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Monopsony Rent Surcharge for SDGs Financing: Case of Japan

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Abstract

As seen in the loss and damage fund for climate change, the shortage of the financial sources for SDGs is a serious issue. From the viewpoint of ecological economics for the externality and monopsony at the intake of resources from ecology to economy should be internalized by monopsony rent surcharge for corporations. The average total amount of monopsony rent of 5581 Japanese listed companies is 10,098.4 billion yen per year in 2010's, estimated by dynamic pseudo-equilibrium approach using mathematical programming. The sum of the corporate income tax rate and the monopsony rent rate, has consistently remained around 50% from 1980 to 2020, meantime the corporate income tax rate has declined from around 44.7% to less than 27.9%. The overall trend is similar to the trend of US S&P 500 registered companies shown by Shimamoto (2023).

If developed countries work together to introduce monopsony rent surcharge system, it would be possible to secure financial resources for the SDGs while we suppress capital flight.

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1. Introduction

COP 27 of UNFCCC (United Nations Framework Convention on Climate Change) held in Sharm el-Sheikh in November 2022 decided to establish new funding arrangements for assisting developing countries that are particularly vulnerable to the adverse effects of climate change, in responding to loss and damage. The funding needs of developing country parties due to the increasing impacts of climate change and their increased indebtedness, currently estimated at USD 5.8–5.9 trillion for the pre-2030 period. However even the goal of developed country Parties to mobilize jointly USD 100 billion per year by 2020 has not yet been met (UNFCCC (2023a)). Deep regret was expressed for the issue again in COP28, although it noted that USD 128 billion were pledged to the second replenishment of Green Climate Fund (UNFCCC (2023b)).

According to Gewirtzman (2018), as the funding sources like climate risk and disaster response, insurances and climate bonds have analyzed since the early period of the Warsaw International Mechanism for Loss and Damage that had been established at

COP19 in 2013. However, it is difficult how climate bonds could be used to finance loss and damage-related projects, though they fit for mitigation projects. Insurance is not well-suited to address slow-onset events such as sea level rise, desertification and glacial melt, and non-economic loss and damage, including loss of heritage, culture, languages and ecosystems. As Pauw et al. (2022) has suggested to include a collective minimum grant target for setting the new collective quantified goal for climate finance under the UNFCCC for the post 2025 period.

Shortage of the funding is not limited to the issue of climate change, but also to all areas related to achieving the SDGs. In recent years Inter-agency Task Force on Financing for Development consisting of more than 60 United Nations agencies, programs and offices, has published *Financing for Sustainable Development Report*. This report in 2023 (United Nations (2023)) emphasizes that SDG financing needs are growing, but development financing is not keeping pace. It also says that financial and economic stress, high debt burdens and tight fiscal space have stretched public finances in most countries, although domestic public resources remain the main way that governments can support the Sustainable Development Goals (SDGs). It recommends not only strengthening international taxation and increasing tax collection rates, but also well-constructed permanent taxes on windfall profits. They are not only from fossil fuel extraction but from

all sectors where external shocks might lead to higher prices on consumers and affect productivity while generating windfall profits for a small number of firms.

Shimamoto (2023) suggested the internationally cooperated taxation of monopsony rent surcharge to global corporations which are raised from structural monopsony and externalities, not only from windfall profits. Windfall taxation proposal needs to step into a similar proposition to monopsony rent surcharge in that it is necessary to draw some sort of line between normal profit and windfall profit.

The reasons why it is effective to use the monopsony rent surcharge on global corporations as a source of revenue to promote the SDGs mentioned in Shimamoto (2023) are as follows.

First, environmental taxes are sometimes regressive, and it is not easy to raise the tax rate even in a developed country because it will impose burden on low-income groups in an unequal society. For example, the European Green Deal (European Commission (2019)) has declared that the transition must be just and inclusive, that would have been necessary because past growth strategies allowed the rise of populism. Environmental policies would also have to respect the policy direction. A monopsony rents surcharge system means redistribution of the rent that should have originally distributed to suppliers in resource markets and environment. Therefore, this system will not further damage

economic efficiency.

The second reason is that mineral and biological resources are mainly produced in developing countries, where low-cost products without consideration for the environment and human rights consequently include external economic effects. However, it is difficult for developing countries to solve these problems due to their fragile governance. It is also difficult to control by trade measures competing with free trade principles. The developed countries have to take the initiative to impose some measures to control these issues. Monopsony rents surcharge will be one of the choices.

The third reason is a public choice perspective. According to Drutman (2015), the ratio of lobbying expenditures of corporations to those of labor unions and miscellaneous interest groups in the U.S. was 22:1 in 1998, 34:1 in 2012, and it continues to grow. Monopsony rent surcharge on global corporations would suppress these rent-seeking expenditure and direct the rebalancing of political power.

Fourth, it would also serve as a countermeasure against tax avoidance by global corporations which causes the deficit of public finance in developed countries. The OECD countries have agreed on a minimum effective tax rate of 15%, and if the governments of developed countries were to cooperate in imposing this surcharge, public finances in the governments could get a powerful financial base for SDGs.

Based on the above points, I have developed a methodology for estimating a monopsony rent surcharge on large corporations in developed countries and conducted an empirical analysis about U.S. global corporations in Shimamoto (2023).

This study examines the ecological economics position of monopsony rent surcharge. Next, how the empirical model of monopsony rents used in this study relates to and differs from the streams of prior researches will be examined. On the basis of them, the scale of the total amount the monopsony rent surcharge for 5,581 listed and unlisted securities report submission general business Japanese companies will be calculated and the result will be evaluated.

2. Taxation for monopsony rent surcharge from the perspective of ecological economics

In global environmental issues, the typical economic instruments for the environment have been environmental taxes or emissions trading. This is partly because each environmental problem has been considered as an individual issue, and the focus has tended to be on emissions. However, one of the reasons for the problems of emissions into the air and water is the excessive mining and harvesting of resources, which must be treated as a set of problems. Ecological economics has made this explicit in the relationship between ecosystems and the economic systems of human society. Daly

(1991) defines an aggregate economy as a system as follows. "The macroeconomy is an open subsystem of the ecosystem and is totally dependent upon it, both as a source for inputs of low-entropy matter-energy and as a sink for outputs of high-entropy matter-energy. *The physical exchanges crossing the boundary between the total ecological system and the economic subsystem constitute the subject matter of environmental macroeconomics.*" He proposed that the major task of environmental macroeconomics is to design an economic institution to keep the absolute scale from making our biospheric ark sink.

Based on this perspective of Ecological economics, environmental problems occur in two places: the intake of resources from the ecology to the economic subsystem, and the discharge of resources from the economic subsystem to the ecology. When the quantities or qualities of extraction of resources or discharge of waste matters are above the sustainable level of ecosystem, various environmental issues will arise for both humans and the earth. In order to control these quantities or qualities, we consider legal regulations or economic methods. The representative methods well-known as the latter are environmental taxes to the emitted matters.

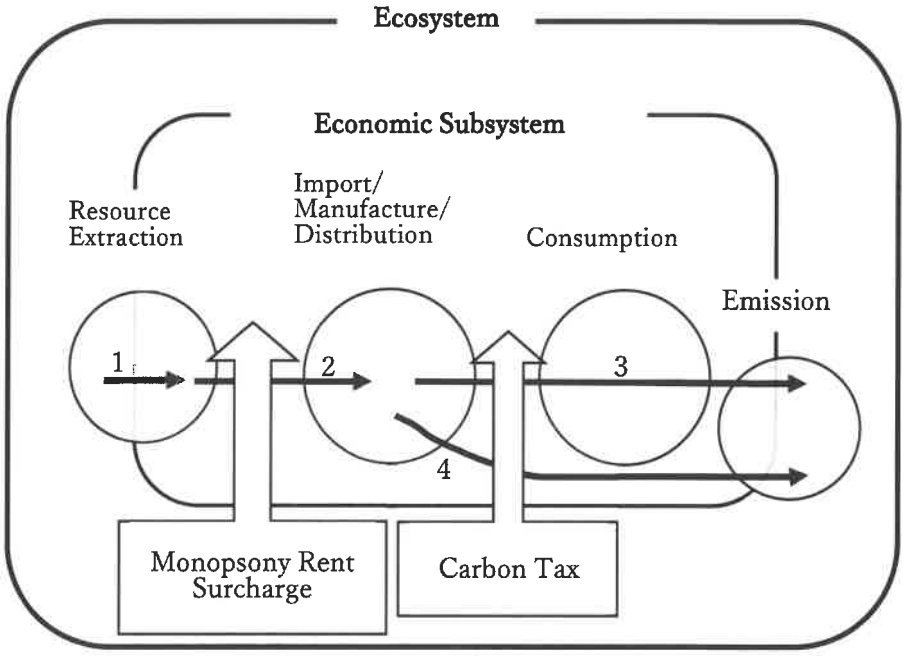

Figure 1. Monopsony Rent Surcharge and Carbon tax from the viewpoint of Ecological Economics

The primary purpose of environmental taxes is to control emissions to the ecosystem by taxing emissions by production (arrow 4) and/or consumption (arrow 3). Their role as a financial resource is also attracting attention.[2] In general, environmental tax systems are analyzed under the assumption that the products with external diseconomy are traded in competitive markets. It is partly because developed countries have had antitrust laws for a long time and they are regarded as functioning to some extent. Furthermore, even if a product market condition is oligopoly under the same production technology,

[2] Systems of emission trading also play similar roles in cases of 'Cap and Trade'. They can bear the financial resource when the initial allocation of emission rights would be decided by auctions.

neoclassical models generally show that the amount of the product supplied in market equilibrium tends to decrease, and this does not worsen emission to ecosystem.

On the other hand, economic methods have not been developed for controlling external diseconomies that arise at the stage of incorporating resources from ecosystem into economic subsystems. In general, it is not easy for people in developed countries to know the real situation of natural resource extraction, and environmental and human right issues relating with soil, water, forests, and mineral resources have been viewed as separate issues. These backgrounds have made it difficult to link economic methods to these issues.

Three types of elements coexist in the input stage from the ecology regardless of exhaustible resources or renewable resources with varying degrees of difficulty in reproduction. One is resource rent (arrow 1). Another one is the external diseconomies (arrow 1) including unsustainable extraction methods and poor working and living conditions for local people. The third element is that the unsustainable resource prices including environment and human rights issues are thought to be formed through monopsonic transactions in primary product markets (arrow 2).

These resource and monopsony rents, which include resource rent, external diseconomies and markdowns in primary products, should originally be returned to the environment, local people and production workers, although it is unclear whether these

are the amount that sufficiently compensates for external diseconomies and human rights considerations, since it is impossible to measure the extent to which external diseconomies are included.[3] Moreover, unlike product markets, there has been virtually no effective competition policies about overseas material markets, including imports from developing countries, in developed countries. [4]

Of course, there are alternative ways to deal with this issue, such as through institutional development, either through the governments of the countries concerned or through international agreements. Another possible alternative is the disclosure of corporate information about their sustainable actions that allows companies that extract resources to voluntarily take sufficient consideration of the environment and human rights. However, as mentioned at the beginning, financial resources are urgently needed to prevent the damage by climate change and overexploitation of natural resources, and to build institutional capacities in developing countries. Rent that has not been paid to the

[3]The case of the Pigouvian tax is as well. A Pigouvian tax rate is theoretically the difference between the private marginal cost and the social marginal cost at the socially optimal amount of pollution, although this is actually impossible to calculate. In the aspect of implement of environmental tax policy, the Baumol Oats tax is used instead, which searches for a proper tax rate that achieves the target pollution level by increasing or decreasing the tax rate (refer to Baumol and Oates (1988)).

[4] As for EU countries, any abuse of a dominant position among trading parties is prohibited in Article 102 of Treaty on the Functioning of the European Union though it is limited to the transactions within the internal markets (Sugisaki (2020)). About U.S. conduct involving import commerce is within the scope of the Sherman Act, however its concern is whether importers do not put domestic consumers at a disadvantage due to their monopoly (U.S. Department of Justic and Federal Trade Commission (2017)). In Japan, although the subcontracting law has controlled abuse of a superior bargaining position by parent businesses against subcontractors, the scope of the crackdown is limited to domestic transactions (Website of Small and Medium Enterprise Agency, https://www.chusho.meti.go.jp/keiei/torihiki/2021/210726ShitaukeSearch02.pdf).

entity to which it originally belongs should be collected and used as a public revenue source for the SDGs.

Although it is possible to build a system with a deduction that the surcharge may be reduced or waived for entities that voluntarily engage in sustainable resource extraction or entities that conduct R&D that actively promotes sustainability.

3. Investigation of Estimating Method for Scale of Financial Source from Monopsony Rent Surcharge

One of the purposes of this paper is to use the case of Japan to estimate how much tax revenue would be obtained if monopsony rent surcharge was imposed on global companies. The dynamic pseudo-competitive equilibrium model in Shimamoto (2023) and Shimamoto (2018) is used to calculate the monopsony rent amount in this study. This method has the similarities and differences with the orthodox econometric approaches to estimate markdown rates caused by monopsony of markets for production factors.

This approach has been developed for the estimation of the markdown rates in labor markets. As Manning (2003) quoted, textbooks of labor economics have generally tended to deny that labor markets were oligopsonic or monopsonic in 20th century. However recently there have become to arise many works that analyze wage markdown rates by

monopsony models and matching models that starts from the premise that there are important frictions in labor markets.

Tracing the origin of researches on estimating monopsony rates in labor markets leads us to the aggregate production function by Solow (1957). In his model production functions had neutral shifts and constant return to scale, and the portion of the growth rate of products that is not due to the growth rate of inputs was defined "technical change" as a short-hand expression for any kind of shift in the production function. It came to be called the Solow Residual. Based on this study many researches estimating total factor productivity applying the production function have been conducted on.

Afterwards researches have been conducted on how to estimate markup rates in cases where product markets may not be perfectly competitive. Hall (1988) showed a method to estimate a markup rate defined by the ratio of marginal cost occupying product price by using Solow Residual under the Hicks-neutral technical progress. However, in the process of estimation of this markup rate, it is necessary but not easy to find proper instrumental variables. De Loecker and Warzynski (2009), De Loecker (2011) evolved Hall's approach into a method that can be applied generally. By handing a cost minimization problem for a production function with labor, that is regarded as free from adjustment costs, and capital as production inputs, he showed that the markup ratio

(price/marginal cost) can be expressed as (output elasticity of labor input/share of labor input cost in revenue). The time series of technological progress variable were estimated in advance using a productivity function that depends on intermediate inputs (raw materials) and capital stock. The coefficients of translog production function, that can encompass the Cobb-Douglas production function as its special form, was estimated using GMM (generalized method of moments) and calculated the markup rate using the estimated values of coefficients.

Dobbolaere and Mairesse (2013) made a development of extending Hall's approach to the cases where both monopoly in the product markets and monopsony in the input factor markets, especially labor markets, exist simultaneously. When one takes the natural logarithm of the Cobb-Douglas production function, whose coefficient of each input factor is the elasticity of output with respect to each input factor, which can be easily estimated by OLS and WLS. Applying a similar method to De Loecker (2011) for both short-term cost minimization and profit maximization, they got a joint parameter of market imperfection that multiplying product of the markup rate by the markdown rate. They calculated it using the estimated coefficient values of elasticities of output with respect to input factors.

Yeh, Macaluso and Hershbein (2022) estimated the markdowns by monopsony for U.S.

labor markets by applying the approach of De Loecker (2011) to both output and input market simultaneously. They assumed a finitely elastic labor supply curve which means monopsonic market, and at least one input is free of adjustment costs and monopsony power. They estimated the markups and markdowns separately under the flexible translog production function form.

There is another development process that has been different from the method of Hall for estimating markup rates of product markets. Roeger (1995) suggested another approach to estimate markup rates to overcome the difficulty of finding a proper instrumental variable, by the method of Hall. He regarded the Solow residual by Hall (1988) as the primal technology residual, and defined the dual Solow residual developed from a general cost function corresponding to the same production technology. He showed that by subtracting the dual Solow residual from the primal Solow residual, it came to be possible to derive an equation from which the markup rate could be estimated by original least square. Afterward there has also been a series of research efforts in estimating markup using this method, for example Molnár and Bottini (2010) estimated markups for European OECD countries for the period 1993-2006. Figueira and Pinheiro-Alves (2023) jointly estimated price-cost margins and workers' bargaining power.

The premises of dynamic pseudo-competitive equilibrium model by Shimamoto (2023) are often considered to be stricter than these orthodox methods. However, the following analysis would show that they would be the reasonable level of assumptions. The series of studies since De Loecker (2011) use not macro data but firm-level or plant-level data which include intermediate inputs such as materials which is as same as that of Shimamoto (2023), therefore they can basically be said to focus on the similar resolution.

Functional forms of the production functions are first point to focus on. Dobbolaere and Mairesse (2013) set a Cobb-Douglas production function to estimate the markup and markdowns simultaneously. The method of De Loecker (2010) and Yeh, Macaluso and Hershbein (2022) set translog production functions which are more flexible functional form, although in these models at least one flexible input with no adjustment costs is indispensable. De Loecker (2010) takes labor input as a flexible input variable to estimate the markup in the product market, while Yeh, Macaluso and Hershbein (2022) use a material input as a flexible input variable to estimate the markdown in the labor market.

Morlacco (2019) takes a similar approach to Yeh el al., although since the markdown of material input is the subject of analysis, material input cannot be treated as a flexible input, and it therefore estimates just the relative markdown. By the above consideration, it is not actually feasible by the limitation of data to assume that input markets are

monopsony for both labor and raw materials when estimating markdowns from accounting data of many companies by the orthodox econometric approaches, because the input variables are generally classified into labor input and material input.

In Roeger's method a production function requires tighter assumption of constant returns to scale in addition to Hicks neutral technology.

The method of Shimamoto (2023) estimates markdowns by assuming a Cobb-Douglas production function, although it can set that all production inputs and product markets are non-competitive, and economies of scale can also be taken into account.

Another focus point is that Shimamoto (2023) calculates parameters of production functions using mathematical programming. They are not test statistics, although the time series values of markdowns can be calculated, and are possible to apply to various statistical analyses on the estimated values.

4. Model

Now the estimating method for the monopsony surcharge, the dynamic pseudo-competitive equilibrium model in Shimamoto (2023) will be briefly explained.

4.1 Short-term and long-term equilibrium conditions of the dynamic pseudo-competitive equilibrium model

A representative producer maximizes short-term profit and have long-term equilibrium under the Cobb–Douglas production technology to produce one product using four production inputs. This function is denoted by:

$$y^t = \alpha_5 v_1^{t\,\alpha 1} v_2^{t\,\alpha 2} v_3^{t\,\alpha 3} K^{t\,\alpha 4} \quad , \tag{1}$$

where the subscript t represents the t th period, y^t is the output quantity, v_1^t, v_2^t *and* v_3^t, the quantities of variable inputs, and K^t is the quantity of the fixed input, namely capital. In the short-term equilibrium, K^t is a given value, and $\alpha_1 + \alpha_2 + \alpha_3 < 1$, which ensures that the marginal cost function is convex.

As the producer simultaneously has market power both in an output and input markets, the short-run profit maximization problem is given as

$$\text{Max } \pi_m = p^t(y^t) \cdot y^t - w_1^t(v_1^t) \cdot v_1^t - w_2^t(v_2^t) \cdot v_2^t - w_3^t(v_3^t) \cdot v_3^t - r^t K^t$$

$$\text{s.t. (1).} \tag{2}$$

The optimal conditions of this problem can be finally expressed as follows.

$$y^t = \alpha_5 \cdot \left(\frac{w_{1m}^{t\,1-\alpha 2-\alpha 3} \cdot w_{2m}^{t\,\alpha 2} \cdot w_{3m}^{t\,\alpha 3}}{\alpha 5 \cdot \alpha 1^{1-\alpha 2-\alpha 3} \cdot \alpha 2^{\alpha 2} \cdot \alpha 3^{\alpha 3} \cdot p_m^t K t^{\,\alpha 4}} \right)^{\frac{\alpha 1}{\alpha 1+\alpha 2+\alpha 3-1}} \cdot \left(\frac{w_{1m}^{t\,\alpha 1} \cdot w_{2m}^{t\,1-\alpha 1-\alpha 3} \cdot w_{3m}^{t\,\alpha 3}}{\alpha 5 \cdot \alpha 1^{\alpha 1} \cdot \alpha 2^{1-\alpha 1-\alpha 3} \cdot \alpha 3^{\alpha 3} \cdot p_m^t K^{t\,\alpha 4}} \right)^{\frac{\alpha 2}{\alpha 1+\alpha 2+\alpha 3-1}} \cdot \left(\frac{w_{1m}^{t\,\alpha 1} \cdot w_{2m}^{t\,\alpha 2} \cdot w_{3m}^{t\,1-\alpha 1-\alpha 2}}{\alpha 5 \cdot \alpha 1^{\alpha 1} \cdot \alpha 2^{\alpha 2} \cdot \alpha 3^{1-\alpha 1-\alpha 2} \cdot p_m^t K^{t\,\alpha 4}} \right)^{\frac{\alpha 3}{\alpha 1+\alpha 2+\alpha 3-1}} \cdot K^{t\,\alpha 4} \quad , \tag{3}$$

$$v_i^t = \alpha_5 \cdot \left(\frac{w_{im}^{t\,1-\alpha j-\alpha k} \cdot w_{jm}^{t\,\alpha j} \cdot w_{km}^{t\,\alpha k}}{\alpha 5 \cdot \alpha i^{1-\alpha j-\alpha k} \cdot \alpha j^{\alpha j} \cdot \alpha k^{\alpha k} \cdot p_m^t K^{t\,\alpha 4}} \right)^{\frac{1}{\alpha 1+\alpha 2+\alpha 3-1}}, \text{ i, j, k=1,2,3 (i} \neq \text{ j} \neq \text{ k)} \tag{4}$$

However, unlike competitive markets equilibrium, p_m^t (y) and $w_{im}^t(v_i^t)$ are endogenous variables and differ from the exogenous prices of an output and inputs in competitive markets. They are defined as,

$$p_m^t \text{ (y)} \equiv \{p^{t\prime}(y^t) \cdot y^t + p^t(y^t)\} = (1+\gamma^t) \cdot p^t(y^t) \quad . \qquad (5)$$

$$w_{im}^t(v_i^t) \equiv \{w_i^{t\prime}(v_i^t) \cdot v_i^t + w_i^t(v_i^t)\} = (1+\sigma_i^t) \cdot w_i^t(v_i^t), \text{ i} = 1, 2, 3. \qquad (6)$$

where γ^t is assumed to have a constant inverse demand elasticity and $-1 < \gamma^t \leq 0$, and σ_i^t is assumed to have a constant inverse factor supply elasticity and $\sigma_i^t \geq 0$. The short-term pseudo-competitive equilibrium can be defined as the solution of a system of simultaneous equations.[5]

Long-term equilibrium conditions are derived by maximizing the time-series total of the discounted present value of profits defined by the short-term pseudo-competitive equilibrium profit minus capital costs. By deriving these long-term pseudo-competitive profit maximization conditions, we can find the optimal $\gamma^t, \sigma_1^t, \sigma_2^t,$ and σ_3^t that make the time series data of K^t, $p^{t*}y^{t*}, w_1^{t*}v_1^{t*}, w_2^{t*}v_2^{t*},$ and $w_3^{t*}v_3^{t*}$ for every four periods the optimal dynamic solution.

The pseudo-competitive profit function in period t is defined as follows:

$$\pi^t = \text{p}^{t*}(1+\gamma^t) \cdot y^t[p^{t*}(1+\gamma^t), w_1^{t*}(1+\sigma_1^t), w_2^{t*}(1+\sigma_2^t), w_3^{t*}(1+\sigma_3^t), K^t]$$

$$-\sum_{i=1}^{3} w_i^{t*}(1+\sigma_i^t) \cdot v_i{}^t[p^{t*}(1+\gamma^t), w_1^{t*}(1+\sigma_1^t), w_2^{t*}(1+\sigma_2^t), w_3^{t*}(1+\sigma_3^t), K^t]$$

[5] For a detailed explanation of the meaning of this short-term equilibrium, see Shimamoto (2023).

$$-Q^t \cdot I^t(K^{t-1}, K^t, \delta^t) \quad , \quad t = 1, \cdots\cdots, T. \qquad (7)$$

where γ^t, $\sigma_1^t, \sigma_2^t,$ and σ_3^t are assumed to change over time. Investment in period t, $I^t(K^{t-1}, K^t, \delta^t)$ is defined as follows:

$$I^t(K^{t-1}, K^t, \delta^t) = K^t - (1 - \delta^t) \cdot K^{t-1}, \qquad (8)$$

where δ^t is the depreciation rate in period t, and Q^t is the exogenous unit price of investment in period t.

The long-term equilibrium condition arises from maximizing the sum of the discounted present value of π^t from period 1 to T based on K^t, as follows:

$$\max_{K^t} \Pi = \pi^1 + \sum_{t=2}^{T} \prod_{s=2}^{t} \frac{1}{(1+r^s)} \pi^t \qquad (9)$$

Thus, the necessary condition for optimization, is given as follows:

$$\partial\Pi/\partial K^t = \prod_{s=2}^{t} \frac{1}{(1+r^s)} \cdot [\, p^{t*}(1+\gamma^t) \cdot \frac{\partial y^t}{\partial K^t} - \sum_{i=1}^{3} w_1^{t*}(1+\sigma_1^t) \cdot \frac{\partial v_1^t}{\partial K^t} - Q^t \cdot \frac{\partial I^t}{\partial K^t}]$$

$$+ \prod_{s=2}^{t+1} \frac{1}{(1+r^s)} [-Q^{t+1} \cdot \frac{\partial I^{t+1}}{\partial K^t}] = 0 \,. \qquad (10)$$

By modifying the partial differentiation using logarithmic differentiation, equation 10 can be finally arranged into the following equation:

$$(1+\gamma^t) \cdot \frac{p^t y^t}{K^t} - (1+\sigma_1^t) \cdot \frac{w_1^t v_1^t}{K^t} - (1+\sigma_2^t) \cdot \frac{w_2^t v_2^t}{K^t} - (1+\sigma_3^t) \cdot \frac{w_3^t v_3^t}{K^t}$$

$$- \frac{\alpha_1+\alpha_2+\alpha_3-1}{-\alpha_4} \cdot \left[Q^t - \frac{1}{(1+r^{t+1})} \cdot Q^{t+1} \cdot (1 - \delta^{t+1}) \right] = 0. \quad (11)^6$$

From a system of the simultaneous equations for every four periods, we can find the

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[6] The depreciation amount for a year is generally included as an item among the costs in accounting data. Therefore, it was set as zero to avoid double counting.

optimal $\gamma^t, \sigma_1^t, \sigma_2^t$, and σ_3^t that make the time series data of K^t, $p^{t*}y^{t*}$, $w_1^{t*}v_1^{t*}$, $w_2^{t*}v_2^{t*}$, and $w_3^{t*}v_3^{t*}$ for t, t+1,t+2, and t+3 the optimal dynamic solution, although σ_2^t is assumed to be zero, therefore the time series data are used for 3 years (t, t+1,+2).

4.2 Scale parameter S of production function

Now, in order to solve this system of simultaneous equations, the parameters of the production function need to be set. Actually, the only predetermined parameter required in Equation 11 is $\frac{\alpha_1+\alpha_2+\alpha_3-1}{-\alpha_4}$. Instead of giving the value of $\frac{\alpha_1+\alpha_2+\alpha_3-1}{-\alpha_4}$, it is sufficient to give the returns to scale (RTS) parameter $\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4$ which is named S, and value of α_4.

In this study the value of RTS parameter S was calculated in a DEA (Data Envelopment Analysis) framework using a variation of the piecewise homogeneous constant elasticity substitution-transformation (CES-CET) model by Boussemart, Briec, Peypoch and Tavéra (2009) and Boussemart, Briec, Leleu, and Ravelojaona (2019). DEA is a technique based on mathematical programming for the evaluation of the efficiency of a set of homogeneous Decision-Making Units, each of which consists of multiple inputs and multiple outputs. The typical approach began with the CCR (Charnes, Cooper and Rhodes (1978)) method, and BCC (Banker, Charnes and Cooper (1984)) method. These nonparametric models were based upon a convexity assumption and a dual representation of the production technology using the profit function. Boussemart et al. (2009)[7] proposed a nonparametric estimation approach of calculate the value of α-returns to

[7] Refer to Boussemart et al. (2009) for the detail review and the methodological foundation of the piecewise homogeneous constant elasticity substitution-transformation (CES-CET) model.

scale of CES-CET production function by connecting α -returns to scale to the frameworks of the distance functions and productivity indexes. Boussemart et al. (2019) actually estimated the value α -returns to scale of U.S. industries in recent years. At this time, a time series of RTS parameter S were obtained by calculating one RTS value for each company using data for 10 years from the current year, the previous four years, and the following five years.

For the value of parameter α_4, since there is no effective method for specifying α_4, in this estimation as well, sensitivity analysis was performed using the small value 0.5 and the large value 0.9 that α_4 can take within the range where $\frac{\alpha_1+\alpha_2+\alpha_3-1}{-\alpha_4} > 0$.

4.3 Capital rewards and rents

After we find the optimal γ^t, σ_1^t and σ_3^t from equation 11, the total rent would be calculated as the sum of $-\gamma^t p^t y^t$, $\sigma_1^t w_1^t v_1^t$ and $\sigma_3^t w_3^t v_3^t$ in case that the value of RTS parameter S equals one. However, the total rent would be proper to be obtained by subtracting $\frac{r^{t+1}}{1+r^{t+1}} \cdot K^t$ (i.e. the net present value in t period of capital reward of t+1 period in case that capital markets are perfectly competitive[8]) from net income of the accounting data, because the values S are not usually just one. This rent was divided into monopoly rent and monopsony rent according to the ratios of monopoly rent and monopsony rent that were calculated from equation 11.

[8] Fuller (2013) explains the dispute about the interpretation of Keynes's theory of investment. There, too, it is generally assumed that competing investors enter the market and bid the same price as other investment opportunities (i.e. the interest rate).

5 Data

The main purpose of this analysis is to estimate the amount of monopsony surcharge for large corporations in Japan as financial resource for SDGs. The companies targeted for analysis are Japanese listed and unlisted securities report submission general business companies, 5,581[9] included in the financial Nikkei Needs Financial Quest. The period of the time series is from 1980 to 2022 for 43 years. These corporations were classified into 29 industries according to Tokyo Stock Exchange industry classification. Each variable in the model is assigned the following financial data accounts: the output value ($p^t y^t$) is the total sales, and the four production factors, $w_1^t v_1^t$, $w_2^t v_2^t$, $w_3^t v_3^t$ *and* K^t are operating expenses, non-operating expenses plus extraordinary losses, corporate taxes, and total assets.[10] The unit price of investment (Q) was set as one for every year.

Data source on discount rates are the average long-term loan contract interest rate by Bank of Japan for each year.

6 Result

First the estimation results for the RTS parameter S of the production function are as follows. Table 1 shows the average values for each industry for the estimated values of S obtained using method of Boussemart et al. (2019). It can be seen that the range of RTS is between 1 and 1.1 for all industries. What should be noted is that RTS of manufacturing industries are higher than material, transportation and service industries.

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[9] According to *Company sample survey* by the National Tax Agency the number of corporations in Japan in 2019 was 2,758,420, the majority of which appear to be stock companies.

[10] In order to solve the linear programming problem, we performed the following processing on the financial data of each company. If net income was negative, the amount was subtracted from the capital stock and adjusted so that net income was zero. If the input was less than or equal to zero, that item was set as 1, and the added value was subtracted from the other items.

Table 1. RTS parameter S by Industry

	Industry	Number of Samples	Average RTS		Industry	Number of Samples	Average RTS
1	Agriculture, forestry and fisheries	16	1.0038	16	Electrical equipment	396	**1.0560**
2	Mining	16	1.0050	17	Transportation equipment	140	**1.0421**
3	Construction industry	322	1.0287	18	Precision machinery	71	**1.0561**
4	Groceries	195	1.0134	19	Other products	156	1.0254
5	Fiber products	100	1.0302	20	Electricity and gas industry	30	1.0038
6	Pulp paper	45	1.0274	21	Land transportation business	85	1.0193
7	Chemistry	292	1.0319	22	Shipping industry	29	1.0218
8	Pharmaceuticals	95	1.0223	23	Air transport business	10	1.0238
9	Petroleum coal products	19	**1.0394**	24	Warehouse transportation related industry	52	**1.0339**
10	Rubber product	22	1.0328	25	Information and communication industry	727	1.0264
11	Glass clay products	91	**1.0481**	26	Wholesale	498	1.0207
12	Steel	78	**1.0998**	27	Retail industry	597	1.0082
13	Nonferrous metals	60	**1.0625**	28	Real estate business	242	1.0281
14	Metal products	128	**1.0598**	29	Service industry	732	1.0161
15	Machine	337	**1.0709**		Total / Average	5581	1.0330

Note: Values higher than the average are marked in bold.

Figure 2. shows the time trends in the total amount of corporate tax paid by 5,581 companies and the total amount of monopsony rents by these corporations. Before the 1990s, monopsony rents and monopoly rent were almost negligible from a macro perspective, though since the 2000s, combined with the decline in interest rates, they have surged. In the 2010s, both of them exceeded corporate income tax revenue for certain years. The sharp decline occurred during the economic downturn caused by the Lehman Shock and the pandemic of COVID-19. The highest ever amount of monopsony rents were 19,466.4 billion yen (US$176.3 billion) in 2018 when α_4 is 0.9. In case that α_4 is 0.5, it is 19,438.0 billion yen in 2018[11]. This exceeds the 14,627.9 billion yen (US$132.5 billion) in corporate income tax revenue paid by these corporations in that year.

[11] In all subsequent results, they are not significantly different when the results of α_4 was 0.5 and when it was 0.9, therefore the results for the case where α_4 was 0.5 was omitted.

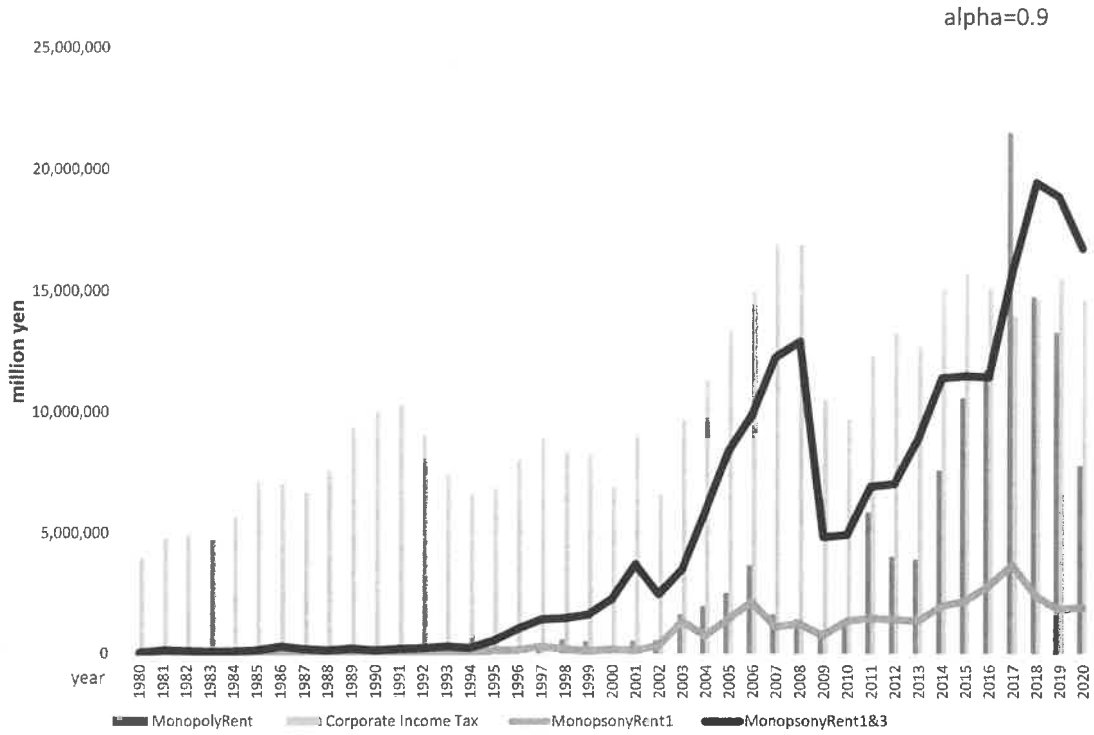

Figure 2. Time Trend of Amount of Monopsony Rents, Monopoly Rents and Corporation Income Tax

Note: The blackest line shows the sum of monopsony rents 1 and 3.

The average value of monopsony rent among 2010s is10,098.4 billion yen, which is a significant amount as a financial source for SDGs. Monopoly rents also increased rapidly in the 2010s, a little later than the period when monopsony rents increased, and in 2017 it reached the highest amount of 21,497.8 billion yen.

Figure 3. shows the time trend of the average monopoly and monopsony rent rates and average corporative income tax rate. The sum of the corporative income tax and the monopsony rents, has consistently remained around 50% from 1980 to around 2020, meantime the corporate income tax rate has declined from around 44.7% to less than 27.9%. Although, since then it appears that there had been an upward swing in the rent rates because the marginal efficiency of capital was extremely low due to the deepening

of the quantitative monetary easing policy under 'Abenomics'. The overall trend is similar to the trend of US S&P 500 registered companies shown by Shimamoto (2023).

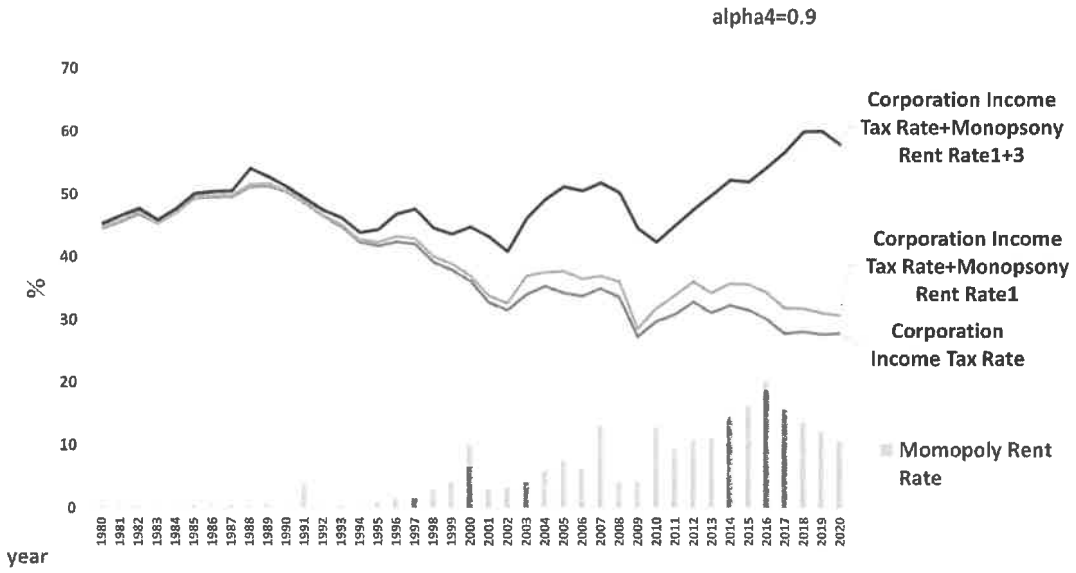

Figure 3. Average Monopsony & Monopoly Rent Rates, Average Corporate Tax Rate
Note: From the bottom, the black lines show the accumulated rates of monopsony rent 1, monopsony rent 3, and corporate tax revenue. The bar graph shows monopoly rent.

Collecting monopsony rent surcharge, it is important to check how much tax revenue can be obtained by targeting companies with annual sales. Table 2 categorizes 5,581 companies by annual sales size and lists the total amount of rent and corporate tax for each category. According to this, it can be seen that the monopsony rent by companies with annual sales of 100 billion yen or more accounts for 84% of the total monopsony rent of 5,581 companies, making up the majority of the total rent.

Table 2. Total rents and corporate income tax in 2020 by annual sales size of 5,581 companies

alpha4=0.9

annual sale / more than	unit	Total	10 tril yen	1 tril yen	100bil yen	10bil yen	1 bil yen	100 mil yen
Monopoly Rent	mil yen	7,786,739	1,453,612	2,997,396	2,555,647	697,157	82,241	684
	%	100.0	18.7	38.5	32.8	9.0	1.1	0.0
Monopsony Rents	mil yen	16,737,717	1,484,742	5,762,013	6,867,560	2,388,451	232,208	2,743
	%	100.0	8.9	34.4	41.0	14.3	1.4	0.0
Corporate IncomeTax	mil yen	14,617,659	1,185,158	6,303,026	5,062,400	1,882,359	182,903	1,813
	%	100.0	8.1	43.1	34.6	12.9	1.3	0.0

note: Annual sales size is evaluated by the average value of time series of PY for each firm.

Table 3. Rent rates / tax rate industry ranking

alpha4 =0.9	year's	Monopoly Rent / Total Income					Monopsony Rent 1/ Total Income					Monopsony Rent3 / Total Income					Corporate Tax Rate				
Industry	sample/ year's	Ave	80	90	0	10	Ave	80	90	0	10	Ave	80	90	0	10	Ave	80	90	0	10
1	16	17	10	**26**	**27**	22	**26**	21	16	**25**	23	**5**	13	**3**	21	9	8	24	13	**3**	**4**
2	16	**2**	**4**	10	13	**1**	9	17	17	**4**	19	19	**1**	8	6	21	17	22	**25**	20	19
3	322	7	**25**	**3**	**2**	16	16	24	23	8	**4**	10	**26**	17	**4**	7	**2**	**2**	**1**	16	8
4	195	22	7	17	23	21	11	8	7	19	**5**	13	9	10	17	12	**5**	12	6	**4**	**3**
5	100	**27**	17	14	20	**26**	23	15	21	12	24	**27**	20	21	**27**	**28**	23	**25**	**26**	**28**	22
6	45	**28**	16	16	**28**	24	**27**	14	19	**27**	21	**26**	22	**26**	**26**	**26**	10	19	19	9	9
7	292	12	23	15	18	12	14	18	15	11	16	9	**2**	15	14	**5**	9	15	9	10	12
8	95	**3**	13	7	**5**	**2**	**4**	9	**4**	**5**	**1**	6	12	7	**1**	18	**25**	**1**	**2**	19	**29**
9	19	16	9	22	22	19	**29**	**28**	**26**	23	**28**	18	24	22	7	17	20	23	17	12	20
10	22	23	**27**	**27**	11	18	18	**26**	8	21	8	17	**4**	19	24	**1**	14	**26**	10	22	10
11	91	24	18	23	**25**	17	22	**27**	24	22	10	**25**	19	18	**25**	15	13	14	18	23	17
12	78	21	14	**25**	12	14	**25**	**5**	**28**	20	**26**	21	18	23	12	20	**26**	**28**	**27**	24	23
13	60	20	24	18	21	11	7	10	**27**	**2**	9	16	**25**	24	13	24	22	**27**	23	**26**	**27**
14	128	14	20	19	19	9	17	19	22	13	18	20	16	14	22	16	12	9	12	21	15
15	337	10	**3**	**2**	16	8	8	11	12	9	14	15	14	13	11	8	18	21	22	18	18
16	396	**5**	11	**1**	7	6	10	**3**	10	10	13	14	6	**5**	15	23	21	16	21	**25**	**26**
17	140	13	15	21	9	**4**	20	23	20	15	22	22	23	16	16	10	11	17	16	13	13
18	71	11	**2**	11	10	10	**5**	13	11	7	**2**	11	21	9	8	11	24	18	20	**27**	24
19	156	9	8	**5**	15	15	13	7	9	17	**25**	7	**5**	12	18	19	15	13	11	17	14
20	30	18	**26**	**28**	**29**	**25**	**28**	20	**25**	**29**	**29**	24	17	**28**	23	**25**	6	6	**4**	7	11
21	85	**25**	**28**	24	**26**	**27**	19	**25**	**29**	24	6	23	**27**	**25**	**28**	14	**1**	8	**3**	**1**	**2**
22	29	**29**	6	12	8	**29**	24	**4**	18	**26**	20	**28**	10	**27**	9	**27**	**28**	**29**	**29**	14	**28**
23	10	**1**	29	29	**1**	**3**	21	**29**	**1**	**28**	**27**	**29**	**29**	**29**	**29**	**29**	**29**	20	**28**	**29**	**25**
24	52	**26**	12	20	24	28	12	22	13	16	17	8	**28**	20	19	6	**3**	11	7	**2**	**1**
25	727	**4**	**1**	**4**	**4**	**5**	**2**	**2**	**3**	**3**	**3**	**2**	**3**	**1**	**2**	**4**	**27**	**5**	24	15	21
26	498	19	21	13	14	20	15	16	14	18	15	12	15	11	20	13	**4**	**3**	**5**	**5**	**5**
27	597	15	19	8	17	23	6	6	**5**	14	11	**4**	11	6	10	22	7	**4**	8	6	6
28	242	8	22	9	**3**	7	**1**	12	6	**1**	12	**3**	7	**4**	**5**	**2**	16	10	15	8	16
29	732	6	**5**	6	6	13	3	1	2	6	7	**1**	8	**2**	**3**	**3**	19	7	14	11	7

note: Ranks 1-5 are highlighted with a box and bold text, and ranks 25-29 are highlighted with bold text only.

Table 3 is used to understand the differences in monopsony rent rates estimated here

between industries. The industries have been ranked based on the highest rent rates and corporate tax rates every 10 years since 1980s. When the rent rates of each industry were evaluated by the number of periods in which it was ranked 5th or higher or 25th or lower, Information and communications, pharmaceutical, real estate, and service industries, especially information and communications industry, have been higher monopsony rent rates than other industries in all periods. On the other hand, the monopsony rent rates have been lower in paper and pulp, electricity and gas, and land transportation industries than in others. The result is that the monopsony rent rates are low in the materials industries, and they are high in intellectual-intensive industries and service industries.

This result is sure to make sense to those who observe those industries. On the other hand, in terms of collecting surcharges in the name of internalizing external diseconomies to the environment and human rights in the process of resource and energy extraction, the system of collecting more surcharges from indirectly related industries than from material industries that are closer to the direct extraction site may seem unreasonable at first glance. However, it is recognized internationally that the process by which resources and energy are extracted from ecosystems and released as waste cannot be controlled quantitatively or qualitatively, causing various global environmental problems such as climate change and deforestation. It can also be seen that such external diseconomy has resulted in materials being traded at excessively low prices under a monopsonic market structure. It can be interpreted that as a result of such low prices formation, downstream industries get higher monopsony rent rates. If the responsibility for controlling external diseconomies were placed solely on industries directly involved in resource extraction or trading in materials, material prices would rise dramatically, potentially pushing the entire economy into stagflation. This is similar to the situation in which it is difficult to raise the

environmental tax rate on emissions in an unequal society.

7 Conclusions and remarks

This study presented the position of monopsony rent surcharge based on ecological economics, and examined. Based on this perspective of ecological economics, environmental problems occur in an entrance and an exit of economic sub-system from /to ecology. Although environmental tax and emission trading are measures targeting emission in the exit, monopsony rent surcharge focuses on the resource intake at entrance. Three types of elements, resource rent, externalities at mining or extraction stage and monopsony in resource and labor markets consist of the source of monopsony rent at entrance of economic sub-system. The rent that has not been paid to the entity to which it should originally attributes should be collected and used as a public revenue source for the SDGs.

As the estimating method of amount of monopsony rent for large companies in Japan updated version of dynamic pseudo-equilibrium model in Shimamoto (2023) was used. The appropriateness to use this estimating method was shown especially by testifying the validity of assumption with comparison with orthodox econometric approaches.

The method was compared with markup and markdown estimating method by the series of Hall (1988) and that of Roeger (1995). In the series of Hall's method at least one input is need to be free of adjustment costs which is actually the material input, although the functional form is translog type which include and not limited to Cobb-Douglas type. In the series of Roeger's method the production technology must be limited to constant returns to scale. The dynamic pseudo-equilibrium approach is nonparametric estimating method using mathematical programing in which the estimated values are not test

statistics and functional form is limited to Cobb-Douglas type. On the other hand, the assumption of free of adjustment is not necessary for all input variables, and the returns to scale is not limited to one.

Based on these analyses, monopsony rents of 5,581 Japanese companies were estimated by dynamic pseudo-competitive equilibrium model in Shimamoto (2023) and verified the specific impact as financial resources.

From table 1 of the estimated values of RTS, RTS of manufacturing industries are higher than ones of material, transportation and service industries.

Figure 2 shows the time trend of the amount of monopsony rents, and corporation income tax. Before the 1990s, monopsony rents and monopoly rent were almost negligible from a macro perspective, though since the 2000s, combined with the decline in interest rates, they have surged. The highest ever amount of monopsony rents were 19,466.4 billion yen (US$176.3 billion) in 2018 when α^4 is 0.9. The average value of monopsony rent among 2010s is10,098.4 billion yen which is a significant amount as a financial source for SDGs. Figure 3 shows the time trend of the rates of these values occupying profit before tax. The sum of the corporate income tax rate and the monopsony rent rate, has consistently remained around 50% from 1980 to 2020, meantime the corporate income tax rate has declined from around 44.7% to less than 27.9%. The overall trend is similar to the trend of US S&P 500 registered companies shown by Shimamoto (2023). Among them it can be seen that the monopsony rent by companies with annual sales of 100 billion yen or more accounts for 84% of the total monopsony rent of 5,581 companies, making up the majority of the total rent from table 2.

Considering the difference of monopsony rent rates among industries, Table 3 shows that information and communications, pharmaceutical, real estate, and service industries,

especially information and communications industry, have been higher monopsony rent rates than other industries in all periods. On the other hand, those rates have been lower in paper and pulp, electricity and gas, and land transportation industries than in others. The result is that the monopsony rent rates are low in the materials industries, and they are high in intellectual-intensive industries and service industries. It can be regarded to be resulted from materials being traded at excessively low prices under a monopsonic market structure. It can be interpreted that as a result of such low prices formation, downstream industries get higher monopsony rent rates. If the responsibility for controlling external diseconomies were placed solely on industries directly involved in resource extraction or trading in materials, as a principle, material prices would rise dramatically, potentially pushing the entire economy into stagflation. Therefore, monopsony rent surcharge for financing SDGs should be collected from all industries according to the amount of monopsony rent.

As a result of looking at the time-series trends of monopsony rent in the U. S. and Japan, we have found that the trends are similar. As far as the case of Japan, it is possible to meet considerable financial needs in terms of amount if it is used for SDGs finance. If the results will be similar for other developed countries, then by working together and introducing monopsony rent surcharge system, it would be possible to secure financial resources for the SDGs while we suppress capital flight.

The remaining question is whether it is possible to specifically add monopsony rent charges to corporate income taxes through mutual cooperation among developed countries. A promising approach would be to focus on the G20 + OECD, because the "G20 + OECD" regime has taken the initiative since 2012 to fight tax evasion, and finally reached the agreement on a minimum effective corporate tax rate of 15%, according to

Zhu (2016). Further analyses are necessary to find how a viable system can be created internationally.

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Monopsony Rent Surcharge for SDGs Financing: Case of Japan

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