increase of 225%. 2005 to date, China's social electricity consumption has risen from 2,468.9 billion kilowatt hours in 2005 to 8,637.2 billion kilowatt hours in 2022, an increase of 250%. A rapid increase in energy demand has accompanied rapid economic growth, which has put negative pressure on the social environment. The rapid growth in energy demand has led to an increase in the scale of carbon emissions, and China is aware that economic development cannot be at the expense of the environment, emphasizing the importance of sustainable development. Since 2005, China has been advocating the green development concept of "green water and green mountains are golden mountains," and in 2020, China proposed at the 75th session of the United Nations General Assembly that it would strive to reach the peak of carbon dioxide emissions by 2030 and to achieve carbon neutrality by 2060. Many

policy documents have been issued around the goals of green development and carbon neutrality to raise enterprises' awareness of environmental protection and social responsibility, to guide and support them in green production and green technology innovation, and to promote the coordinated development of technology, economy, society, environment, and natural resources to achieve the goal of sustainable development.

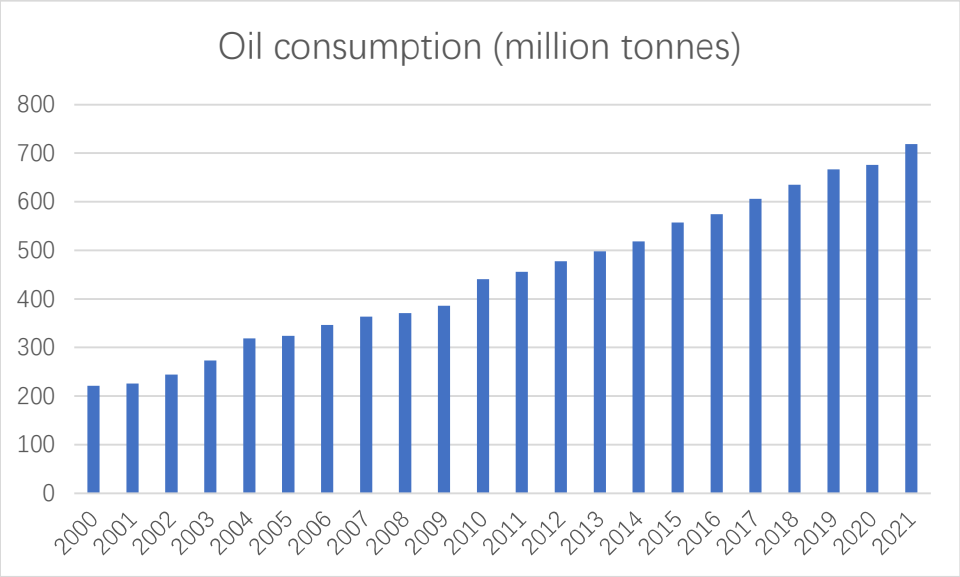

Figure 1: Oil consumption in China

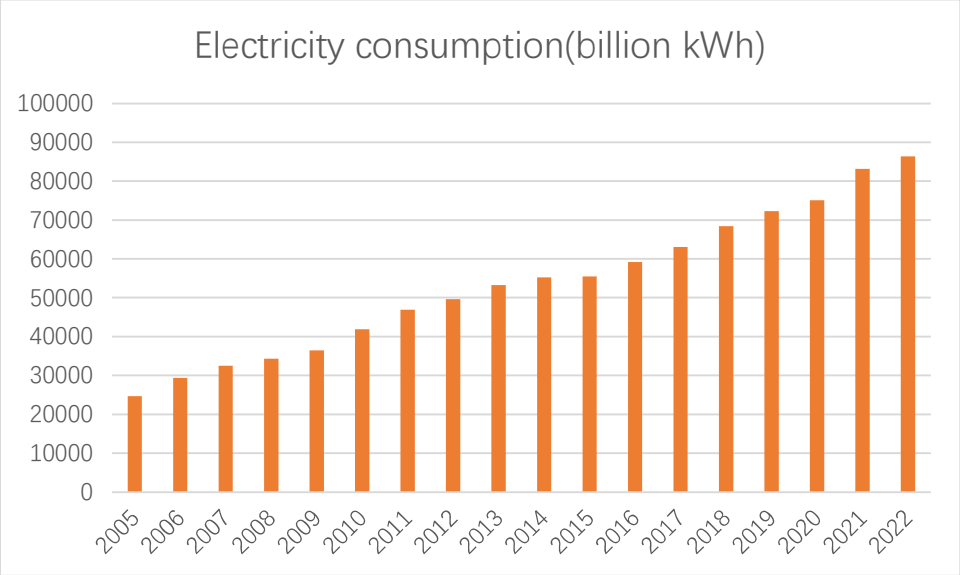

Figure 2: Electricity consumption in China

ESG refers to the three aspects of environmental, social, and corporate governance, which assess a company's operations' sustainability and social responsibility. ESG emphasizes the need for companies to focus on ecological and environmental protection, fulfilll their social responsibilities and improve their governance. After decades of rapid development, China has entered a stage of high-quality development. This stage of high-quality development places higher demands on enterprises. In addition to focusing on their profitability, they must consciously take on social responsibilities such as environmental protection, concern for low-income groups, and sustainable development. We advocate the upgrading of profitable operations to high-quality operations. Improving corporate ESG performance is also conducive to industrial upgrading and promoting sustainable development for society as a whole. At present, China has fully begun the transition to high-quality development. Improving corporate ESG performance is an essential part of achieving high-quality development. Since 2002, China has introduced the Code on Governance of Listed Companies, which requires listed companies to disclose corporate governance information to investors in accordance with regulations. In 2007, establishing a social responsibility reporting system was included as a significant component of central enterprises' fulfilllment of social responsibility. In 2018, the Securities and Futures Commission further required that listed companies should disclose environmental information in accordance with laws and regulations and the requirements of relevant authorities (E), fulfill poverty alleviation and other social responsibility (S), and provide information related to corporate governance (G). In 2022, the State Council further explored establishing a

sound ESG system to enhance the quality of corporate development further.

Green bonds are issued by companies to finance projects that meet the required conditions. A particular type of bond is designed to encourage sustainability and support climate-related or other types of special environmental projects. Green bonds are issued to finance sustainability-related green projects such as energy efficiency, pollution prevention, sustainable agriculture, ecosystem protection, clean transport, water management and more. Humanity is currently facing a deteriorating climate, a food crisis, and various plants and animals on the verge of extinction. These crises are a severe threat to the survival of humanity. However, the response to these crises requires substantial financial support. In response, international institutions and governments are linking environmental projects with capital markets and investors, issuing green bonds to support green projects by companies or institutions to address these crises and allow companies to take on more ESG responsibility. Green bonds are now an important tool for addressing the impacts of climate change and related challenges. The first international green bonds were issued in Europe in 2007. It has been 15 years since the first green bond was issued, and the number of green bonds issued globally has reached US$207.6 billion.

Different from traditional bonds, green bonds offer some preferential terms and conditions for green bonds, in addition to stipulating that the funds are to be used primarily for green project investments, with lower interest rates than regular bonds. However, as the scale of green bond issuance has increased significantly in recent years, the European Commission has found that some companies have been "greenwashing".

In its 2022 report on green bonds, European Parliament pointed out that there is a lack of transparency in the external review market for green bonds, which increases the risk of 'greenwashing' by companies. The risk of "greenwashing".

Although many green bonds are issued after strict certification and auditing to ensure that the funds are actually used for green projects, the European Commission has recently concluded that some companies have issued green bonds without taking up their ESG responsibilities and have not invested the funds in green projects, thus "greenwashing". Does the issuance of green bonds really improve ESG performance and make companies ESG responsible? Can we identify the types of companies that may be at risk of 'greenwashing'? We focus on this question in depth.

2.2 Literature Review and Hypothesis

2.2.1 Green bonds

As an emerging financing tool, green bonds have become an important focus for investors and issuers in recent years. Green bond issuers typically follow standards such as the International Green Bond Principles to ensure that funds raised are used in accordance with environmental sustainability standards. At the same time, these bonds offer investors a way to support sustainable development by earning a return while acting in a socially responsible manner. From a social and economic perspective, the issuance of green bonds contributes to the achievement of sustainable development goals and is expected to provide positive solutions to environmental issues such as climate change.

Green bonds emerged late in China, with the Stock Exchange of Hong Kong Limited only issuing China's first green bond in 2015. Despite its late start, China has attached great importance to green bonds. Policy documents to support the development of green bonds were issued in December 2015, November 2020, and April 2021 respectively, promoting the rapid development of green bonds in China, and according to Wind data, the balance of green bonds in China was approximately RMB 1.3 trillion by the end of 2022, which is among the highest in the world. As a result, a series of supportive policies introduced by the Chinese government have made China the largest issuer of climate-related bonds in the world in a short period of time(Kidney et al., 2015). The issuance of green bonds provides a direct financing channel for enterprises, which can effectively guide the flow of funds to green projects and industries and promote the sustainable development of enterprises (Xuefeng & Xinqi, 2023).

Previous research on green bonds has focused on the pricing mechanism and the impact of green bonds. Firstly, in terms of the pricing mechanism, green bonds usually have a higher issue price compared to ordinary bonds, but this difference is not reflected in the bond trading market(Ehlers & Packer, 2017). Reboredo (2018) finds that the green bond market has more substantial synergies with the corporate bond and treasury bond markets and weaker synergies with the equity and energy commodity markets. In other words, green bond pricing is influenced by corporate bond and treasury fixed income bond market premiums but not by price volatility in equity and energy markets. Nanayakkara and Colombage (2019) examine the pricing differences between green bonds and conventional bonds in the global bond market, using day-ahead data for 82

green bonds for 2016-2017, empirically showing a premium of 63 BPs for green bonds. Löffler et al. (2021) studied the green bond premium in the primary and secondary bond markets and found that green bonds have a "green effect" as their yields are generally 15-20 basis points lower than those of regular bonds and the issuers have lower credit ratings. Li et al. (2020) use data on green bonds in China as an example, finding that issuing green bonds is a sign of CSR and that the interest cost of green bonds with green certification is lower than that of bonds without green certification. Sheng et al. (2021) examine the drivers of green bond premiums, suggesting that financial institutions have a more favorable financing environment than firms and that state ownership also has a significant impact on green premiums. Secondly, regarding impact effects, the issuance of green bonds by companies can trigger a positive market reaction, which can increase the company's price and reduce risk (Allet & Hudon, 2015; Danning, 2018). This positive response is even stronger in the case of first-time and third-party certified green bonds (Flammer, 2018; Tang & Zhang, 2020). Green bonds are both financial instruments and green attributes, playing an essential role in social capital and green projects, and can guide social capital to low-carbon, environmentally friendly and sustainable green projects (Reichelt, 2010).

2.2.2 ESG Performance

The literature exploring the factors influencing corporate ESG performance is relatively sparse, but these studies have verified that digital finance, corporate digitalization, and the behavior and characteristics of corporate managers all have an impact on corporate ESG performance. Mu et al. (2023) studied the impact of digital

finance on firms' ESG performance and found that digital finance can enhance firms' ESG performance, and this boosting effect is mainly since digital finance enhances ESG performance by alleviating firms' financing constraints. At the same time, this boosting effect is more pronounced in non-state enterprises, small enterprises, and enterprises with a lower degree of marketization. Ren et al. (2023) similarly support the view that digital finance can contribute to corporate ESG performance and finds that digital finance affects corporate ESG performance mainly through green innovation and external regulation. The impact of digital finance is more pronounced for firms with low digitalisation and low profitability, as well as for firms in regulated industries and high carbon emission industries. They argue that firms should pay attention to ESG disclosure and regulators should incorporate ESG performance into their regulatory systems. Jang et al. (2022) and Huang et al. (2022) find that the equity pledging behavior of corporate executives negatively affects the ESG performance of firms. Fang et al. (2023) find that the digitization of firms can improve ESG performance. Digitization enables companies to reduce agency costs, improve their governance (G) scores, and also helps them to improve their goodwill and improve their social (S) scores. They argue that governments should encourage companies to undertake digital upgrades. Shu and Tan (2023) find that carbon control policy risk has a significant negative impact on corporate ESG performance. This was particularly evident among non-state-owned firms, firms that were not sensitive to green innovation, firms in carbon-sensitive industries, and firms located in areas with strict environmental regulations. Meng and Zhu (2023) find that ESG performance improves when female

executives play a greater role in management, and that this boost is a result of female executives significantly contributing to the digitization of the firm and thus to ESG performance.

2.2.3 Green Bonds and ESG Performance

Green bonds are a significant area of environmental, social, and governance investment where investors seek to combine social responsibility with a return on investment. In terms of environmental performance, Mathews and Kidney (2010) point out that green bonds are a necessary support tool for sustainable economic development and call on investment institutions to invest in green bonds to promote the viability and sustainability of green bonds. Clapp et al. (2015), Clapp and Pillay (2017) and Flammer (2018) argue that in the field of green investment, green bonds can effectively complement the funding gap of capital-intensive projects and that the issuance of green bonds provides financial support for green patents, which in turn improves the environmental performance of firms. Flaherty et al. (2017), Heine et al. (2019) and Banga (2019) highlight the potential of green bonds in financing the costs of climate change and in achieving the SDGs in developing countries. The study finds that issuers can improve their environmental performance (i.e., higher environmental ratings and lower CO2 emissions) when they issue green bonds. In terms of social responsibility, the idea of green investment stems from the fact that corporate social responsibility. Green Finance Initiatives in the G20 Communiqué (2016) suggest that issuing green bonds by companies can build up a green reputation for the company and present a good image to the market that the company is taking more social responsibility. In terms

of corporate governance, Hart and Zingales (2017) argue that companies need to maximize shareholder equity rather than stock returns. Magill et al. (2015) propose a stakeholder model that suggests that a more sustainable equilibrium can be achieved when managers maximize the firm's total value, not just the shareholders' value. In addition, Wang and Wang (2022) also find that good ESG practices not only increase the propensity of listed companies to issue green bonds but also help them to issue more green bonds. In general, the issuance of green bonds by companies is a reflection of their commitment to environmental protection and the promotion of sustainable economic development (Huang et al., 2022). Therefore, we propose the first hypothesis:

H1: Corporate green bond issuance helps to improve corporate ESG performance.

2.2.4 Corporate Heterogeneity and ESG Performance

2.2.4.1 Financing constraint

The issuance of green bonds by enterprises is a positive manifestation of their social responsibility, which determines their access to financing (Roberts & Dowling, 2002). When enterprises actively undertake social responsibility, it helps to ensure that they have more stable financing channels and sources, alleviate financing constraints, reduce the difficulty of financing, and thus improve the efficiency of corporate financing. The issuance of green bonds requires enterprises to assume more social responsibility and increase the transparency of green information. This non-financial information can play a role in information transfer, i.e., allowing investors to examine the costs and risks of investment from more aspects, compensating for the information

gap caused by information asymmetry, eliminating the uncertainty of investors' judgment due to information disadvantage, and thus alleviating the financing constraints of green bonds. El Ghoul et al. (2011) argue that disclosing corporate social responsibility and information about corporate social responsibility can help companies establish a more scientific system of corporate governance, reduce information asymmetry between investors and companies, and alleviate financial constraints. Therefore, we propose a second hypothesis:

H2: Compared to firms with significant financing constraints, green bonds issued by firms with smaller financing constraints have a more significant ESG-enhancing effect.

2.2.4 Age of Executives

Upper Echelon Theory suggests that the behavior of executives, as subjects of strategic choice and decision making, is influenced by psychological traits that play a key role in shaping organizational strategy, as well as acting on other organizational members (Hambrick & Mason, 1984). Whether or not to implement ESG and the extent to which it is implemented is a strategic choice for the company and reflects the values and personal characteristics of the company's executives (Hambrick, 2007). Corporate executives play a pivotal role in the decision-making, implementation, and disclosure of social responsibility strategies. (Waldman & Siegel, 2008).Constrained by psychological traits and the difficulty of measuring and obtaining samples, scholars have used demographic factors such as the age of corporate executives as proxy variables for psychological characteristics to explain the drivers of social

responsibility(Huang, 2013; Manner, 2010). The older the executive, the more conservative his or her personality tends to be and the more inclined he or she is to choose behavior patterns that are in line with society's first norms and low risk(Carlsson & Karlsson, 1970). As executives grow older and more experienced, they should become more aware of the positive interaction between the fulfillment of social responsibility and the company's long-term value while taking into account the needs of internal and external stakeholders as far as possible. However, young executives destined to become leaders in the near future are becoming increasingly responsible, both in the face of individualism and collectivism and are supporting the sustainable development of their companies (Alonso-Almeida & Llach, 2019).In addition, younger people tend to be more environmentally aware than older ones(Hao et al., 2019). Based on this, the following hypothesis is proposed:

H3: Green bonds issued by companies with younger executives have a more significant effect on ESG performance than those with older executives.

2.3. Model Design and Statistics Descriptive

2.3.1 Model Design

We use a fixed effects model to investigate the impact of green bond issuance on corporate ESG performance:

$$ESG_{i,t} = \alpha_0 + \alpha_1 Grebond_{i,t} + \alpha Control_{i,t} + \sigma_t + \lambda_i + \varepsilon_{i,t}$$

Where, i is company i, t is time, σ_t and λ_i represent time-fixed effects and individual (industry) fixed effects, respectively.$Grebond_{i,t}$denotes whether firm i has

issued green bonds in year t.$Control_{i,t}$denotes the set of control variables. α_0、α_1、α denote the intercept term, the coefficient estimates for the core variable green bonds, and the coefficient estimates for the control variables, respectively.

2.3.2 Variable Definition

2.3.2.1 Dependent Variable

In this study, we focus on what factors influence ESG performance, and we use ESG performance evaluation as the Dependent Variable; there are various indicators of ESG performance, including CSI, Bloomberg and STOXX. Both the CSI ESG Indicator and the Bloomberg ESG Indicator are publicly available information based ESG assessments. However, the China Securities ESG Indicator is based on publicly available information on Chinese listed companies, while the Bloomberg ESG Indicator is based on a global assessment of listed companies. In addition, the STOXX ESG Indicators are mainly assessed for European companies. Finally, the China Securities ESG Indicator considers the specific political, legal and cultural context of China and is, therefore, more relevant to the actual situation of listed companies in mainland China. As our observation sample is drawn from China, we use the CSI ESG Indicator to describe ESG performance to obtain more realistic findings.

2.3.2.2 Key explanatory variables

We study the impact of green bonds on ESG performance, and the key variable is green bonds. However, due to the lack of data on green bond issuance at the company level in China, we use whether the company issued green bonds in the year i as the data and takes the value of 1 if the company issued green bonds in the year i, and 0 otherwise.

2.3.2.3 Control variables

Company-level factors mainly influence the factors of a company's ESG performance. The following three primary levels of factors are included: i) the company's debt profile, ii) the company's profitability and operations, and iii) the company's managerial structure. Specifically, we choose the following control variables:

Businessyear: It is representative of the number of years the company has been in existence.

Lev: It is the gearing ratio. It is equal to total liabilities divided by total assets. It is usually used to measure the financial risk of a company. The higher the gearing ratio, the greater the debt pressure on the company and the greater the financial risk it is likely to face.

ROA: It is a company's return on assets, which is the ratio of profit to total assets and is equal to net profit divided by the average balance of total assets. It describes the profit that a company can generate per unit of total assets and reflects, to some extent, the profitability of the company's assets. As a general rule, a higher ROA means that a

company is more profitable, which makes it more willing and able to invest and improve its ESG performance.

Inc_equ: It is the net asset turnover ratio. It is equal to operating income divided by net assets. It is usually used to measure the ability of net assets to generate operating income.

Cash_ass: The cash recovery rate is equal to the cash flow generated from operating income divided by total assets. It is usually used to measure the ability of total assets to generate operating cash.

Growth: The growth rate of operating income. It is equal to the company's current period operating income divided by the previous period's operating income. It is often used to measure the rate of growth of a company's business and the rate of growth of a company's expansion.

Firstshr: The percentage of shares held by the first largest shareholder. The proportion of the total share capital held by the shareholder holding the largest number of shares.

Mng: The proportion of shares held by managers. It is the proportion of the company's total share capital held by the company's senior management, such as the CEO, CFO and Chairman. It reflects the degree of control and confidence that the company's managers have in the company. If the ratio of managerial shareholding is higher, it indicates that the more confidence there is in the company's growth prospects and that it is more likely to have an eye on the company's long-term development.

The following are the control variables used for robustness testing:

ROE: Rate of Return on Common Stockholders' Equity. It is the ratio of a firm's net profit to its average net worth, reflecting the level of compensation or profitability earned by owners' equity.

IndDirectorRatio: The number of independent directors as a proportion of the total number of board members.

Cash_ratio: Cash_ratio = (money + marketable securities) / current liabilities. The higher the cash ratio, the better the liquidity.

2.3.3 Statistics Descriptive

The data in this chapter is sourced from the China CSMAR database and the wind database. We selected data for A-share listed companies from 2014-2020. i) All companies with abnormal trading or operating conditions, such as st, st*, were removed. The SFC indicated these companies as having delisting risks due to operating problems that may face financial abnormalities, corporate financial fraud, business abnormalities, etc. Companies with these conditions would have an impact in our research process and were therefore excluded from the study. ii) Excluding banking, financial, and real estate companies. iii) Excluding the sample of observations with missing values for each variable. After these exclusions, there are a total of 13,030 observations. See Table 1 for details.

In addition, we also did a multicollinearity test, and the results are shown in Table 2. The results show that the data of VIF are all less than 5, so there is no significant multicollinearity problem.

Table 1: Descriptive statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
Esg hz	13,030	6.461	1.090	1	9
Grebond	13,030	0.00169	0.0411	0	1
businessyear	13,030	2.825	0.318	1.609	4.127
Lev	13,030	0.408	0.194	0.00906	1.112
ROA	13,030	0.0423	0.0749	-1.859	0.880
Inc equ	13,030	0.0134	0.0403	-1.418	1.749
Cash ass	13,030	0.0476	0.0698	-0.650	0.664
Growth	13,030	0.00303	0.0465	-0.00985	4.290
firstshr	13,030	0.358	0.145	0.00230	0.891
mng	13,030	0.160	0.204	0	0.900

Table 2: Multicollinearity test

Variable	VIF	1/VIF
ROA	1.320	0.755
Lev	1.270	0.790
Cash ass	1.190	0.842
mng	1.160	0.863
businessyear	1.070	0.932
Inc equ	1.070	0.938
firstshr	1.050	0.952

Grebond	1	0.997
Growth	1	0.998
Mean	VIF	1.130

2.4 Results

In this section, we present a specific analysis of the empirical results, report the correlation analysis of the variables, the fixed effects regressions, and provide a detailed analysis.

2.4.1 Correlation Analysis

We conducted correlation analysis on all variables and the results are shown in Table 3. The results of the correlation coefficient analysis indicate that the relationship between green bond issuance and ESG performance is positively correlated at 1% significance. This tentatively verifies our hypothesis 1. Green bond issuance has a positive impact on a company's ESG performance. On the other hand, the absolute values of the correlation coefficients of all variables are less than 0.5, so there is almost no issue of multicollinearity.

Table 3: Correlation analysis

	Esg hz	Grebond	businessyear	Lev	ROA	Inc equ	Cash ass
Esg hz	1						
Grebond	0.034***	1					
businessyear	0.067***	0.028***	1				
Lev	0.056***	0.043***	0.147***	1			

ROA	0.129***	-0.00900	-0.067***	-0.330***	1		
Inc equ	-0.00900	-0.00100	0.037***	0.233***	-0.134***	1	
Cash ass	0.099***	-0.00500	0.0110	-0.150***	0.381***	-0.0110	1
Growth	-0.0120	-0.00200	0.0130	0.019**	0.024***	0.0120	-0.00700
firstshr	0.090***	-0.00100	-0.103***	-0.028***	0.158***	0.022**	0.119***
mng	-0.143***	-0.030***	-0.230***	-0.293***	0.167***	-0.073***	0.00500

	Growth	firstshr	mng
Growth	1		
firstshr	-0.00100	1	
mng	-0.00500	0.110***	1

2.4.2 Benchmark Regression

The results of the Benchmark Regression analysis are shown in Table 4. The results in the first column present the one-way regression with the explanatory variable ESG performance when only green bonds are included as the explanatory variable, and the results indicate that at 1% statistical significance, the coefficient is positive and that issuing green bonds by a company can significantly improve a company's ESG performance rating by 0.698 units without the inclusion of control variables. In contrast, in the second column of results, we include only the control and explanatory variables, but not the core control variables. In the third column, we include the core explanatory variable Grebond in the second column, and the results show that the issuance of green

bonds significantly contributes to a firm's ESG performance at 1% statistical significance. Each green bond issuance can contribute to a 0.653 unit rating increase in corporate ESG performance, which validates our hypothesis 1 that issuing green bonds, can significantly improve corporate ESG performance ratings.

Table 4: Result of Benchmark Regression

	(1)	(2)	(3)
VARIABLES	Esg_hz	Esg_hz	Esg_hz
Grebond	0.698***		0.653***
	(0.226)		(0.220)
businessyear		0.178***	0.178***
		(0.0307)	(0.0307)
Lev		0.450***	0.448***
		(0.0558)	(0.0557)
ROA		2.242***	2.239***
		(0.139)	(0.139)
Inc_equ		-0.850***	-0.849***
		(0.233)	(0.233)
Cash_ass		0.735***	0.740***
		(0.145)	(0.145)
Growth		-0.479**	-0.478**
		(0.192)	(0.192)
firstshr		0.542***	0.544***

		(0.0661)	(0.0661)
mng		-0.654***	-0.652***
		(0.0492)	(0.0492)
Constant	6.460***	5.569***	5.568***
	(0.00917)	(0.0956)	(0.0956)
Observations	13,030	13,030	13,030
R-squared	0.084	0.133	0.134

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

2.5 Robustness Tests

To ensure the reliability of these results, we conducted Robustness Tests in 2 ways. These include: i) giving more control variables; ii) changing the method, we replace the fixed effects model with the ologit method for validation.

2.5.1 More Control Variables

We add the ROE, IndDirectorRatio, and Cash_ratio control variables to the original control variables to test the robustness of our model. As shown in the results in column (3) of Table 5, it still obtain similar results to those obtained in Table 4 after adding more control variables. The coefficient on the core variable Grebond is 0.649 and the result is statistically significant at 1%. This result effectively supports the reliability of our model.

Table 5: Regression results for adding more control variables

	(1)	(2)	(3)
VARIABLES	Esg_hz	Esg_hz	Esg_hz
Grebond	0.698***		0.649***
	(0.226)		(0.220)
businessyear		0.177***	0.177***
		(0.0307)	(0.0307)
Lev		0.463***	0.461***
		(0.0601)	(0.0600)
ROA		2.057***	2.056***
		(0.177)	(0.177)
Inc_equ		-0.853***	-0.851***
		(0.233)	(0.233)
Cash_ass		0.745***	0.750***
		(0.145)	(0.145)
Growth		-0.479**	-0.478**
		(0.192)	(0.192)
firstshr		0.536***	0.538***
		(0.0664)	(0.0663)
mng		-0.654***	-0.652***
		(0.0493)	(0.0493)
ROE		0.0903*	0.0895*

		(0.0521)	(0.0520)
IndDirectorRatio		0.171	0.168
		(0.165)	(0.165)
Cash_ratio		0.00423	0.00408
		(0.00667)	(0.00666)
Constant	6.460***	5.502***	5.502***
	(0.00917)	(0.114)	(0.114)
Observations	13,030	13,030	13,030
R-squared	0.084	0.133	0.134

2.5.2 Ologit

In addition, we further verify the reliability of the regression results by replacing the regression model. As the explanatory variable is the rating score from 1-9, based on this data characteristic, I replaced the fixed effects model with an ologit method for regression analysis to test the robustness. The results are shown in Table 6, where the coefficient on the core explanatory variable Grebond is still positive and statistically significant at 1% statistical significance. This shows that the results are robust.

Table 6: Result of ologit regression

VARIABLES	Esg_hz
Grebond	1.337***
	(0.402)
businessyear	0.260***

	(0.0526)
Lev	0.688***
	(0.0960)
ROA	4.015***
	(0.271)
Inc_equ	-0.872**
	(0.394)
Cash_ass	1.372***
	(0.258)
Growth	-0.684*
	(0.394)
firstshr	1.160***
	(0.116)
mng	-1.355***
	(0.0849)
/cut1	-8.159***
	(1.013)
/cut2	-5.267***
	(0.285)
/cut3	-3.477***
	(0.188)
/cut4	-2.054***

	(0.168)
/cut5	-0.580***
	(0.163)
/cut6	1.815***
	(0.163)
/cut7	2.862***
	(0.165)
/cut8	5.330***
	(0.175)
Observations	13,033

2.6 Heterogeneity Tests

2.6.1 Heterogeneity of Financial Constrain

I grouped firms by the size of their financing constraints and the results are shown in Table 7. The first column shows the grouping of companies facing small financing constraints and the second column shows the grouping of companies facing large financing constraints. We found that the issuance of green bonds had a more significant contribution to ESG performance for firms with small financing constraints, while it was not significant for firms with large financing constraints. This may be because firms with small financing constraints have greater financing availability and more generous matching funds to invest in ESG projects, thus contributing to ESG performance. However, firms with more significant financing constraints will generally be relatively stretched to obtain financing through green bonds and will be more

cautious about investing, preferring to use the funds for precautionary purposes, resulting in less investment in ESG. On the other hand, for companies with high financing constraints, there may be 'greenwashing' behavior, and because they are cash-strapped, when they issue green bonds, they may not actually use the funds to invest in green projects. Therefore, the green bonds of these companies do not contribute significantly to ESG performance.

Table 7: Heterogeneity of financing constraints regression results

	(1)	(2)
VARIABLES	Esg_hz	Esg_hz
Grebond	0.770***	0.313
	(0.283)	(0.340)
businessyear	0.390***	-0.215***
	(0.0504)	(0.0819)
Lev	0.771***	0.134
	(0.0762)	(0.0818)
ROA	2.258***	2.349***
	(0.181)	(0.215)
Inc_equ	0.196	-1.069***
	(0.398)	(0.293)
Cash_ass	0.749***	0.666***
	(0.194)	(0.214)
Growth	-0.603*	-0.445*

	(0.363)	(0.231)
firstshr	0.450***	0.572***
	(0.0890)	(0.0983)
mng	-0.433***	-0.905***
	(0.0617)	(0.0793)
Constant	4.877***	6.910***
	(0.141)	(0.257)
Observations	6,516	6,513
R-squared	0.173	0.136

2.6.2 Heterogeneity of Executive Age

We use the median age of CEOs as a basis for grouping into young managerial firms and older managerial firms, and the results are shown in Table 8. The first column of the table shows the grouping of listed companies with younger CEOs, while the second column shows the grouping of listed companies with older CEOs. We find that the issuance of green bonds has a significant contribution to ESG performance in companies with younger managers. Conversely, among firms with older managers, the issuance of green bonds did not significantly enhance ESG performance.

Table 8: Regression results for managerial age heterogeneity

	(1)	(2)
VARIABLES	Esg_hz	Esg_hz

Grebond	0.828***	0.467
	(0.273)	(0.379)
businessyear	0.189***	0.161***
	(0.0418)	(0.0461)
Lev	0.242***	0.733***
	(0.0757)	(0.0844)
ROA	2.146***	2.392***
	(0.175)	(0.235)
Inc_equ	-0.594**	-1.363***
	(0.265)	(0.515)
Cash_ass	0.665***	0.749***
	(0.191)	(0.223)
Growth	-2.288***	-0.317
	(0.637)	(0.198)
firstshr	0.555***	0.536***
	(0.0934)	(0.0943)
mng	-0.502***	-0.827***
	(0.0686)	(0.0719)
Constant	5.574***	5.563***
	(0.129)	(0.144)
Observations	6,995	6,032
R-squared	0.133	0.163

2.7 Mechanism test

In the mechanism test, we argue that green bonds promote ESG performance through a mechanism whereby green bonds promote ESG performance by promoting the size of the financing and hence the size of the financing. This study take the logarithm of the financing size as the value lnFinsize, and regress the financing size as the dependent variable on the set of core and control variables. In addition, we also include the financing size variable as a control variable in the benchmark regression for analysis with ESG performance as the dependent variable. The results in the second column of Table 9 shows that an increase in financing size significantly increases the ESG performance of firms at the 1% statistical significance level and that the coefficient of Grebond is higher compared to that in the benchmark regression (Table 4, third column) is reduced. This suggests that our proposed mechanism holds, i.e., issuing green bonds leads to an increase in the size of the financing and thus improves the ESG performance of firms.

Table 9: Mechanism test

	(1)	(2)
VARIABLES	lnFinsize	Esg_hz
Grebond	3.544**	0.628***
	(1.518)	(0.220)
lnFinsize		0.00692***
		(0.00127)
businessyear	-0.465**	0.181***

	(0.212)	(0.0307)
Lev	12.31***	0.363***
	(0.385)	(0.0578)
ROA	4.134***	2.211***
	(0.962)	(0.139)
Inc_equ	-5.357***	-0.812***
	(1.610)	(0.233)
Cash_ass	-2.703***	0.758***
	(0.999)	(0.145)
Growth	-0.504	-0.474**
	(1.328)	(0.192)
firstshr	-0.415	0.547***
	(0.456)	(0.0660)
mng	-1.550***	-0.641***
	(0.339)	(0.0491)
Constant	12.27***	5.483***
	(0.660)	(0.0968)
Observations	13,030	13,030
R-squared	0.352	0.136

2.8 Conclusion

While in the past, investors usually focused only on the financial position and

profitability of a company, nowadays, investors also focus on the ESG performance of a company. In addition to investors, governments also promote the development of companies while focusing on ESG performance. However, in the past, the focus has mostly been on the benefits that can be derived from improved ESG performance, while less exploration has been done on the factors that influence ESG performance. This study argues that since ESG performance improvement of companies can bring such great benefits, it is also of a greater significance to study the factors that affect ESG performance. After analyzing data from Chinese listed companies, four main findings emerge from this study. Firstly, benchmark regression analysis finds that the issuance of green bonds significantly enhances corporate ESG performance. Second, the boosting effect of green bond issuance on ESG performance is more significant for firms with small financing constraints and young managers. Thirdly, firms' ESG performance is affected by increasing the size of their financing after issuing green bonds. Finally, the findings remain robust and reliable even by adding control variables and using ologit regressions.

This study has identified the critical role of green bonds in promoting ESG performance. These findings have practical value for policy makers in guiding and promoting firms' ESG performance. Using green bonds to enhance ESG performance by guiding and encouraging companies to issue green bonds, even at subsidized interest rates, is an effective tool. On the other hand, the findings of we identify companies with low financing constraints and young managers that are more likely to promote ESG performance by issuing green bonds. Prioritizing the issuance of green bonds by these

firms can be effective in improving overall ESG performance and may theoretically be more likely to draw the attention of other firms to ESG performance, thereby driving more firms to invest more in ESG performance. Finally, for investors who take ESG performance as a major consideration in their investment decisions, the issuance of green bonds by listed companies can be taken as one of the reference factors for investment.

Although we found that one of the factors affecting ESG performance is the issuance of green bonds, we are unable to detect how much the size of green bond issuance contributes to ESG performance due to data constraints, so future research work can further explore the contribution of the size of green bonds to ESG performance. Apart from this, many benefits can be derived from an increase in ESG performance, and these studies are already more abundant. However, there are few studies that examine the factors that influence ESG performance, and future research work could explore more factors that influence ESG performance, which would give policy makers more ways to promote enhanced corporate ESG performance. Finally, further research could also be conducted on whether the issuance of green bonds can be used as an indicator to predict corporate ESG performance in advance, for investors who are concerned about ESG performance, predicting corporate ESG performance in advance has a certain investment reference value for them.

Appendix

Remark 1:

Given $b_{ij} = c_{jij}$ and $b_{ji} = c_{iji}$, we can derive the reciprocal utility functions of the two represetative respectively:

$$U_i(a_i; a_j) = w_l(a_i; a_j) + Y_{ij}\left[w_j(a_i; a_j) - w_j^{e_i}\right]\lambda_{iji}$$

$$U_j(a_j; a_i) = w_j(a_j; a_i) + Y_{ji}\left[w_l(a_j; a_i) - w_i^{e_j}\right]\lambda_{jij}$$

By the first order condition, we conclude:

$$\frac{\partial U_i(a_i; a_j)}{\partial a_i} = \frac{\partial w_i}{\partial a_i} + Y_{ij}\lambda_{iji}\frac{\partial w_j}{\partial a_i} = 0$$

$$\frac{\partial U_j(a_j; a_i)}{\partial a_j} = \frac{\partial w_j}{\partial a_j} + Y_{ji}\lambda_{jij}\frac{\partial w_i}{\partial a_j} = 0$$

Since a is determined jointly by $a_i \, and a_j$, $a = a(a_i, a_j)$ and hence $\frac{\partial a}{\partial a_i}$ and $\frac{\partial a}{\partial a_j}$ are not equal to zero. We can conclude that:

$$\frac{\partial w_i}{\partial a} + Y_{ij}\lambda_{iji}\frac{\partial w_j}{\partial a} = 0$$
$$\frac{\partial w_j}{\partial a} + Y_{ji}\lambda_{jij}\frac{\partial w_i}{\partial a} = 0$$

We combine these two equations to obtain:

$$\frac{\partial w_j}{\partial a}(1 - Y_{ij}Y_{ji}\lambda_{iji}\lambda_{jij}) = 0$$

Since w_j is determined by t, hence $\frac{\partial w_j}{\partial a} \neq 0$, from which we obtain the reciprocal equilibrium condition (REC, iii) $Y_{ij}Y_{ji} = \frac{1}{\lambda_{iji}\lambda_{jij}}$. Since λ_{iji} and λ_{jij} are of the same sign, it is guaranteed that $Y_{ij}Y_{ji} > 0$. Furthermore, the REC ensures $\frac{\partial U_i(a_i;a_j)}{\partial a_i} = \frac{\partial U_j(a_j;a_i)}{\partial a_j} = 0$.

We denote a_i^* and a_j^* as the optimal solutions to the reciprocal equilibrium of player i and player j, respectively. Although the choices of both players affect the final result, we can think of it as player i changing by choosing a_i, and in turn, a change in individual utility by a. We can then transform the problem of finding the

optimal profile (a_i^*, a_j^*) that maximizes the individual utility function to find the optimal solution $a^*(a_i^*, a_j^*)$ for both players' individual utility functions at the same time. As a consequence, in the strategy interval $a \in [\underline{a}, \overline{a}]$, we can obtain the following reciprocal equilibrium optimal solution (a_i^*, a_j^*):

$$\begin{cases} (\underline{a}, \underline{a}), if\ a < \underline{a} \\ (a_i, a_j), if\ a \in [\underline{a}, \overline{a}] \\ (\overline{a}, \overline{a}), if\ a > \overline{a} \end{cases}$$

We observe that since $a^*(a_i^*, a_j^*)$ is jointly determined by a_i^* and a_j^*, so there exists $a' = a(a', a')$. Thus, reciprocal equilibria necessarily have $a_i^* = a_j^*$, where $a \in [\underline{a}, \overline{a}]$.

Proposition 2:

We derive the first-order partial derivatives and second-order partial derivatives of the utility functions for the representatives of the poor and the worker:

$$\frac{\partial U_l(t_l; t_u)}{\partial t_l} = -\frac{\bar{s}^2\,(t_l + t_u)}{4} - \frac{Y_{lu}\,\lambda_{lul}\,\bar{s}^2\,(t_l + t_u - 1)}{2}$$

$$\frac{\partial U_u(t_u; t_l)}{\partial t_u} = -\frac{\bar{s}^2\,(t_l + t_u - 1)}{2} - \frac{Y_{ul}\,\lambda_{ulu}\,\bar{s}^2\,(t_l + t_u)}{4}$$

$$\frac{\partial^2 U_l(t_l; t_u)}{\partial t_l^2} = -\frac{\bar{s}^2\,(2\,Y_{lu}\,\lambda_{lul} + 1)}{4}$$

$$\frac{\partial^2 U_u(t_u; t_l)}{\partial t_u^2} = -\frac{\bar{s}^2\,(Y_{ul}\,\lambda_{ulu} + 2)}{4}$$

If $\lambda > 0$, it makes $\frac{\partial^2 U_l(t_l; t_u)}{\partial t_l^2} < 0$ and $\frac{\partial^2 U_u(t_u; t_l)}{\partial t_u^2} < 0$. It satisfies REC (ii). Then, we can derive the best response function as follows:

$$t_l(t_u) = \frac{2\,Y_{lu}\,\lambda_{lul}}{2\,Y_{lu}\,\lambda_{lul} + 1} - t_u$$

$$t_u(t_l) = \frac{2}{Y_{ul}\,\lambda_{ulu} + 2} - t_l$$

We substitute the reciprocal equilibrium condition (iii) $Y_{ul}Y_{lu} = \frac{1}{\lambda_{lul}\lambda_{ulu}}$ to obtain the best response function and the following equations:

$$t_l(t_u) = \frac{2}{2 + Y_{ul}\,\lambda_{ulu}} - t_u$$
$$t_u(t_l) = \frac{2}{2 + Y_{ul}\,\lambda_{ulu}} - t_l$$

Thus far, all profiles(t_l, t_u) satisfying $t_l + t_u = \frac{2}{2 + Y_{ul}\,\lambda_{ulu}}$ are positive reciprocal equilibria, provided all reciprocal equilibrium conditions are satisfied, and in particular $t_l = t_u = \frac{1}{2 + Y_{ul}\,\lambda_{ulu}}$ when both the poor and the workers have the same choice of UBI.

Likewise, if $-\frac{1}{2\,Y_{lu}} < \lambda_{lul} < 0$ and $-\frac{2}{Y_{ul}} < \lambda_{ulu} < 0$, all profiles (t_l, t_u) satisfying $t_l + t_u = \frac{2}{2 + Y_{ul}\,\lambda_{ulu}}$ is negative reciprocal equilibria, satisfying $t_l = t_u = \frac{1}{2 + Y_{ul}\,\lambda_{ulu}}$ is negative consistent reciprocal equilibria.

Proposition 3:

Total social welfare function is:

$$sw = sw_l + sw_u = n_1 g(t) + \sum_{i=n_1+1}^{n} \frac{(1-t)^2 s_i^2}{2} + n_2 g(t)$$
$$= nt(1-t)\bar{s}^2 + \frac{1}{2}(1-t)^2 \sum_{i=n_1+1}^{n} s_i^2$$
$$= t(1-t) \sum_{i=n_1+1}^{n} s_i^2 + \frac{1}{2}(1-t)^2 \sum_{i=n_1+1}^{n} s_i^2$$
$$= \frac{1}{2}(1-t^2) \sum_{i=n_1+1}^{n} s_i^2$$

We may find that total social output is a strictly monotonically decreasing function of the tax rate t. As the consistent reciprocal equilibrium has to satisfy $t_u = t_l = \frac{1}{2 + Y_{ul}\,\lambda_{ulu}}$. If $\lambda > 0$, then $t_u = t_l < \frac{1}{2}$. We can conclude $sw(t) > sw\left(\frac{1}{2}\right)$. Likewise, if $\lambda < 0$, then $t_u = t_l > \frac{1}{2}$. We can conclude $sw(\tilde{t}) < sw\left(\frac{1}{2}\right)$. Therefore $sw(t) > sw\left(\frac{1}{2}\right) > sw(\tilde{t})$.

Corollary 1:

We find the partial derivatives of material payoff with respect to $t$separately:

$$\frac{\partial w_l}{\partial t} = -\bar{s}^2 t$$

$$\frac{\partial w_u}{\partial \mathrm{t}} = \bar{s}^2 (1 - 2t)$$

Preferred tax rate for worker representative and poor representative are $t = 0$ and $t = \frac{1}{2}$ respectively. Since the tax rate $t^* < \frac{1}{2}$ when a positive consistent reciprocal equilibrium is reached and $\tilde{t} > \frac{1}{2}$ when a negative consistent reciprocal equilibrium is acheieve, $w_l(t^*) > w_l\left(\frac{1}{2}\right) > w_l((\tilde{t}),\ w_u\left(\frac{1}{2}\right) > \max(\ w_u(t^*),\ w_u(\tilde{t})\ )$.

Proposition 4

We assume that incomes above $\tilde{y}$, are taxed more than t, which we denote by θt, where $\theta > 1$. Moreover, we suppose that n_1 poor people, n_{21} workers are subject to tax rate t, and n_{22} workers are subject to tax rate θt. The individual utility is:

$$w_i = \begin{cases} g(t), if\ y_i = 0 \\ (1-t)y_i + g(t) - C(l_i), if\ y_i \in (0, \tilde{y}] \\ (1-\theta t)y_i + g(t) - C(l_i), if\ y_i > \tilde{y} \end{cases}$$

We can conclude:

$$w_i = \begin{cases} g(t), if\ y_i = 0 \\ \frac{1}{2}(1-t)^2 s_i^2 + g(t), if\ y_i \in (0, \tilde{y}] \\ \frac{1}{2}(1-\theta t)^2 s_i^2 + g(t), if\ y_i > \tilde{y} \end{cases}$$

Where $(t) = t\frac{\sum y}{n} = t\frac{\sum s_i l_i}{n} = \frac{t\left(\sum_{i=n_1+1}^{n_1+n_{21}}(1-t)s_i^2 + \sum_{i=n_1+n_{21}+1}^{n}(1-\theta t)s_i^2\right)}{n}$, and we denote $\widetilde{s_1}^2 := \sum_{i=n_1+1}^{n_1+n_{21}} s_i^2$, $\widetilde{s_2}^2 := \sum_{i=n_1+n_{21}+1}^{n} s_i^2$. Since the worker's representative income is an average income, his labor skills have the following relationships:

$$s_l^2 = \bar{s}^2 = \begin{cases} \frac{\widetilde{s_1}^2 + \frac{1-t\theta}{1-t}\widetilde{s_2}^2}{n}, if\ y_l \in (0, \tilde{y}] \\ \frac{\frac{1-t}{1-t\theta}\widetilde{s_1}^2 + \widetilde{s_2}^2}{n}, if\ y_l > \tilde{y} \end{cases}$$

The utility functions represented by both groups are then as follows:

$$w_u = \frac{t(1-t)\widetilde{s_1}^2 + \theta t(1-\theta t)\widetilde{s_2}^2}{n}$$

$$w_l = \begin{cases} \frac{1}{2}(1-t)^2\bar{s}^2 + g(t)\,, if\ y_l \in (0, \tilde{y}] \\ \frac{1}{2}(1-\theta t)^2\bar{s}^2 + g(t), if\ y_l > \tilde{y} \end{cases}$$

If $y_l \in (0, \tilde{y}]$,the second partial derivatives of the utility functions of both players are as follows:

$$\frac{\partial^2 U_l(t_l; t_u)}{\partial t_l^2} = -\frac{\widetilde{s_1}^2 + \widetilde{s_2}^2\theta(2\theta - 1) + 2Y_{\mathrm{lu}}\lambda_{\mathrm{lul}}\left(\widetilde{s_1}^2 + \widetilde{s_2}^2\theta^2\right)}{4n}$$

$$\frac{\partial^2 U_u(t_u; t_l)}{\partial t_u^2} = -\frac{2\left(\widetilde{s_1}^2 + \widetilde{s_2}^2\theta^2\right) + Y_{\mathrm{ul}}\lambda_{\mathrm{ulu}}\left(\widetilde{s_1}^2 + 2\widetilde{s_2}^2\theta^2 - \widetilde{s_2}^2\theta\right)}{4n}$$

If $\lambda > 0, \frac{\partial^2 U_l(t_l;t_u)}{\partial t_l^2} < 0\ and\ \frac{\partial^2 U_u(t_u;t_l)}{\partial t_u^2} < 0$. It satisfies condition (ii) of the REC. We can derive the best response function by FOC:

$$t_l(t_u) = \frac{2Y_{\mathrm{lu}}\lambda_{\mathrm{lul}}\widetilde{s_1}^2 + (2Y_{\mathrm{lu}}\lambda_{\mathrm{lul}}\theta + \theta - 1)\widetilde{s_2}^2}{(2Y_{\mathrm{lu}}\lambda_{\mathrm{lul}} + 1)\widetilde{s_1}^2 + (2\theta^2 + 2Y_{\mathrm{lu}}\lambda_{\mathrm{lul}}\theta^2 - \theta)\widetilde{s_2}^2} - t_u$$

$$t_u(t_l) = \frac{2\widetilde{s_1}^2 + (2\theta + Y_{\mathrm{ul}}\lambda_{\mathrm{ulu}}\theta - Y_{\mathrm{ul}}\lambda_{\mathrm{ulu}})\widetilde{s_2}^2}{(2 + Y_{\mathrm{ul}}\lambda_{\mathrm{ulu}})\widetilde{s_1}^2 + (2\theta^2 + 2Y_{\mathrm{ul}}\lambda_{\mathrm{ulu}}\theta^2 + Y_{\mathrm{ul}}\lambda_{\mathrm{ulu}}\theta)\widetilde{s_2}^2} - t_l$$

Substituting the equilibrium condition (REC) (iii) $Y_{ul}Y_{lu} = \frac{1}{\lambda_{lul}\lambda_{ulu}}$ which means that $Y_{ul}\lambda_{ulu} = \frac{1}{Y_{lu}\lambda_{lul}}$ into $t_u(t_l)$, then $t_u(t_l)$ is as follows:

$$t_u(t_l) = \frac{2Y_{\mathrm{lu}}\lambda_{\mathrm{lul}}\widetilde{s_1}^2 + (2\theta Y_{lu}\lambda_{lul} + \theta - 1)\widetilde{s_2}}{(2Y_{lu}\lambda_{lul} + 1)\widetilde{s_1}^2 + (2Y_{lu}\lambda_{lul}\theta^2 + 2\theta^2 + \theta)\widetilde{s_2}^2} - t_l$$

As the constant term (denote C) of $t_u(t_l)$ is the same as the constant term of $t_l(t_u)$, we thus know that the profile (t_l, t_u) satisfying $t_l + t_u = C$ is a positive reciprocal equilibrium and the particular profile (t_l, t_u) is a positive consistent reciprocal equilibrium if satisfies $t_l = t_u = \frac{C}{2}$.

Similarly, if $y_l > \tilde{y}$, the second partial derivatives of the utility functions of both players are as follows:

$$\frac{\partial^2 U_l(t_l;t_u)}{\partial t_l^2} = -\frac{\theta(\widetilde{s_2}^2\theta - \widetilde{s_1}^2) + 2\widetilde{s_1}^2 + 2Y_{\mathrm{lu}}\lambda_{\mathrm{lul}}\left(\widetilde{s_1}^2 + \widetilde{s_2}^2\theta^2\right)}{4n}$$

$$\frac{\partial^2 U_u(t_u;t_l)}{\partial t_u^2} = -\frac{2\widetilde{s_1}^2 + \widetilde{s_2}^2\theta^2 + Y_{\mathrm{ul}}\lambda_{\mathrm{ulu}}\left(2\widetilde{s_1}^2 + \widetilde{s_2}^2\theta^2 - \widetilde{s_1}^2\theta\right)}{4n}$$

Since $\widetilde{s_2}^2 > \widetilde{s_1}^2$ and $\theta > 1$, both $\frac{\partial^2 U_l(t_l;t_u)}{\partial t_l^2}$ and $\frac{\partial^2 U_u(t_u;t_l)}{\partial t_u^2}$ are less than 0 when $\lambda > 0$, which satisfies the condition of REC(ii). We can obtain the best response function as follows:

$$t_l(t_u) = \frac{(1 + 2\,Y_{\mathrm{lu}}\,\lambda_{\mathrm{lul}} - \theta)\widetilde{s_1}^2 + 2\theta\,Y_{\mathrm{lu}}\,\lambda_{\mathrm{lul}}\,\widetilde{s_2}^2}{(2 + 2\,Y_{\mathrm{lu}}\,\lambda_{\mathrm{lul}} - \theta)\,\widetilde{s_1}^2 + \theta^2\,(1 + 2\,Y_{\mathrm{lu}}\,\lambda_{\mathrm{lul}})\widetilde{s_2}^2} - t_u$$

$$t_u(t_l) = \frac{(2 + Y_{\mathrm{ul}}\,\lambda_{\mathrm{ulu}} - \theta Y_{\mathrm{ul}}\,\lambda_{\mathrm{ulu}})\widetilde{s_1}^2 + 2\theta\,\widetilde{s_2}^2}{(2 + 2\,Y_{\mathrm{ul}}\,\lambda_{\mathrm{ulu}} - Y_{\mathrm{ul}}\,\lambda_{\mathrm{ulu}}\,\theta)\widetilde{s_1}^2 + \theta^2\,(2 + Y_{\mathrm{ul}}\,\lambda_{\mathrm{ulu}})\,\widetilde{s_2}^2} - t_l$$

Substituting the equilibrium condition (REC, iii) $Y_{ul}Y_{lu} = \frac{1}{\lambda_{lul}\lambda_{ulu}}$ which means that $Y_{ul}\lambda_{ulu} = \frac{1}{Y_{lu}\lambda_{lul}}$ into $t_u(t_l)$, then $t_u(t_l)$ is as follows:

$$t_u(t_l) = \frac{(1 + 2\,Y_{ul}\lambda_{ulu} - \theta)\widetilde{s_1}^2 + 2\theta\,Y_{ul}\lambda_{ulu}\widetilde{s_2}^2}{(2Y_{ul}\lambda_{ulu} + 2 - \theta)\widetilde{s_1}^2 + (1 + 2Y_{ul}\lambda_{ulu})\,\theta^2\widetilde{s_2}^2} - t_l$$

As the constant term (denote $\tilde{C}$) of $t_u(t_l)$ is the same as the constant term of $t_l(t_u)$, we thus know that the profile (t_l, t_u) satisfying $t_l + t_u = \tilde{C}$ is a positive reciprocal equilibrium and the particular profile (t_l, t_u) is a positive consistent reciprocal equilibrium if satisfies $t_l = t_u = \frac{\tilde{C}}{2}$.

Likewise, if $y_l \in (0, \tilde{y}]$, $0 > \lambda_{\mathrm{lul}} > -\frac{\widetilde{s_1}^2 + \widetilde{s_2}^2\theta(2\theta-1)}{2Y_{\mathrm{lu}}(\widetilde{s_1}^2 + \widetilde{s_2}^2\theta^2)}$ and $0 > \lambda_{\mathrm{ulu}} > -\frac{2(\widetilde{s_1}^2 + \widetilde{s_2}^2\theta^2)}{Y_{\mathrm{ul}}(\widetilde{s_1}^2 + 2\widetilde{s_2}^2\theta^2 - \widetilde{s_2}^2\theta)}$, the profile (t_l, t_u) satisfying $t_l + t_u = C$ is a negative reciprocal equilibrium and the particular profile (t_l, t_u) is a negative consistent reciprocal equilibrium if satisfies $t_l = t_u = \frac{C}{2}$. If $y_l > \tilde{y}$, $0 > \lambda_{\mathrm{lul}} > -\frac{\theta(\widetilde{s_2}^2\theta - \widetilde{s_1}^2) + 2\widetilde{s_1}^2}{2Y_{\mathrm{lu}}(\widetilde{s_1}^2 + \widetilde{s_2}^2\theta^2)}$ and $0 > \lambda_{\mathrm{ulu}} > -\frac{2\widetilde{s_1}^2 + \widetilde{s_2}^2\theta^2}{Y_{\mathrm{ul}}(2\widetilde{s_1}^2 + \widetilde{s_2}^2\theta^2 - \widetilde{s_1}^2\theta)}$, the profile (t_l, t_u) satisfying $t_l + t_u = \tilde{C}$ is a negative reciprocal equilibrium and the particular the profile (t_l, t_u) is a negative consistent reciprocal equilibrium if satisfies $t_l = t_u = \frac{\tilde{C}}{2}$.

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논문 초록

이 논문은 두 장으로 구성되어 있습니다. 첫 장은 호혜성이 보편적 기본소득 정책에 대한 근로자의 지지에 미치는 영향에 관한 것입니다. 두 번째는 중국 상장기업 데이터를 활용한 녹색 채권 기업 ESG 성과 개선 연구입니다.

제 1 장은 호혜성이 빈곤층과 근로자 대표 간의 보편적 기본소득(UBI) 협상에 어떤 영향을 미치는지 보여줍니다. 이 장에서는 근로자와 빈곤층 간의 일반적인 형태의 게임을 구축하여 호혜성이 보편적 기본소득(UBI) 정책에 미치는 영향을 조사합니다. 우리는 인간이 합리적이고 경제적이라는 가정 하에서, 양측이 서로를 만족시키는 UBI 정책에 대한 일관적인 균형에 도달할 수 없다는 것을 발견했습니다. 그와는 반대로, 상호주의는 근로자와 빈곤층이 기본소득 정책 옵션에 동의하도록 이끌 수 있습니다. 둘째, 양쪽이 모두 이기적이라면, 사회적 후생은 긍정적인 상호 균형 하에서보다 낮을 것입니다. 그리고 부정적인 상호 균형은 이기주의보다 사회적 후생을 더 감소시킵니다. 마지막으로, 일관된 상호적 균형을 찾기 위해, 우리는 2 명의 참가자가 있는 상호 균형 게임의 상호 균형 조건(REC)을 찾고, 조건이 충족되면 항상 일관된 상호 균형을 찾을 수 있다는 것을 발견했습니다.

제 2 장에서는 중국 상장기업의 자료를 활용하여 녹색채권 발행이 기업 ESG 성과를 크게 향상시키는 것을 발견했습니다. 이러한 효과는 젊은 관리자가 있거나 다른 기업보다 재정적 제약이 적은 기업에서 더 유의미하게 나타납니다. 또한 녹색채권은 자금 조달 규모를 늘려 ESG

성과를 향상시킵니다. 결과의 일관성은 다중 제어 변수와 ologit 방법을 사용하여 확인하였고, 결과는 일관적이었습니다. 이 연구 결과는 정책 입안자들에게 녹색채권이 기업의 ESG 성과를 개선할 수 있는 효과적인 도구라는 것을 제시합니다.