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Examining the relationship between rent and political expenditure: Using rent information obtained from financial statements

By Mihoko SHIMAMOTO [†]

Abstract. This study aims to develop a standard method for measuring the rent of an individual enterprise from its financial statement data and to analyze the relationship between rents of companies and their political and R&D expenditures. This method will allow for the decomposition of various causes that yield rents by regression analyses. This study set the equation of the first-order condition of profit maximization as a function of the capital amount, satisfying both short-term and long-term optimal conditions, and obtained the mark-up rate that can realize the production level in monopolistic equilibrium as a competitive equilibrium. The average rents for 29 industries in Japan were calculated using a linear algebraic method from 30 years' time-series financial statement data. Moreover, this study also managed to substitute production factors for pseudo-production factors applicable to global companies whose breakdown of manufacturing and sales costs are usually not disclosed. These rents are regressed by political and R&D expenditures of each industry. In several models, political expenditure has a significant relationship with rent, although R&D expenditure does not.
Keywords. Rent, Political expenditure, Financial statement, R&D expenditure, Japanese industries.
JEL. D72, P16, D22, C61, M41.

1. Introduction

Free trade and free capital movement are considered more efficient. However, trade liberalization does not always improve efficiency, such as incases involving market failure. When free trade accompanies environmental deterioration, for example, if trade liberalization is done without internalizing environmental externality, there is a decline in social welfare. Nevertheless, the reduction of tariff and elimination of non-tariff barriers have been rapidly implemented under insufficient domestic environmental policies. A political scientist, Gilligan (1997), explained that changes in the political power balance between importing industries and exporting industries has caused the acceleration of free trade in the United States since before World War II. As Krueger (1974) asserted, if enterprises secure more rent through their political behavior, they will compete to access the political process. In fact, according to Drutman (2015), the total expenditure for lobbying in 2012 amounted to more than three billion dollars in the United States, and 78 percent of this consisted of business-related lobbying. If it is rational for enterprises to allocate some part of their rent to their political activity to get more rent, not only their economic variables but also their political behaviors should endogenize into an economic model.

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The purpose of this study is to construct a standard method to measure the rent of corporations and especially to analyze the relationship between their rent and political behavior. This is partly because rent can be an investment resource for their political behaviors like lobbying. It also examines the relationship between corporations' rent and their R&D investment, which is said to enhance profitability and yield Schumpeter rent in comparison.[1]

2. Objectives of the study

2.1. Rent and Political Expenditure

This paper provides a briefover view of political expenditure and rent measurement and demonstrates why the measurement of real rent for each company is important.

Until the 1960s, deadweight losses were considered social costs because of monopoly. Harberger (1954) and Schwartzman (1960) made quantitative estimations of deadweight losses. However, Tullock (1967) argued that not only deadweight loss but also the excess profit brought to companies because of entry barriers and tariffs (i.e., rent) are a social cost. Thereafter, many empirical studies of rent by governmental regulations have been conducted, as reviewed by Posner (1975). More recently, for example, Tarr (1994) calculated rent by the regulated price of bicycles and television before and after socialism in Poland. Salhofer, Hofreither, & Sinabell (2000) evaluated the rent for agricultural promotion measures in Austria. Jarvis (2005) regarded an increase in export earnings because of export quota to Brazilian coffee as rent. They have been estimated generally by measuring producer surplus at the industrial level and by aggregated variables. However, it is a rather rough basis for analyzing the relationship between companies and rents, and actual measures such as taxation and surrogacy for individual companies.

In another field, studies focusing on the impact on macroeconomic performances by rent-seeking activities have appeared. There is empirical evidence suggesting that rent-seeking or corruption among companies is negative for economic growth. For example, Mauro (1995) analyzed 68 countries using indicators of bureaucratic organization efficiency, corruption, judicial system efficiency, and political stability, and found that GDP is highlycorrelatedwith bureaucratic efficiency and low corruption. Cole & Chawdhry (2002) showed that rent-seeking activities have a negative impact on state economic growth through a panel data analysis of US states. However, empirical studieshave also suggested that rent-seeking or corruption has positive effectson economic growth. Khan & Sundaram (2000) sometimes found a positive relationship between rent seeking and economic development in several Asian countries in their case studies. Ayyagari, Demirgüç-Kunt, & Maksimovic (2014) concluded that innovating firms are more likely to pay bribes to government officials than firms that do not innovate by the data of World Bank Enterprise Surveys.

Depending on countries, industries, and periods, a simple result about the relationship between rent and growth cannot be concluded; however, it can be asserted that more specific data and indicators can yield more precise results. Drutman (2015) conducted a comprehensive analysis of corporate political expenditure in the United States. Drutman conducted an empirical analysis of what kind of variable the size of the lobbying of companies correlates to. It should be noted that the size of lobbying has a significant positive correlation with a company's sales value and does not have a significant relationship with the company's profit.

If the rent amount of each company can be precisely specified, it will be possible tofind more direct and quantitative results of the relationship between rent and corporate political expenditure. Furthermore, multivariate regression analyses of rent amounts with various variables will enable the decomposition of causes yielding rents. Subsequently, it may be possible, for example, to find a proper corporate tax rate or the government may find appropriate support measures for improving productivity of firms.

This study developed a method to identify the rent of each company and to directly analyze the relationship between rent and political expenditure. This will make it easier and clearer to analyze the relationship between corporate political activities and the economy.

2.2. Monopoly and Monopsony Rent

In this study, a method to measure monopoly and monopsony rent will be applied as the method for measuring the inclusive rent of an enterprise using financial statements of enterprises. Section 3 will explain this further. This section discusses the review and scope of monopoly and monopsony rent.

To measure the amount of monopoly and monopsony rent, the measurement of the degree of monopoly and monopsony is useful. Once the degree of monopoly is obtained, the amount of monopoly rent is calculated from monopoly price and quantity in the equilibrium. Let us follow the process of the progress of the degree of monopoly and monopsony.

Since the 1970s, studies applying the new empirical industrial organization (NEIO) method have been conducted. This method measures the degree of monopoly and monopsony on an industrial level. Under this method, the general necessary profit-maximization condition for a monopolistic firm is considered to be

$$\mathrm{p}\left(1+\frac{1}{\delta}\right) = MC \tag{1}$$

where p is the demand price of the product (and is a function of y, the quantity of the product demanded at the industrial level), MC is the marginal cost of production, and δ is the elasticity of demand with respect to the product price, defined by

$$\delta = \frac{\partial y}{\partial p} \Big/ \frac{y}{p} \tag{2}$$

In the case of oligopoly, the necessary condition for the i^{th} firm is

$$\mathrm{p}\left(1+\frac{\theta}{\delta}\right) = MC_i \tag{3}$$

where MC_i is the marginal cost faced by the i^{th} firm, and θ is the conjectural elasticity of total industry output with respect to the output of the i^{th} firm, defined by

$$\theta = \frac{\partial y}{\partial y_i} \Big/ \frac{y}{y_i} \tag{4}$$

where y_i is the quantity produced by the i^{th} firm, and $\mathrm{y} = \sum_i^N y_i$.

In the monopoly model, if δ equals zero, then the product market is competitive; thus, the null hypothesis to test is δ=0. In the oligopoly model, the focus is on the conjectural elasticity, θ. If θ equals zero, a supply increase by the i^{th} firm has no effect on the total industry-wide amount of the product produced; thus, the market can be seen as competitive. When θ equals 1, the market is a complete monopoly for the i^{th} firm. The NEIO approach is generally used to estimate conjectural elasticity in oligopoly models: that is, the degree of oligopoly.

The pioneering works in this field are Iwata (1974) and Gollop & Roberts (1979), with the empirical study of Appelbaum (1982) providing the standard for modelling. This approach uses an equation system consisting of an inverse demand function for the product, the (shadow) profit-maximization condition of the behavioral profit function, and the input demand functions developed by estimating a generalized Leontief cost function to obtain a value of θ. Subsequently, a considerable body of empirical analysis using this technique has appeared.

The source of the excess profits earned under oligopoly is considered to be a discrepancy between market prices and the marginal revenues of the oligopolistic firms. This can be estimated by multiplying the inverse price elasticity of demand for the product by the conjectural elasticity. Similarly, the differences between the marginal factor cost and market price of the factor give the firm's excess profit, which can be estimated on the basis of the inverse price elasticity of factor supply multiplied by the conjectural elasticity.

Empirical studies seeking to estimate the degree of oligopsony/monopsony in the factor market using simultaneous equation systems have been undertaken since the late 1980s.

In the late 1980s, Schroeter (1988) and Azzam & Pagoulatos (1990) analyzed the degree of oligopoly and oligopsony simultaneously by applying the Appelbaum (1982) technique to not only the output market but also the input market; thus, the simultaneous equation system also included an inverse input supply function. In recent years, many additional studies in this vein have emerged, such as Bouras & Engle (2007) and Mei & Sun (2008). Atkinson & Kerkvliet (1989) simultaneously analyzed monopoly and monopsony pricing of electric utility companies.

Furthermore, in the 1990s, there were models that estimated only the degree of oligopsony, such as Murray (1995), Bergman & Bräunland (1995), and Ronnila & Toppinen (2000). In these models, an inverse input supply function was used to replace the inverse product demand function in the simultaneous equation system developed by Appelbaum (1982). These models were set in the oligopsonistic industrial structure of the forest product processing industry.

One key constraint of most empirical models of the degree of oligopoly/oligopsony is that they have been constructed by considering only the short-term optimal behavior of firms in the oligopolistic/oligopsonistic market using time-series data. Several researchers have sought to improve upon this from a dynamic point of view. For example, regarding the issue of time-series data, Aiginger, Brandner, & Wüger (1995) focused on the non-stationarity of time-series data, specifying simultaneous equations to remove the effects of autocorrelation. To consider a long-term equilibrium condition, Bernstein (1992) simultaneously examined the degree of monopoly and monopsony but focused on not only the static equilibrium but also the long-term equilibrium condition. Such a long-term perspective is key, because real joint-stock corporations usually aim to maximize capital investment across every accounting period rather than seek short-term profit maximization, as in the static analysis of economic theory. Although pioneering, the complicated equilibrium conditions in Bernstein (1992) included some omitted forms of capital adjustment costs, which were proportional to the square of the change in capital stock. Both approaches tried to smooth out changes in the degree of monopoly over time. In the dynamic real-world activities of corporations, however, the degree of monopoly/monopsony itself may fluctuate over time. Thus, an approach that can capture these dynamic movements would be more desirable.

One more issue is data limitations that pose an essential problem for estimating the degree of monopoly and that have constrained empirical modelling. The estimation requires quantity and price data for both products and production inputs; it is difficult to gather such data for individual companies as a time series, because revenue and cost items in corporate financial statements typically include only the total amount-that is, prices multiplied by quantities. Appelbaum (1982) assumed a form for individual firms' cost functions that made it possible to aggregate the cost functions over firms; then, she estimated the degree of oligopoly at the industry level. Most subsequent studies have followed this technique. Furthermore, even at an industry level, it is difficult to obtain quantity data for labor and energy inputs, which are used widely in many kinds of industries and production processes. Muth & Wohlgenant (1999) developed a model for estimating the degree of oligopoly that did not require quantity data for labor or energy inputs and required only price data. However, generally, in most empirical studies in the field, proxy variables are used.

In this study, the above two points are managed as follows. Dynamic modelling is necessary for tracking fluctuations in the degree of oligopoly/oligopsony. As such, this study follows Bernstein's dynamic equilibrium method, which maximizes the sum of the discounted present value of profits at discrete times. If we solved an equation of the long-term optimizing condition using linear algebra, not regression, we would have the degree of monopoly and monopsony in each period. When we seek to obtain three degrees of monopoly and monopsony, and scale variables, solving the equation requires data for just five terms. If we change the time-series data by one term and repeatedly calculate the degree of monopoly/monopsony, we can monitor any trends. To escape solving quadratic equations and having imaginary number solutions, this study will suggest a simple solving method using linear equations to secure real number solutions.

This empirical application is based on data from the financial statements of individual companies. The equation for the dynamic maximization of profits based on Cobb–Douglas production technology includes only total amount variables, so price and quantity data for the product and the inputs are not necessary. This method can be used to analyze either an individual firm or an industrial sector, with no concerns regarding data availability in the former case.

3. Model

3.1. Short-Term Equilibrium Condition

This study begins by considering a case in which producers simultaneously face monopolistic product markets and monopsonistic ones. They maximize short-term profits and have a long-term equilibrium. The following analysis lays out the conditions for these two kinds of optimization.

First, the short-term optimizing conditions will be considered. Assume a producer uses a general Cobb–Douglas production technology to produce one product using four production factors: capital, labor, material inputs, and other input factors (e.g., transportation and energy costs). This function is denoted by

$$y = \alpha_5 v_1^{\alpha 1} v_2^{\alpha 2} v_3^{\alpha 3} K^{\alpha 4} \tag{5}$$

where y is the output quantity, v_1 is the quantity of labor input, v_2 is the quantity of material inputs, v_3 is the quantity of other inputs, and K is the quantity of capital. In the short-term equilibrium, K is a given value, and $\alpha_1 + \alpha_2 + \alpha_3 < 1$, which secures convexity of the marginal costs function.

As the producer simultaneously faces monopolistic product markets and monopsonistic ones, the short-run profit maximization problem is given by

$$\max \pi_m = p(y) \cdot y - w_1(v_1) \cdot v_1 - w_2(v_2) \cdot v_2 - w_3(v_3) \cdot v_3 - rK \text{ s.t.} \tag{6}$$

The optimal conditions come from differentiating the Lagrange equation by the variable factors $v_1, v_2,$ and v_3. These are given as

$$\{p'(y) \cdot y + p(y)\} \cdot f'_{v_i} = \{w'_i(v_i) \cdot v_i + w_i(v_i)\}, \qquad \text{i =1, 2, 3.} \tag{6}$$

where $\{p'(y) \cdot y + p(y)\}$ indicates the marginal revenue, which can also be expressed as (1+γ)·p(y), where γ is the inverse demand elasticity. We now introduce the popular assumption that γ is constant-that is, it does not depend on the value of y. p_m(y) can be defined by

$$p_m(y) = \{p'(y) \cdot y + p(y)\} = (1+\gamma) \cdot p(y) \tag{7}$$

$\{w_i^{'}(v_i) \cdot v_i + w_i(v_i)\}$ in turn indicates the marginal factor costs, which can be expressed as $(1+\sigma_i) \cdot w_i$, where σ_i is the inverse factor supply elasticity and is now supposed to be constant regardless of the value of v_i. In the same way, $w_{im}(v_i)$ can be defined by

$$w_{im}(v_i) = \{w_i^{'}(v_i) \cdot v_i + w_i(v_i)\} = (1+\sigma_i) \cdot w_i(v_i), \quad i=1, 2, 3 \tag{8}$$

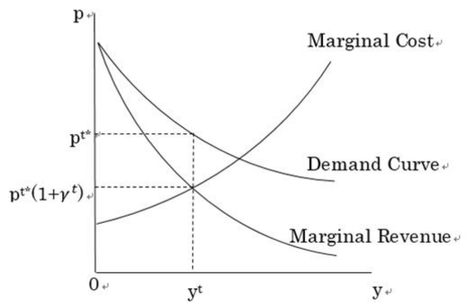
The short-run optimization conditions in the monopoly and monopsony markets can be expressed by arranging eqs. (6), (7), and (8) as follows.

$$y = \alpha_5 \cdot \left(\frac{w_{1m}^{1-\alpha 2-\alpha 3} \cdot w_{2m}^{\alpha 2} \cdot w_{3m}^{\alpha 3}}{\alpha 5 \cdot \alpha 1^{1-\alpha 2-\alpha 3} \cdot \alpha 2^{\alpha 2} \cdot \alpha 3^{\alpha 3} \cdot p_m K^{\alpha 4}}\right)^{\frac{\alpha 1}{\alpha 1+\alpha 2+\alpha 3-1}} \cdot \left(\frac{w_{1m}^{\alpha 1} \cdot w_{2m}^{1-\alpha 1-\alpha 3} \cdot w_{3m}^{\alpha 3}}{\alpha 5 \cdot \alpha 1^{1} \cdot \alpha 2^{1-\alpha 1-\alpha 3} \cdot \alpha 3^{\alpha 3} \cdot p_m K^{\alpha 4}}\right)^{\frac{\alpha 2}{\alpha 1+\alpha 2+\alpha 3-1}} \cdot \left(\frac{w_{1m}^{\alpha 1} \cdot w_{2m}^{\alpha 2} \cdot w_{3m}^{1-\alpha 1-\alpha 2}}{\alpha 5 \cdot \alpha 1^{1} \cdot \alpha 2^{\alpha 2} \cdot \alpha 3^{1-\alpha 1-\alpha 2} \cdot p_m K^{\alpha 4}}\right)^{\frac{\alpha 3}{\alpha 1+\alpha 2+\alpha 3-1}} \cdot K^{\alpha 4} \tag{9}$$

$$v_i = \alpha_5 \cdot \left(\frac{w_{im}^{1-\alpha j-\alpha k} \cdot w_{jm}^{\alpha j} \cdot w_{km}^{\alpha k}}{\alpha 5 \cdot \alpha i^{1-\alpha j-\alpha k} \cdot \alpha j^{\alpha j} \cdot \alpha k^{\alpha k} \cdot p_m K^{\alpha 4}}\right)^{\frac{1}{\alpha 1+\alpha 2+\alpha 3-1}}, \quad i, j, k=1,2,3\ (i \neq j \neq k) \tag{10}$$

It is important to note that these equations are not normal supply and factor demand functions: p_m(y) and $w_{im}(v_i)$ are endogenous variables and differ fromexogenous prices of a product and factors. The variable p depends on y through an inverse product demand function, and w_i depends on v_i (i =1, 2, 3) through inverse supply functions of production factors. Both y in the supply equation and v_i in the factor demand equations also depend on p_m(y) and $w_{im}(v_i)$, respectively, considering (9) and (10). This interdependence makes it difficult to find an optimal point and to formulate an empirical model.

To facilitate these calculations, we can utilize the relationship between imperfect competition models and perfect competition models. Nowy^{t*} indicates the short-term optimum production level, and p^{t*} is the equilibrium price in this imperfect competition model, as described in Graph1. A superscript t indicates a value in the *t* period.

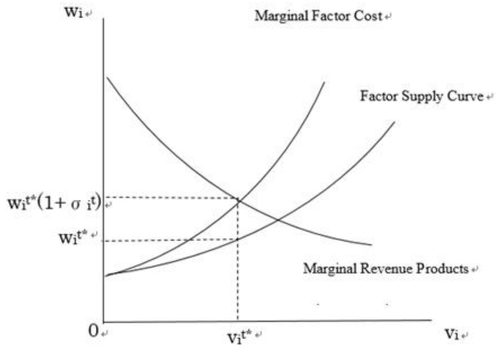


Graph 1. *Imperfect Competition and perfect Competition in the Products*

Under the same production technology and the same given value of K^t, $p^{t*}(1+\gamma^t)$ is defined as a given market price with constant $p^{t*}$and γ^t in a perfect competition. Subsequently, theybring the same production level y^{t*}as the short-term competitive equilibrium value. Further, γ^t is just the degree of monopoly in this imperfect competition model in the optimal point.

We can consider the production factor markets in the same manner. In this model, the producer is a monopsonist in the factor markets. Further, $v_1^{t*}, v_2^{t*}, v_3^{t*}$

are the short-term optimal factor quantities, and $w_1^{t*}, w_2^{t*}, w_3^{t*}$ are the equilibrium prices in this monopsonic equilibrium, as described in Graph 2.



Graph 2. *Imperfect Competition and perfect Competition in the Factor Market*

Under the same production technology and the same given value of K^t, $w_1^{t*}(1+\sigma_1^t), w_2^{t*}(1+\sigma_2^t), w_3^{t*}(1+\sigma_3^t)$ are defined as the market price with constant $w_1^{t*}, w_2^{t*}, w_3^{t*}, \sigma_1^t, \sigma_2^t, and\ \sigma_3^t$, which bring the short-term equilibrium factor quantities $v_1^{t*}, v_2^{t*}, v_3^{t*}$ in a perfect competition. We can then get the mark-up rates of $\sigma_1^t, \sigma_2^t, \sigma_3^t$, which satisfy the condition where $w_1^{t*}v_1^{t*}, w_2^{t*}v_2^{t*}$, $w_3^{t*}v_3^{t*}$ are the costs for each realized by profit maximization in the imperfect competition in the t period.

Therefore, in consideration of the long-term equilibrium conditions, the supply equation (9) and factor demand equations (10) can be regarded as supply function and factor demand functions under the given K^t,$p^{t*}(1+\gamma^t)\ and\ w_i^{t*}(1+\sigma_i^t)$, which satisfy the short-term equilibrium conditions in the perfect competitive model.

3.2. Long-Term Equilibrium Condition

Long-term equilibrium conditions are derived from the problem of maximizing the time-series total of the discounted present value of profits defined by the short-term pseudo-competitive equilibrium model minus capital costs. By solving these long-term pseudo-competitive profit maximization conditions, we can find optimal$\gamma^t, \sigma_1^t, \sigma_2^t, and\ \sigma_3^t$ 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 each four periods the optimal dynamic solution.These past data can then be regarded as results that have satisfied both the short-term and long-term equilibrium conditions. At the same time, we can get the rent ratio, γ^t and σ_i^t, which are the proportion of rent to a product price and factor prices.

Now, let us formulate the long-term pseudo-competitive profit maximization. It is maximized for discrete time periods from 1 to T. The pseudo-competitive profit function in period t is defined as follows.

$$\begin{aligned}\pi^t = {} & p^{t*}(1+\gamma^t)\cdot y^t(p^{t*}(1+\gamma^t), w_1^{t*}(1+\sigma_1^t), w_2^{t*}(1+\sigma_2^t), w_3^{t*}(1+\sigma_3^t), K^t) \\ & - w_1^{t*}(1+\sigma_1^t)\cdot {v_1}^t(p^{t*}(1+\gamma^t), w_1^{t*}(1+\sigma_1^t), w_2^{t*}(1+\sigma_2^t), w_3^{t*}(1+\sigma_3^t), K^t) \\ & - w_2^{t*}(1+\sigma_2^t)\cdot {v_2}^t(p^{t*}(1+\gamma^t), w_1^{t*}(1+\sigma_1^t), w_2^{t*}(1+\sigma_2^t), w_3^{t*}(1+\sigma_3^t), K^t) \\ & - w_3^{t*}(1+\sigma_3^t)\cdot {v_3}^t(p^{t*}(1+\gamma^t), w_1^{t*}(1+\sigma_1^t), w_2^{t*}(1+\sigma_2^t), w_3^{t*}(1+\sigma_3^t), K^t) \\ & - Q^t\cdot I^t(K^{t-1}, K^t, \delta^t) \qquad (11)\end{aligned}$$

Where $y^t(\cdot)\ and\ {v_i}^t(\cdot)$ are eqs. (9) and (10), and $\gamma^t, \sigma_1^t, \sigma_2^t, and\ \sigma_3^t$ are assumed to change over time. Investment in period t, $I^t(K^{t-1}, K^t, \delta^t)$ is defined as follows.

$$I^t(K^{t-1}, K^t, \delta^t) = K^t - (1-\delta^t)\cdot K^{t-1} \qquad (12)$$

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.

$$\begin{aligned}\max_{K^t} \Pi &= \pi^1\{p^{1*}(1+\gamma^1), w_1^{1*}(1+\sigma_1^1), w_2^{1*}(1+\sigma_2^1), w_3^{1*}(1+\sigma_3^1), K^1, K^0, \delta^1\} \\ &\quad + \sum_{t=2}^{T}\prod_{s=2}^{t}\frac{1}{(1+r^s)}\pi^t\{p^{t*}(1+\gamma^t), w_1^{t*}(1+\sigma_1^t), w_2^{t*}(1 \\ &\quad + \sigma_2^t), w_3^{t*}(1+\sigma_3^t), K^t, K^{t-1}, \delta^t\} \\ &= \cdots\cdots + \prod_{s=2}^{t}\frac{1}{(1+r^s)}\{p^{t*}(1+\gamma^t)\cdot y^t(\cdot) - w_1^{t*}(1+\sigma_1^t)\cdot v_1^t(\cdot) - w_2^{t*}(1+\sigma_2^t)\cdot \\ &\quad v_2^t(\cdot) - w_3^{t*}(1+\sigma_3^t)\cdot v_3^t(\cdot) - Q^t\cdot I^t(K^{t-1}, K^t, \delta^t)\} \\ &\quad + \prod_{s=2}^{t+1}\frac{1}{(1+r^s)}\{p^{t+1*}(1+\gamma^{t+1})\cdot y^{t+1}(\cdot) - w_1^{t+1*}(1+\sigma_1^{t+1})\cdot v_1^{t+1}(\cdot) \\ &\quad - w_2^{t+1*}(1+\sigma_2^{t+1})\cdot v_2^{t+1}(\cdot) - w_3^{t+1*}(1+\sigma_3^{t+1})\cdot v_3^{t+1}(\cdot) \\ &\quad - Q^{t+1}\cdot I^{t+1}(K^t, K^{t+1}, \delta^{t+1})\} + \cdots\cdots \end{aligned} \tag{13}$$

Thus, the necessary condition for optimization is given as follows:[2]

$$\begin{aligned}\partial\Pi/\partial K^t &= \prod_{s=2}^{t}\frac{1}{(1+r^s)}\cdot[\mathrm{p}^{t*}(1+\gamma^t)\cdot\frac{\partial y^t}{\partial K^t} - w_1^{t*}(1+\sigma_1^t)\cdot\frac{\partial v_1^t}{\partial K^t} - w_2^{t*}(1+\sigma_2^t)\cdot\frac{\partial v_2^t}{\partial K^t} \\ &\quad - w_3^{t*}(1+\sigma_3^t)\cdot\frac{\partial v_3^t}{\partial K^t} - Q^t\cdot\frac{\partial I^t}{\partial K^t}] + \prod_{s=2}^{t+1}\frac{1}{(1+r^s)}[-Q^{t+1}\cdot\frac{\partial I^{t+1}}{\partial K^t}] = 0\end{aligned} \tag{14}$$

Generally, partial differentiations can be developed as follows:

$$\frac{\partial B}{\partial A} = \frac{\partial B}{\partial \ln B}\cdot\frac{\partial \ln B}{\partial \ln A}\cdot\frac{\partial \ln A}{\partial A} \tag{15}$$

Referring to the short-term optimizing conditions, eqs. (9) and (10):

$$\frac{\partial \ln y}{\partial \ln K} = \frac{-\alpha_1\alpha_4}{\alpha_1+\alpha_2+\alpha_3-1} + \frac{-\alpha_2\alpha_4}{\alpha_1+\alpha_2+\alpha_3-1} + \frac{-\alpha_3\alpha_4}{\alpha_1+\alpha_2+\alpha_3-1} + \alpha_4 = \frac{-\alpha_4}{\alpha_1+\alpha_2+\alpha_3-1} \tag{16}$$

$$\frac{\partial \ln v_i}{\partial \ln K} = \frac{-\alpha_4}{\alpha_1+\alpha_2+\alpha_3-1}, \quad i = 1, 2, 3 \tag{17}$$

Using $\partial \ln x/\partial x = 1/x$ and eqs. (15) to (17) yields

$$\frac{\partial y}{\partial K} = \frac{-\alpha_4}{\alpha_1+\alpha_2+\alpha_3-1}\cdot\frac{y}{K} \tag{18}$$

$$\frac{\partial v_i}{\partial K} = \frac{-\alpha_4}{\alpha_1+\alpha_2+\alpha_3-1}\cdot\frac{v_i}{K}, \quad i = 1, 2, 3 \tag{19}$$

From eq. (12), $\partial I^t/\partial K^t = 1, \partial I^{t+1}/\partial K^t = -(1-\delta^{t+1})$. Arranging (14) and using eqs. (18) to (19), we obtain the long-term equilibrium condition as follows.

$$\begin{aligned}\frac{\partial\Pi}{\partial K^t} &= \prod_{s=2}^{t}\frac{1}{(1+r^s)}\cdot[\frac{-\alpha_4}{\alpha_1+\alpha_2+\alpha_3-1}\cdot(1+\gamma^t)\cdot\frac{p^t y^t}{K^t} - \frac{-\alpha_4}{\alpha_1+\alpha_2+\alpha_3-1} \\ &\quad \cdot(1+\sigma_1^t)\cdot\frac{w_1^t v_1^t}{K^t}\end{aligned}$$

$$-\frac{-\alpha_4}{\alpha_1+\alpha_2+\alpha_3-1}\cdot(1+\sigma_2^t)\cdot\frac{w_2^t v_2^t}{K^t}-\frac{-\alpha_4}{\alpha_1+\alpha_2+\alpha_3-1}\cdot(1+\sigma_3^t)\cdot\frac{w_3^t v_3^t}{K^t} - Q^t]$$
$$+\prod_{s=2}^{t+1}\frac{1}{(1+r^s)}\cdot Q^{t+1}\cdot(1-\delta^{t+1})=0 \tag{20}$$

Arranging this into a simple equation,

$$(1+\gamma^t)\cdot\frac{p^t y^t}{K^t}-(1+\sigma_1^t)\cdot\frac{w_1^t v_1^t}{K^t}-(1+\sigma_2^t)\cdot\frac{w_2^t v_2^t}{K^t}-(1+\sigma_3^t)\cdot\frac{w_3^t v_3^t}{K^t}$$
$$-\frac{\alpha_1+\alpha_2+\alpha_3-1}{-\alpha_4}\cdot\left[Q^t-\frac{1}{(1+r^{t+1})}\cdot Q^{t+1}\cdot(1-\delta^{t+1})\right]=0 \qquad (21)[3]$$

3.3. Meaning of Rent

Are the above-induced mark-up ratios $\gamma^t, \sigma_1^t, \sigma_2^t, and\ \sigma_3^t$ only monopolistic rent? These ratios should be regarded to include many kinds of rents: rent based on transfers, Schumpeterian rent, natural resource rent, and monitoring and management rent.[2] Subsidies, a kind of transfer rent, are generally items of non-operating income, which consist of *py*, and seem to enhance $p^{t*}$and (absolute value of) γ^t. Schumpeterian rent is an achievement where investment ahead of other companies improves production technology, which also enhances$p^{t*}$and (absolute value of) γ^t. Monitoring and management rent are also reflected in $p^{t*}$and γ^t. If natural resource rents are not internalized, the resource procurement costs of manufacturing companies, w_2^{t*} are kept low, and σ_2^t seems to increase.

Thus, various kinds of rents are included in mark-up ratios $\gamma^t, \sigma_1^t, \sigma_2^t, and\ \sigma_3^t$. It can be said that the following calculation is not only for monopoly rent but also for the sum of various rents.

4. Application: Estimating the Parameters and Rent for Industrial Sectors in Japan

4.1. Calculation Method

This section uses the theoretical model developed in Section 3, specifically the long-term equilibrium condition, eq. (21), to specify the mark-up rates,γ and σ_i, in an applied case study of Japanese industrial sectors. The estimation is done not by using econometric methods but rather by solving a system of equations.

When firm-level financial data are available for at least four years, it is possible to obtain four equations by creating each equation using a given year's financial data, if the value of the scale parameter $R^t(=\alpha_1+\alpha_2+\alpha_3-1/-\alpha_4)$[4] is given. However, if scale parameter R is not given, we suppose that σ_3 is zero.[5]The unknown variables are γ, σ_1, σ_2, and R^t, and the number of equations is also four. If the inverse matrix of the coefficient matrix exists, it would be possible to obtain a solution for γ, σ_1, σ_2, and R^t.

The system of equations was solved using MATLAB software (MATLAB ver. R2016a),[6] which supports the manipulation of symbolic and numerical expressions. Using matrix expressions, simultaneous equations for γ, σ_1, σ_2, andR^tin eq. (21) can be set for the four years of financial data as follows:

$$\begin{bmatrix}\widehat{V_3^t}\\ \widehat{V_3^{t+1}}\\ \widehat{V_3^{t+2}}\\ \widehat{V_3^{t+3}}\end{bmatrix}=\begin{bmatrix}\widehat{Y^t} & -\widehat{V_1^t} & -\widehat{V_2^t} & -\widehat{Q^t}\\ \widehat{Y^{t+1}} & -\widehat{V_1^{t+1}} & -\widehat{V_2^{t+1}} & -\widehat{Q^{t+1}}\\ \widehat{Y^{t+2}} & -\widehat{V_1^{t+2}} & -\widehat{V_2^{t+2}} & -\widehat{Q^{t+2}}\\ \widehat{Y^{t+3}} & -\widehat{V_1^{t+3}} & -\widehat{V_2^{t+3}} & -\widehat{Q^{t+3}}\end{bmatrix}\begin{bmatrix}(1+\gamma^t)\\ (1+\sigma_1^t)\\ (1+\sigma_2^t)\\ R^t\end{bmatrix} \tag{22}$$

where $\widehat{Q^t} \equiv Q^t - \frac{1}{1+r^{t+1}} \cdot Q^{t+1} \cdot (1-\delta^{t+1})$, $\widehat{Y^t} \equiv \frac{p^t y^t}{K^t}$, $\widehat{V_i^t} \equiv \frac{w_i^t v_i^t}{K^t} . \gamma^t$, and σ_i^t (i=1,2) are the mark-up rates in an output and inputs in periods t to t+3. If the coefficient matrix has an inverse matrix,

By calculation of these equations, we obtain γ, σ_1, σ_2, and R^t. Using financial data covering 30 years, it is possible to set t from the first year to the 27th year. For each t, the solutions of γ, σ_1, σ_2, and R^t are given; however, the equation for period t contains the discount rate of the t+1 period, r^{t+1}, and so the number of solutions is 26. Thus, the following subsection calculates and presents the average values of rents, which are calculated by $-\gamma^t p^t y^t + \sigma_1 w_1^t v_1^t + \sigma_2 w_2^t v_2^t$ and the average rent rates (rent/py) across 26 years for each industry.

4.2. Data

Based on information from Teikoku Data Bank (2017), 29 major industrial sectors in Japan were selected for the analysis. Subsequently, approximately 25of the largest sales companies in each industrial sector were selected based on fiscal year 2015 sales rankings, as listed in Teikoku Data Bank (2017; as far as financial statements exist in the database). Financial data for these companies were downloaded from Nikkei NEEDS Financial QUEST 2.0., which is a database of financial statements. The contents of the costs of banks, stock brokerage firms, and insurance companies differ from other industries for the case of single account closing in a database; thus, the industrial sector was reduced to 26 sectors. The data cover the most recent 30 years. Many companies have data covering the full period of 1984–2017, but in some cases, the data period is shorter, or the data are from an earlier period. The total number of companies is 392.

Data on discount rates come in the form of nationwide average loan rates for each year, as provided by the Bank of Japan (1970–2013). The unit price of investment (Q) was set as one every year.

5. Results

The rent calculations are carried out both for the non-consolidated account closing and for the consolidated account closing. We examined one proposition before we focused on comparing rent among industrial sectors. For the data of non-consolidated closing, the sales amount and operating revenues (py), labor costs ($w1v1$), material costs ($w2v2$), other costs ($w3v3$), and total assets (K) are available. For consolidated closing, specifications of production costsare not available in Japan.[7] It is also difficult to find a breakdown of expensesfor European and American global companies.

Therefore, three pseudo-production factors were set: (1) operating expenses ($w1v1$), (2) non-operating expenses and extraordinary losses ($w2v2$), and (3) income taxes ($w3v3$). It was examined whether the calculation of rent by these pseudo-production factors can substitute rent calculation for real production factors. For convenience, calculation by normal production factors is method 1, and that by pseudo-production factors is method 2.

The above hypothesis is tested by correlation coefficients between method 1 and method 2 for each industrial sector using the data of non-consolidated closing. Table 1 shows the results of the weighted average of correlation coefficients weighted by the number of time-series samples of each company in each industry.

Table 1. *Weighted Average of Correlation Coefficient Between Methods 1 and 2 in Each Industry*

		Weighted Average of Correlation Coefficient in Each Industry	Amount of Sample Companies	Total Time Series Samples
1	Mining	0.93	3	78
2	Agriculture	0.89	2	46
3	Construction		0	0
4	Food and Beverage	0.87	4	88
5	Textiles	0.88	4	73
6	Wood and Furniture	0.8	3	70
7	Paper and pulp	0.95	4	96
8	Printing	0.85	5	84
9	Chemical	0.97	5	128
10	Rubber and Leather	0.96	3	75
11	Ceramics and Cement	0.95	3	78
12	Steel	0.92	2	52
13	Non-ferrous Metals	0.92	2	35
14	Machinery	0.99	1	26
15	Cars and Parts	0.94	6	156
16	Electrical Machinery	0.91	2	51
17	Wholesale	0.98	1	26
18	Department Store	0.84	1	26
19	Retailer	0.94	11	235
23	Real Estate	1	1	15
24	Transportation	1	1	4
25	Telecommunication		0	0
26	Electricity, Gas, and Water	0.91	6	139
27	Newspapers and Publishers	0.97	2	30
28	Advertising	0.98	1	26
29	Information	0.96	2	27
	Weighted Average of All	0.92		
	Total		75	1664

Among 75 companies,[8] the null hypotheses of the t test were not rejected for data of only one company at 2.5 percent significance level on one side; however, the hypotheses were also rejected at 5 percent significance level. For the total 1664 samples, the correlation coefficient of the rent amount was 0.987; the average rent amount by method 1 was 6628.6 mil yen, and that by method 2 was 6657.5 mil yen. This means that the error between them was 0.43 percent.Thus, method 2 can be used as the proxy of method 1 depending on analytic purposes. The following will show the results of the rent calculations, which were carried out for both the non-consolidated account closing and the consolidated account closing.

TABLE 2: *Result of Calculation/Rent Amount and Rent Rate of Each Industry*

		Non-Consolidated Account Closing					Consolidated Account Closing				
		Sample	Rent (mil yen)	Rent / Sales (%)	Ranking of Rent	Ranking of Rent/ Sales	Sample	Rent (mil yen)	Rent/ Sales (%)	Ranking of Rent	Ranking of Rent/ Sales
1	Mining	8	6716.5	0.072	9	1	6	32171.8	0.058	1	3
2	Agriculture, Forestry, and Fishery	4	996.5	0.025		6	3	1340.1	0.024	6	
3	Construction	14	6111.2	0.011			19	8041.3	0.01		
4	Food and Beverage	14	3447	0.01			18	8860	0.014		
5	Textiles	15	541.4	0.01			15	1456.2	0.011		
6	Wood and Furniture	15	1016.6	0.019			15	1569.6	0.016		
7	Paper and pulp	16	1385.7	0.019			11	3390.1	0.013		
8	Printing	15	3696	0.018			14	4133.1	0.018		
9	Chemicals	17	14887.3	0.048	6	3	20	29495.9	0.034	3	6
10	Rubber and Leather	16	3033.7	0.016			16	7010.1	0.021		
11	Ceramics and Cement	17	2291	0.014			14	5508	0.02		
12	Steel	16	6704.7	0.017	10		18	9103.1	0.017		
13	Non-ferrous Metals	18	3700.3	0.019			15	13985.2	0.018		
14	Machinery	20	13197.5	0.022	8	10	16	25871.5	0.022	10	
15	Cars and Parts	22	23174.5	0.012	3		17	84840.8	0.018		
16	Electrical Machinery	18	15418.1	0.022	5	9	17	36997.1	0.028	9	8
17	Wholesale	18	14400.8	0.006	7		17	20957.6	0.005		
18	Department Store	15	641.2	0.004			11	3730.5	0.006		
19	Retail	18	5791.8	0.024		7	13	10241.1	0.029	7	7
20	Bank						16	38393.1	0.057		4
21	Stock Brokerage Firm						3	16595	0.089		2
22	Insurance Company						7	34296.1	0.018		
23	Real Estate	17	4415	0.024		8	17	8569	0.037	8	5
24	Transportation	18	15824.3	0.018	4		15	24627.4	0.022		
25	Telecommunications	13	62667.8	0.067	1	2	7	110524	0.11	2	1
26	Electricity, Gas, and Water	17	25198.1	0.025	2	5	18	23561.6	0.023	5	
27	Newspapers and Publishers	6	1216.3	0.006			7	3575.9	0.013		
28	Advertising	8	1632.7	0.008			9	2965.8	0.024		10
29	Information	17	4374.1	0.03		4	16	9399.1	0.025	4	9

The industries whose rent amount or rent rate was ranked from 1st place to 3rd place were telecommunications, mining, electricity, gas and water, chemicals, cars and pars, and stock brokerage firms. This means that these industries earned a lot of rent for the past 30 years.

6. The Relationship Between Political Expenditure and/or R&D and Rent

Now, using the calculated rent, let us examine through an empirical study whether rent induces political expenditure of corporates, as Bhagwati (1982) pointed out, even though rent is probably the result of corporates' political behavior, such as lobbying. At the same time, rent may induce innovation through R&D investment, or R&D expenditure may cause Schumpeter rent. Although it is difficult to clarify the cause-and-effect relations, we can clarify the significant correlation between political or R&D expenditure and rent.

6.1. Data

Two kinds of data were available about the political expenditure of companies. One was the expenditure for political donation, lobbying activities, etc., from 2008 to 2015, which Toyokeizai Shinposha researched using a questionnaire survey (political expenditure 1). The other included data from the political funds balance report of corporate donations to Kokumin Seiji Kyokai, a political fund organization of the Liberal Democratic Party (LDP) for 2015 (political expenditure 2). This is because most corporate donations in Japan are for the LDP.

The R&D expenditure data of those companies consist of development and testing research expenses from Nikkei NEEDS Financial QUEST.

6.2. Method

First, the calculated and average rent amounts or rent ratesin all periods and in each industry were regressed by political expenditure and/or R&D expenditure, which were also averaged among all periods of each company and within each industry by ordinary least squares regression. The number of samples was dependent on the available industry sectors, so there were 26 for non-consolidated settlement and 29 for consolidated settlement. Table 3 lists only the results in which at least one independent variable cleared the t test.

TABLE 3: *Regression of Political and R&D Expenditures for Rent (Cross-Section)*

Consolidated or Non-consolidated	Dependent Variable	Rent Amount (RA) or Rent Rate (RR)	Significant Coefficient	Coefficient	t-statistic	Prob>|t|	Adj R-squared
Non-Consolidated	P1	RA	P1	1039.5	2.48	0.02	0.171
Consolidated	P1	RA	P1	1285.1	2.14	0.042	0.113
Consolidated	P2, R	RR	P2	0.00133	2.33	0.028	0.11
Consolidated	P2	RR	P2	0.00128	2.34	0.027	0.138

Notes. Dependent Variable :Political Expenditure 1 = P1, Political Expenditure 2 = P2, R&D Expenditure = R

Political expenditure 1 and R&D expenditure for each company are time series data. This means that we can also try a panel data analysis. Rent amounts with attributes of each company and each period are regressed by those data using panel methods with dummy variables of industry sectors. The number of samples was 68 for simple settlement data and 275 for consolidated settlement data. Pooling regression (OLS), fixed-effects model, and GLS random-effects model were implemented. Table 4 also lists only the results in which at least one independent variable cleared the t test.

TABLE 4: *Regression of Political and R&D Expenditures for Rent (Panel Data)*							
Consolidated or Non-Consolidated	**Dependent Variable a)**	**Model b)**	**Significant Coefficient**	**Coefficient**	**t-statistic**	**Prob>|t|**	**R-squared**
Consolidated	P1	OLS	P1	8272.8	7.69	0	0.177 c)
Non-Consolidated	P1, R	Fixed	P1	1772.7	2.42	0.019	0.261 d)
Non-Consolidated	P1, R	Random	P1	1819.9	2.55	0.011	0.2606 d)
Non-Consolidated	P1	Fixed	P1	1971.1	2.91	0.005	0.2531 d)
Non-Consolidated	P1	Random	P1	2013.3	3.05	0.002	0.2531 d)

Notes. a) Political Expenditure 1 = P1, R&D Expenditure = R; b) OLS = Pooling Regression, Fixed = Fixed-Effects Model, Random = GLS Random-Effects Model; c) Adjusted R-Squared; d) within

6.3. Results

Interesting findings were obtained from the above analyses. Generally, political expenditure has a significant correlation with rent, even though the coefficients of determination are nothigh. Furthermore, the parameter estimates of political expenditure are between 1039.5 and 2013.3,except for 8272.8 by the pooled OLS. This means that 1million yen of political expenditure will induce 1 or 2 billion yen of rent or will be provided as the result of it. The rent rate will be raised 0.1 percent by 1 million yen of political expenditure.

R&D expenditure never cleared the t test in all regressions. It is unfortunate for Japanese industries that in 30 years, R&D investment has not securedexcessive profits, even though this might be because of data quality.

7. Conclusion

This study developed a new approach that could become a standard method for calculating the comprehensive rent of each company from financial data. Regarding the methodological aspect, the degree of monopoly in the monopoly model was shown to be equal to the mark-up rate that could realize the production level in monopolistic equilibrium as a competitive equilibrium based on past time-series financial data. One of the advantages of using financial statements is that the rent calculated from the mark-up rate includes not only monopolistic rents but also a comprehensive rent total, including various other rents. By this calculation method, even if there was no breakdown of expenses in calculating corporate rents from financial data, approximate values could be obtained using pseudo-production factors such as operating expenses, non-operating expenses and extraordinary losses, and corporate taxes.

Based on the financial data of major Japanese industries (single and consolidated settlements) over the past 30 years, the average value and rent rate of large enterprises in 29 industrial sectors (26 single settlement industries) were calculated. As a result, industries that ranked third in terms of rents or rent rates in single or consolidated accounts were telecommunications, mining, electricity, gas and water, chemicals, cars and parts, and insurance companies.

Remarkably, based on Japan's regressions over the past 30 years, R&D expenditure did not show any significant correlation with rent amount and rent rate. On the other hand, in several models, political expenditure showed a significant correlation with rent both for single and consolidated settlements, even though the coefficients of determination were low. It was estimated that1 million yen of political expenditure was the cause or the result of 1 or 2-billion-yen rent.

Based on the above analysis, if rent was the result of political expenditure, entrepreneurs would find it far more profitable to invest in political processes than to aim for the market. It is suggested that political expenditure should be added to economic variables. Although this study conducted analyses using a simple regression model without a time lag from the limited data of the time series in political expenditure,[9] in the future, it is hoped that a more detailed empirical analysis will be conducted to examine the relationship between political expenditure and rent.

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Notes

[1] Furthermore, as we will explain later, all kinds of rent that a company can get seem to be comprehensively captured by the monopoly and monopsony rent measuring method in this study.
[2] About the detailed explanation of these rents, see, for example, Khan & Sundaram (2000).
[3] In this empirical study, financial statements are used as data from each company. The depreciation amount for a year is included in the item of costs. Therefore, δ^{t+1} was set as zero, escaping from double count.
[4] Suppose that S $= \alpha_1+\alpha_2+\alpha_3+\alpha_4 \geq 1$, which means that in the long term, the return to scale is equal to, or more than, 1. As mentioned before,

$\alpha_1+\alpha_2+\alpha_3<1$. Then

$$R^t=(\alpha_1+\alpha_2+\alpha_3-1)/(-\alpha_4)=(\alpha_1+\alpha_2+\alpha_3-1)/(\alpha_1+\alpha_2+\alpha_3-S)$$
$$\alpha_1+\alpha_2+\alpha_3-S \leq \alpha_1+\alpha_2+\alpha_3-1<0$$
$$\therefore 0<R^t \leq 1$$

[5] The production factor v_3 is defined as other costs, excluding labor costs $v_1$and material costs v_2, as mentioned in detail later. Further, $v_3$includes various factors; therefore, we cannot interpret their rent.
[6] These equations systems were solved by the command "lsqlin" in MATLAB, which is a solver of constrained linear least-squares problems.
[7] Additionally, for non-consolidated account closing, for enterprises that have disclosed the segment information, the publication of manufacturing cost specifications has been exempted since fiscal year 2014.
[8] During rent calculation, when a datum of a production factor input was 0 or blank, the value of it was set to 1, and 1 was suppressed from another production factor input. In obtaining the correlation coefficients data of companies, such treatments were excluded to escape estimation bias.
[9] In Japan, long time-series data of the political expenditure of corporates is not open.

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