NATURAL RESOURCES, AND RENT-SEEKING ANALYSIS IN THE CONTEXT OF DUTCH DISEASE

by

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Abstract

The thesis refers to the literature of natural resource curse, and it is known as a theory that the resource-rich countries perform much worse than resource-poor countries. Dutch disease and rent-seeking are both considered as the symptoms of the resource curse theory. The Dutch disease is the paradox that comes from the extent of boom (resource abundance or technological advancement) in energy sector and the discovery of resources harms a country's broader economy. Dutch disease induces stagnation of non-resource sectors along with the rapid development of resource sector. It is comprised of resource movement and spending effects. The resource movement effect is the movement of labor inputs from services to energy sector. The spending effect is considered as an increasing consumption (higher spending) due to the higher incomes coming from the energy sector. Moreover, rent-seeking is a phenomenon where resources are wasted for inefficient activities for creating profitable opportunity by inducing welfare loss to society. The relation between the resource movement effect and rent-seeking will be explained by only concentrating on the resource movement effect and omitting the spending effect. An assumption of the fixed consumer behavior will be made meaning that consumers do not assume the level of income. So, demand is fixed in the model up to chapter 5, and demand curve does not depend on technological advancement because if demand depends on that, then the spending effect will occur. The main goal of the research is rent-seeking and, hence, the research will show the direction of labor inputs by focusing only on the resource movement effect in order to analyze rent-seeking.

The objective of the thesis is to determine how rent seeking firms under various settings in a booming energy sector affects labor inputs in two sectors (energy and services) and overall total output. Previous studies do not mention models of rent seeking firms in different settings

such as monopoly, mergers, collusion and Stackelberg cases (and also rent has different formulations in different chapters of the thesis) affecting the above-mentioned sectors. The models also intend to determine differences with existing studies and add theoretical contribution to rent-seeking analysis due to the previous empirical studies which demonstrate that rent-seeking is a widespread phenomenon in extractive economies. By focusing on Dutch disease and rent-seeking literature, it will be clarified that the resource discovery facilitates rent-seeking and reduces of total output depending on different firms' settings. Rent seeking monopoly and merger cases are more detrimental to the society compared to collusion and Stackelberg cases, because they waste more resources for rent seeking activities. The results in the models are different from former rent-seeking models because of the formulation of a rent under the application of complete dissipation theorem. Thus, the paper will contribute to the literature of Dutch disease and political economy by explaining the impact of rent seeking firms (under various settings) on two sectors in terms of labor inputs and outputs by using complete dissipation theorem. Furthermore, In the sixth chapter, the model explains how energy monopolies engage in rent-seeking activities in Azerbaijan. Supplementary time-series analysis is also used in order to describe these activities. The model and results of data analysis show that the monopolies in the country use increasing gasoline prices as a rent-seeking tool during the times of crises. The empirical analysis and the rent seeking monopoly model in chapter 6 will be used for future empirical research by applying to other country cases in Middle East, Central Asia and Latin America. This is because the resource-rich countries in those areas are also affected negatively due to rent seeking activities of firms, and it is necessary to conduct an empirical research for analyzing the rent seeking behaviour of energy monopolies in those countries.

Chapter 1. Resource Movement Effect and Total Output under Rent Seeking Monopoly

In this chapter a new model is developed by referring to the literature of Dutch disease and rent-seeking for explaining how a natural resource boom in energy sector decreases total output and induces resource movement effect under a rent seeking monopoly. In the rent seeking monopoly model, it is shown that resource movement effect certainly occurs during the boom where labor inputs will move to energy sector from services sector. The reason is that the rent seeking monopoly uses some labor inputs for making profits through production, and some labor inputs will be used in order to engage in rent-seeking activities. Moreover, the boom definitely facilitates rent-seeking but decreases total output under certain parameter values. Dutch disease has clear signs in the monopoly case because of resource movement effect and reduction of output in a non-resource sector. The rent will be formulated as the difference of profits between monopoly and social optimum cases which is different from previous rent-seeking models in energy sector.

Chapter 2. Rent Seeking Duopoly Collusion Analysis in Energy Sector

A new model is proposed in the second chapter by concentrating on Dutch disease phenomenon along with rent-seeking in order to demonstrate how a natural resource abundance (or a resource boom) affects resource movement effect and total output under rent seeking duopoly collusion (Cournot competition) in energy sector. The resource movement effect occurrence or the movement of labor inputs from services to energy sector depends on the degree of the boom. Most importantly, rent formulation is unique in this model that refers to the complete dissipation theorem, and the rent is calculated as the difference between profits of collusion and no collusion cases under Cournot duopoly. The model adds theoretical contribution to rent-seeking duopoly collusion in extractive economies. In rent seeking duopoly collusion case, the rent seeking activity is facilitated. Dutch disease occurs depending on the degree of the boom. The impact of the boom on total output also depends on parameter values.

Chapter 3. Vertical Mergers and Rent-seeking During Natural Resource Boom

A new model is proposed in the third chapter for showing how natural resource abundance affects resource movement effect and total output when rent-seeking upstream and downstream firms merge in energy sector. This adds theoretical contribution to rent-seeking M&A (merger and acquisition) analysis because of the previous studies which demonstrate that rent-seeking is a widespread phenomenon in extractive economies. By focusing on Dutch disease and rent-seeking literature it will be clarified that the resource movement effect occurrence or the movement of labor inputs to energy sector from services sector depends on parameter values during the resource abundance (or resource boom). The rent-seeking is facilitated and the output decreases regardless of parameter values. The results in the model are different from former rent-seeking models because of the formulation of a rent (difference of profits between merger and no merger cases) under the application of complete dissipation theorem. Furthermore, only rent-seeking upstream firm participates in production before and after merger cases and, thus, the reduction of total output or the existence of resource movement effect (Dutch disease as well) is not definite.

Chapter 4. Natural Resource Abundance under Stackelberg Rent-seeking

Another theoretical model is developed in the fourth chapter for explaining how natural resource abundance affects total output and resource movement effect under Stackelberg rent-seeking. The study aims to clarify the differences from previous chapters and theoretically contribute to rent seeking dominant firm analysis due to the existence of past studies describing that rent-seeking is rampant in energy sector. The two sector (energy and services) model demonstrates that under resource boom, the decline of total output depends on parameter values and the result is different from preceding models of rent-seeking due to distinct formulation of the rent. Another reason is that only a dominant firm engages in rent-seeking to gain a leader position for higher profits. A follower firm will not participate in rent-seeking because of advantages of staying in competition or collusion. Hence, the firms in energy sector under Stackelberg duopoly are less detrimental to society because fewer resources are dissipated for capturing rents. Dutch disease phenomenon is not strong in this case. Furthermore, during the boom the resource movement effect may occur which means that labor inputs may move to energy sector from services sector, and the boom may facilitate rent-seeking regardless of parameter values.

Chapter 5. The Effect of Increasing Demand for Energy on Rent-seeking Analysis of Monopoly, Duopoly Collusion, Mergers and Stackelberg Cases

This chapter analyses increasing consumption in the energy sector, and it examines how increasing demand impacts total output and rent-seeking under various cases mentioned in previous four chapters. It will be shown that increasing demand for energy facilitates rent-seeking under certain parameter values. Total output also depends on parameter values. Increasing demand for energy is more powerful in terms of facilitation of resource movement effect and reduction of output in the non-resource sector.

Chapter 6. Monopoly Rent-seeking in the Case of Azerbaijan

In this chapter, energy sector's monopoly behavior is analyzed theoretically in the case of Azerbaijan. As a theoretical background, a new general equilibrium model is developed, and it explains unusual surge of gasoline prices in Azerbaijan. The reason is related to the political stability within the country. Monopolies in Azerbaijan use the price as a rent-seeking tool for gaining a rent available in the energy market. Through tentative and supplementary time series

analysis, the relationship between crude oil price and local gasoline prices (rent-seeking in this paper) will be demonstrated. There is a cointegrating relation between two variables under Johansen Cointegration Test, and it supports the idea in the theoretical general equilibrium model. Monopolies use higher local gasoline prices as rent-seeking for covering their losses.

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Chapter 1

Resource Movement Effect and Total Output under Rent Seeking Monopoly[1]

1. Introduction

Dutch disease is a paradox which shows that the export of the natural resources negatively affects the non-resource sector and cause exchange rate appreciation along with increased unemployment rate (Bruno and Sachs, 1982; Cassing and Warr, 1982; Corden and Neary, 1982; Corden, 1984, Neary, 1985). This phenomenon is studied under the natural resource curse theory and it describes that resource-rich countries usually have slower growth compared to resource-poor countries (Nankani, 1979; Neary and Van Wijnbergen, 1984; Gelb, 1988; Auty, 1990, 1993, 1994; Sachs and Warner 1995, 1999, 2001; Gylfason et al., 1999, 2004; Hausmann and Rigobon, 2003; Bulte and Damania, 2008; Barma et al., 2011). Corden and Neary's (1982) model analyzes the phenomenon by describing the natural resource boom as a degree of technological improvement in resource sector. One of the core factors of the model is resource movement effect. The resource movement effect is considered as the movement of labor inputs from services to energy sector.

The aforementioned paper discusses these two effects of the boom, taking the political issues as given. This is problematic because rent-seeking is considered as another problem which negatively affects welfare in resource-rich countries (Lane and Tornell, 1996; Tornell and Lane, 1999; Ross, 1999, 2012; Torvik, 2002; Larsen, 2006; Mehlum, et al., 2002, 2006; Congleton et al., 2008; Dunning, 2008; Deacon and Rode, 2015). According to Hindricks and Myles (2013, p.

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[1]Muradov, A. (2023). Natural resources, national income, and resource movement effect under a rent seeking monopoly. *El Trimestre Economico (1934)*, vol. 90, no. 357, (SSCI). Nonlinear cost function (energy) is used in publication but linear cost function is used here for comparison with other chapters.

389), rent-seeking is the dissipation of resources for making profitable opportunity that is harmful for society. The existing studies also show how damaging rent-seeking can be for countries with abundant resources (Auty, 2001a, 2001b; Kolstad and Wiig, 2009; Van der Ploeg, 2010; Van de Ploeg, 2011; Vicente, 2010; Caselli and Michaels, 2013; Bertrand and Quatrebarbes, 2015). Lane and Tornell (1996) and Tornell and Lane (1999) describe that higher productivity may push the rate of return on investment with the powerful firms within an economy. Due to higher productivity, the firms will try to obtain a higher portion in production by requiring more transfers. These transfers will increase the tax rate and decrease the return on capital. Afterwards, the redistribution effect will exceed the impact of increased productivity. Lane and Tornell (1996) mention that economic growth falls due to decreased savings, but in Tornell and Lane (1999), economy stagnates due to the fact that the capital is used in unproductive informal sector (which is safe from taxation (rent-seeking)). According to Baland and Francois (2000), the rents are formed through import quotas. If great number of firms engage in rent-seeking within an economy, the result shows that more firms will move to rent-seeking. Aggregate income will decrease because the value of an import quota will induce the resources to move into rent-seeking activities. Moreover, higher number of rent seekers will reduce each firm’s expected income by allowing the tax rate to increase with the number of rent seekers (Torvik, 2002). The rents will be the public sector income which are tax, bribes, and natural resources. Table 1 briefly summarizes the above-mentioned studies.

Table 1.Brief description of the literature

Models	Rent	Number of firms
Tornell & Lane (1996, 1999)	Taxes	Several firms
Baland & Francois (2000)	Import quotas	Several firms
Torvik (2002)	Public sector income	Several firms
This chapter	Difference between profits of monopoly and social optimum cases (complete dissipation)	Monopoly

The focus will be on Corden and Neary's (1982) paper (where labor is the only mobile factor between sectors) and rent-seeking activities of a monopoly (Hindricks and Myles, 2013, pp. 398-408) because rent-seeking affects resource labor and distorts the utilization of labor inputs which could be used for producing other outputs. More rent-seeking activities impact profits of producers negatively and, hence, remaining producers increase their resources for wasteful rent-seeking activities. The objective of the chapter is to figure out how a rent seeking monopoly in a booming energy sector affects labor inputs in both sectors and overall total output. Previous studies do not mention a model of rent seeking monopoly affecting the above-mentioned sectors under the Dutch disease model. Also, rent is calculated as the difference of profits between monopoly and social optimum cases under the application of complete dissipation theorem (Hindricks and Myles, 2013, pp. 398-408). Rent-seeking activities of monopolies in some resource-abundant countries negatively affect the welfare of societies by inducing more deadweight loss, and the hybrid model in this chapter would be of contributory theoretical explanation in literature for problems related to rent-seeking in mineral extracting economies.

The relation between the resource movement effect and rent-seeking will be explained by only concentrating on the resource movement effect and omitting the spending effect for simplicity. An assumption of the fixed consumer behavior will be made meaning that consumers do not assume the level of income. So, demand is fixed in the model, and demand curve does not depend on technological advancement because if demand depends on that, then the spending effect will occur. The main goal of the research is rent-seeking and, hence, the research will show the direction of labor inputs by focusing only on the resource movement effect in order to analyze rent-seeking. The research will examine how rent-seeking activities of a monopoly have an impact on the above-mentioned resource movement effect and total output. The model will show that the extent of technological advancement in energy sector facilitates rent-seeking. The resource movement effect will occur if there is a rent seeking monopoly in energy sector because it utilizes labor inputs for creating monopoly profits, and some of these inputs will be used for rent-seeking activities. The model will also demonstrate that the effect of the boom on the total output will depend on parameter values.

2. The Model

The model assumes that there are two sectors: services and energy sectors. Several specific assumptions are made in this model in order to reinforce the causal relationships which will be derived from the model. Firstly, each sector uses only specific factor which is labor input (omitting capital for simplicity) as the single factor. For clear results, the skill categories (in human capital) for labor is not taken into account here because the model assumes that labor is perfectly mobile between sectors, and full employment is maintained which means there are no distortions in commodity or labor markets. A quantity of labor is supplied in-elastically by workers. This is divided between production of the two goods in services and energy sectors. Mainly, by ignoring monetary considerations (implications for real variables, not the nominal ones), the effects of asymmetric growth between energy and services on resource allocation is examined. The model also shuts down the possibility of real exchange rate appreciation by assuming a closed economy (all outputs of firms are sold domestically). Services are assumed to be produced with constant return to scale, and one unit of labor can produce one unit of output. The cost function $C_N(x_N)$ in the services sector is

$$C_N(x_N) = x_N, \tag{1}$$

where x_N is the output level of production in the services sector. Profit maximization in this sector is

$$\max_{x_N} P_N x_N - C_N(x_N), \tag{2}$$

where P_N is the price of good in the services sector. For the adjustment process: in the services sector, there are many small size firms whose profit function is expressed as (2). If the price (P_N) is larger than α, then the firms produce more, hence the price goes down. If the price becomes too low (under α), then the supply is stopped, but the demand becomes larger. So, the excess demand pulls the price up. Hence, the solution of this maximization problem is $x_N = 0$ if $P_N < 1$, $x_N = \infty$ if $P_N > 1$, and x_N is any number if $P_N = 1$.

On the other hand, the cost function in the energy sector $C_T(x_T)$ is

$$C_T(x_T) = \alpha x_T, \tag{3}$$

where x_T is the output level of production in the energy sector and $\alpha(\alpha>0)$ is the parameter about productivity. Linear cost function is chosen in all chapters for simplicity and finding clear results for rent-seeking and resource movement. Otherwise, results will depend on parameter values which become difficult for comparison among chapters. Hence, the cost functions (1 and 3) are useful in terms of rent-seeking facilitation and specific results. The parameter α is seen as a boom (natural resource abundance) or a technological advancement. Profit maximization in the energy sector is

$$\max_{x_T} P_T x_T - C_T(x_T), \quad (4)$$

where P_T is the price of good in the energy sector.

Let's assume that all of the output of the firm is sold on the domestic market. The inverse demand function in the energy sector is given by

$$P(x_T) = \beta - \gamma x_T, \quad (5)$$

where x_T is the quantity of demand in the energy sector. $\beta > 1$ and γ is the positive parameter. The assumption of $\alpha<\beta$ remains in chapter 1 through chapter 5.

2.1 Social optimum case

Commodity market in the energy sector

Let $(x_T{}^0, P_T{}^0)$ be an allocation of commodity markets of the energy sector at equilibrium. From the equation (3), the marginal cost is equal to its price in a social optimum case and it gives

$$P_T{}^0 = \alpha. \quad (6)$$

Solving the equations (5) and (6) yields

$$x_T{}^0 = \frac{\beta-\alpha}{\gamma}. \quad (7)$$

In the social optimum quantity case, the profit of the firm will be zero in the energy sector. We get

$$\pi(x_T{}^0) = 0. \quad (8)$$

Namely we get

$$P(x_T{}^0)\, x_T{}^0 - \alpha x_T{}^0 = 0. \quad (9)$$

Labor market

Suppose that the total number of workers is unity. Let $(l_T{}^O, l_N{}^O)$ be a pair of labor at equilibrium in each sector. An equilibrium condition of labor market is

$$l_T{}^O + l_N{}^O = 1. \tag{10}$$

Because one unit of labor produces one unit of services, the wage rate at equilibrium is unity. Also, services are the numeraire of the economy and all prices are in terms of units of the service good, whose price is normalized to one. The chapter only considers equilibriums where the economy produces some output of the numeraire sector. In general, the cost of production in this model is the product of wage rate and the use of labor. By using the equations (3) and (7) the labor in the energy sector is determined as follows:

$$l_T{}^0 = \alpha x_T{}^0$$

or

$$l_T{}^0 = \frac{\alpha(\beta-\alpha)}{\gamma}. \tag{11}$$

From equilibrium condition of labor market, the labor in the services sector:

$$l_N{}^0 = 1 - l_T{}^0. \tag{12}$$

After plugging the equation (11) into the equilibrium condition of labor market we get

$$l_N{}^0 = \frac{\gamma-\alpha(\beta-\alpha)}{\gamma}. \tag{13}$$

Commodity market in the services sector

Let $(x_N{}^0, P_N{}^0)$ be an allocation of commodity markets of the services sector at equilibrium. This model formulation does not depend on the services sector. The equation (1) and the first order condition for the equation (2) shows that the price in services sector will be equal to unity in the model.

$$P_N{}^0 = 1. \tag{14}$$

Because of the equation (1) labor inputs are equal to the quantity in the services sector, we get

$$x_N{}^0 = l_N{}^0. \tag{15}$$

By using equation (12), we can rewrite (15) as

$$x_N{}^0 = 1 - \frac{\alpha(\beta-\alpha)}{\gamma}$$

$$= \frac{\gamma-\alpha\beta+\alpha^2}{\gamma}. \tag{16}$$

2.1.1 Analysis of the social optimum case

The effect of the boom on the labor markets

By referring to Corden and Neary (1982), the boom will be improvement in technological productivity. For the model, decreasing α is taken as a boom because it implies decreasing costs due to advancement in technology. Differentiating the equations (11) and (13) with respect to α gives

$$\frac{dl_N{}^0}{d\alpha} = \frac{2\alpha-\beta}{\gamma}, \tag{17}$$

and

$$\frac{dl_T{}^0}{d\alpha} = \frac{\beta-2\alpha}{\gamma}. \tag{18}$$

If $\alpha > \frac{\beta}{2}$, then the equation (17) is positive, and the equation (18) is negative. It implies that when the degree of technological advancement is sufficiently large, the boom in the energy sector induces the labor inputs to move from the services sector to the energy sector. Following Corden and Neary (1982), this movement of labor is called as resource movement effect.

The effect of the boom on the commodity markets

Additionally, by following Corden and Neary (1982), the effect of the boom on outputs will be determined. The boom in the energy sector increases the output in this sector:

$$\frac{d{x_T}^0}{d\alpha} = -\frac{1}{\gamma} < 0. \tag{19}$$

A marginal effect of the boom on the output in the services sector depends on parameter values:

$$\frac{d{x_N}^0}{d\alpha} = \frac{2\alpha-\beta}{\gamma}. \tag{20}$$

Let $Y^0 = {x_T}^0 + {x_N}^0$ be the total output in the social optimum case with given world prices (Hindricks and Myles, 2013). A marginal effect of the boom on the total output is

$$\frac{dY^0}{d\alpha} = \frac{2\alpha-\beta-1}{\gamma}. \tag{21}$$

The sign of the equation (21) is negative (positive) if

$\beta > (<) 2\alpha - 1$ or $\alpha < (>) \frac{\beta}{2} + \frac{1}{2}$.

The equations (17), (18) and (21) give the following Lemma:

Lemma 1

i. If $\frac{\beta}{2} < \alpha < \frac{\beta}{2} + \frac{1}{2}$, then the boom generates resource movement effect and increases total output.

ii. If $\alpha > \frac{\beta}{2} + \frac{1}{2}$, then the boom generates resource movement effect and decreases total output.

iii. If $\alpha < \frac{\beta}{2}$, then the boom does not generate the resource movement effect.

It is clear from Figure 1 that the first argument of the lemma 1 includes the place which is mentioned between two vertical lines ($\frac{\beta}{2}$ *and* $\frac{\beta+1}{2}$). The second argument is located on the right side of the vertical line ($\frac{\beta+1}{2}$). Finally, the third argument is on the left side of the vertical line ($\frac{\beta}{2}$).

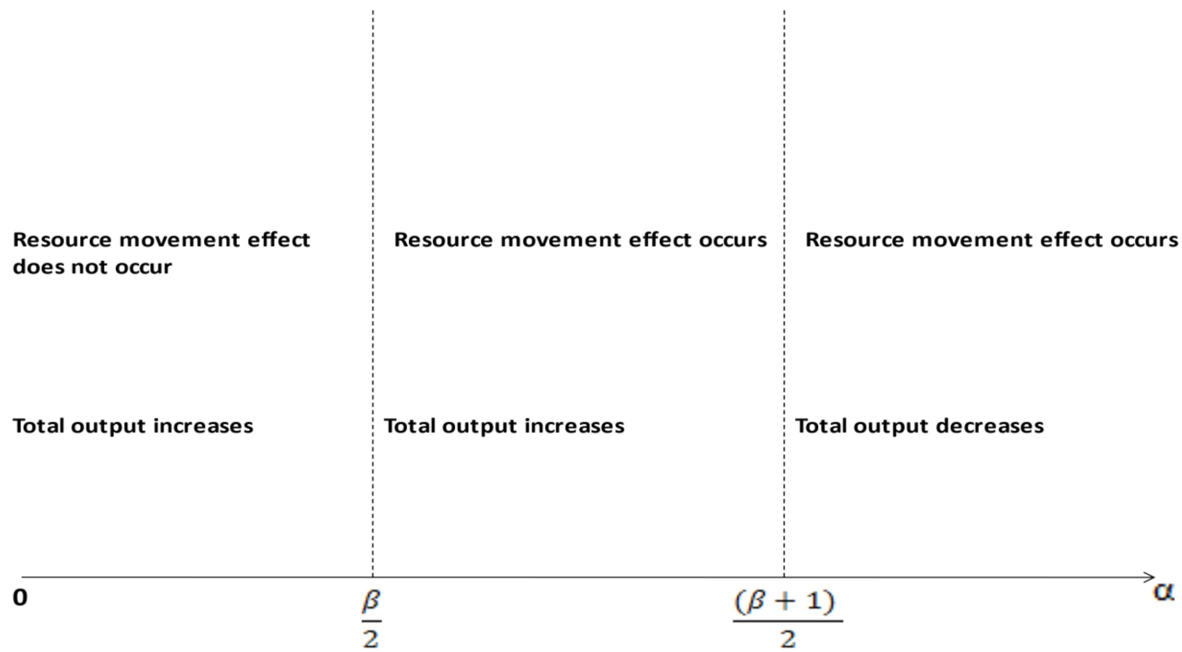

Figure 1. Lemma 1

As it is mentioned previously, workers in the non-resource sector move from this sector to the energy sector under the Dutch disease concept, and the output level in the services sector decreases due to the boom. In the social optimum case, in order to determine whether the Dutch disease occurs, the arguments with resource movement occurrence in the lemma 1 together with the income reduction in the services sector should be checked. The first and the second arguments of the lemma 1 show the occurrence of the resource movement effect. The equations

(19) and (20) show that the output of the energy sector will increase but the output of the services sector depends on the parameter values. The equations (17) and (20) mean that when $\alpha > \frac{\beta}{2}$, then the resource movement will occur together with the reduction of output in the services sector (Dutch disease occurs). The first and the second arguments correspond to the Dutch disease outcomes. The second argument is more serious because of the reduction of total output. If alfa is sufficiently large ($\alpha > \frac{\beta}{2} + \frac{1}{2}$), the total output decreases due to the boom along with the resource movement effect.

Intuitively, the occurrence of the Dutch disease in the lemma 1 is related to the sufficient degree of the boom ($\alpha > \frac{\beta}{2}$) due of the cost function (3) in the energy sector. With higher α the costs in the energy sector will be higher by making it more inefficient. And labor is the only input in this model and, thus, with higher costs the wages will increase in the energy sector. Increasing wages will motivate the workers in the services sector to move to the energy sector by inducing the resource movement effect and the Dutch disease phenomenon.

2.2 Monopoly case

In this section, the focus will be on a monopoly for figuring out commodity market and labor market differences from the social optimum case. Monopolies in some resource-abundant countries can impact markets negatively by causing insufficient development of competition due to their powers through creation of barriers. In Chernova and Razmanova (2018) paper, it is mentioned that large oil companies in Russia operate in all segments of oil market, which allows them to have a full domination in every aspect of the market by hindering others to have an access. High level of economic concentration of these companies (Rosneft, Lukoil, Surgutneftegas, Gazprom-Neft) in the Russian oil market and their existence is considered the main barriers for entry. Monopolies can also set high gasoline prices which negatively influence consumers in a local market. One study (Luis et al., 2020) in Spain shows that two largest monopolies (Repsol and Cepsa) charge high fuel prices to consumers due to having excessive level of market concentration and control of market.

Moreover, the monopoly case is added here in order to compare with other studies because they focus on several firms, and as it is mentioned above, a single firm model with a rent formulation in this chapter is not mentioned previously in the context of Corden and Neary (1982) model.

Commodity market in the energy sector

Let $(x_T{}^m, P_T{}^m)$ be an allocation of commodity markets of energy sector at equilibrium with the monopoly. These are determined as follows:

$$MC = \alpha, \tag{22}$$

and

$$MR = \beta - 2\gamma x_T{}^m, \tag{23}$$

where *MC* is a marginal cost and *MR* is a marginal revenue.

From the profit maximization condition, marginal revenue is equal to marginal cost *(MR = MC)* in the monopoly case and solving these equations yields

$$P_T{}^m = \frac{\beta+\alpha}{2}, \tag{24}$$

and

$$x_T{}^m = \frac{\beta-\alpha}{2\gamma}. \tag{25}$$

Profit of the monopoly will be

$$\pi(x_T{}^m) = \frac{(\beta-\alpha)^2}{4\gamma}. \quad (26)$$

Labor market

Let $(l_T{}^m, l_N{}^m)$ be a pair of labor at equilibrium in each sector. In the monopoly case, labor input in the energy sector will be

$$l_T{}^m = \frac{\alpha(\beta-\alpha)}{2\gamma}\,. \quad (27)$$

From the equation (11) we get

$l_T{}^m < l_T{}^0$.

This inequality means the labor input in the social optimum case is larger than the labor input in the monopoly case. Intuitively, in the social optimum quantity case, more quantities of goods are produced for a society by using more labor compared to the monopoly case.

From the equilibrium condition of labor market, the labor in the services sector:

$$l_N{}^m = \frac{2\gamma-\alpha\beta+\alpha^2}{2\gamma}. \quad (28)$$

Commodity market in the services sector

Let $(x_N{}^m,\ P_N{}^m)$ be an allocation of commodity markets of the services sector at equilibrium. The equation (1) and the first order condition for the equation (2) give

$$P_N{}^m = 1, \quad (29)$$

and

$$x_N{}^m = \frac{2\gamma-\alpha\beta+\alpha^2}{2\gamma}. \quad (30)$$

2.2.1 Analysis of the monopoly case

The effect of the boom on the labor markets

Differentiating labor inputs in both sectors with respect to α gives

$$\frac{d{l_N}^m}{d\alpha} = \frac{2\alpha-\beta}{2\gamma}, \tag{31}$$

and

$$\frac{d{l_T}^m}{d\alpha} = \frac{\beta-2\alpha}{2\gamma}. \tag{32}$$

If $\alpha > \frac{\beta}{2}$, then the equation (31) is positive and the equation (32) is negative. It means that the resource movement effect will occur. By comparing the equation (17) with the equation (31), it is clear that the resource movement effect will occur under the condition of $\alpha > \frac{\beta}{2}$ in both of social optimum and monopoly cases. Dutch disease also occurs due to reduction in the services sector under the case of $\alpha > \frac{\beta}{2}$. The reason is related to the cost function of the monopoly (3), and marginal cost is constant.

The effect of the boom on the commodity markets

The boom in the energy sector increases the output in this sector:

$$\frac{d{x_T}^m}{d\alpha} = \frac{1}{2\gamma} < 0. \tag{33}$$

From the equation (1) we get

$$\frac{d{x_N}^m}{d\alpha} = \frac{d{l_N}^m}{d\alpha}. \tag{34}$$

From the equations (34) and (31) we get

$$\frac{d{x_N}^m}{d\alpha} = \frac{2\alpha-\beta}{2\gamma}. \tag{35}$$

The above equation implies a marginal effect of the boom on the output in the services sector can be positive or negative depending on parameter values.

Let $Y^m = x_T{}^m + x_N{}^m$ be the total output of the monopoly case with given world prices (Hindricks and Myles, 2013). A marginal effect of the boom on the total output is given as

$$\frac{dY^m}{d\alpha} = \frac{2\alpha-\beta-1}{2\gamma}. \tag{36}$$

The sign of the equation (36) is negative (positive) if

$\beta > (<) 2\alpha - 1$ or $\alpha < (>) \frac{\beta}{2} + \frac{1}{2}$.

The equations (31), (32) and (36) give the same results to the lemma 1. As it is mentioned above, it is related to the cost function (3) in the energy sector. Dutch disease will occur under the same condition as in the social optimum case ($\alpha > \frac{\beta}{2}$).

2.3 Monopoly with rent-seeking case

The main goal of the model is to determine how rent seeking monopoly in the energy sector affects labor inputs in both sectors and overall total output. Previous studies also do not mention a model of rent seeking monopoly affecting the above mentioned sectors under Corden and Neary's (1982) model. Additionally, social costs of rent seeking monopolies can actually be higher, and Posner (1975) estimates that between 1.7-3.5 percent of GNP (Gross National Product) of the USA could have been lost due to monopolization. According to Cowling and Mueller (1978) calculation, the loss for the USA and the UK altogether is between 3-7.2 percent of GNP. Rent-seeking activities of oil companies can harm the society through increasing level of corruption as well. Vicente (2010) shows that ExxonMobil received oil exploration rights in Sao-Tome and Principe in 1998 and, afterwards, corruption level significantly increased in that country compared to the previous years. In the case of Brazil, oil industry is predominantly monopolistic, and one study (Caselli and Michaels, 2013) finds that corruption is widespread in oil-rich municipalities where rents are acquired through political process.

Labor market

Hindricks and Myles (2013, p. 389) state that unlike profit-seeking, rent-seeking is considered to be the dissipation of resources for generating profitable opportunity that is harmful for society. This chapter features the level of resources (labor) wasted in the rent-seeking process, a time. Rent seekers utilize discussion opportunity with politicians for rent-seeking activities. This could have been used in some more productive activities (profit-seeking), and this generates huge opportunity cost.

Suppose that there are a number of potential monopolists. A monopolist can hike the market price of energy and receive a profit represented by the equation (26). The value of having a monopoly position, that is, a rent which is the extra profit generated by a monopoly position and it will be the difference between the profits in monopoly and social optimum cases. Potential monopolists enter the energy sector by simultaneously proposing how much money they will burn. It is assumed that potential monopolists are all identical and risk-neutral. A potential monopolist that burns the most money will be a monopolist in the energy sector. The entire value of the rent will be dissipated, and it will be shown below in the equation (38). These are known as complete dissipation theorem (Hindrick and Myles, 2013, p. 393).

In this model, the money that a potential monopolist burns corresponds to a labor. Let ${l_L}^l$ be the use of labor for rent-seeking activity. An equilibrium condition of labor market will be

$${l_T}^l + {l_N}^l + {l_L}^l = 1, \tag{37}$$

where superscript l indicates monopoly with rent-seeking case.

In this model, the prize for the monopolist will be a rent, which is the difference between profits in the social optimum case $(\pi(x_T{}^0))$ and the monopoly case $(\pi(x_T{}^m))$ because the monopoly profit is higher than the one in the social optimum case. By applying the previously mentioned theorem, the labor that is used for rent-seeking can be determined, which means that resources that are used in rent-seeking up to the point where additional profit is exactly equal to the resource cost. The value of labor that the monopoly will allocate to rent-seeking is obtained by the equations (8) and (26)

$$l_L{}^l = \pi(x_T{}^m) - \pi(x_T{}^0)$$

$$= \frac{(\beta-\alpha)^2}{4\gamma}. \qquad (38)$$

From the equilibrium condition of labor market, the labor in the services sector:

$$l_N{}^l = 1 - l_T{}^l - l_L{}^l. \qquad (39)$$

The labor inputs in the services sector is obtained by using the equations (27) and (38) as

$$l_N{}^l = \frac{4\gamma-\beta^2+\alpha^2}{4\gamma}. \qquad (40)$$

Commodity market in the services sector

Let $(x_N{}^l, P_N{}^l)$ be an allocation of commodity markets of the services sector at equilibrium. The equation (1) and the first order condition for the equation (2) give

$$P_N{}^l = 1, \qquad (41)$$

and

$$x_N{}^l = l_N{}^l. \qquad (42)$$

From the equation (40) and (42) we get

$$x_N{}^l = \frac{4\gamma-\beta^2+\alpha^2}{4\gamma}. \qquad (43)$$

2.3.1 Analysis of the monopoly with rent-seeking case

The effect of the boom on the labor markets

Differentiating labor inputs in the equations (27), (38) and (40) with respect to α gives

$$\frac{d{l_T}^l}{d\alpha} = \frac{\beta - 2\alpha}{2\gamma}, \tag{44}$$

$$\frac{d{l_L}^l}{d\alpha} = -\frac{(\alpha+\beta)}{2\gamma} < 0, \tag{45}$$

and

$$\frac{d{l_N}^l}{d\alpha} = \frac{\alpha}{2\gamma} > 0. \tag{46}$$

The equation (44) is negative when $\alpha > \frac{\beta}{2}$. In words, when the degree of technological advancement is sufficiently large, the boom in the energy sector increases the labor in this sector. The equation (45) means that if the boom occurs, the labor resource used in rent-seeking strictly increases because the monopoly will be motivated to gain more rent by engaging in more rent-seeking activities, which in turn will increase labor inputs for rent-seeking activities according to the complete dissipation theorem mentioned above. There are two sectors in the model, and the equation (46) means that the resource movement effect will definitely occur because the equation is strictly positive and does not depend on the parameter values. Workers who move from the services sector will engage in either rent-seeking activity (45) or production of energy (44) and this depends on the parameter values. For the production of energy to occur, there needs to be an adequate degree of the boom ($\alpha > \frac{\beta}{2}$) because the equation (44) shows that the labor inputs in the energy sector increases under the condition of $\alpha > \frac{\beta}{2}$.

The effect of the boom on the commodity markets

The boom in the energy sector increases the output in this sector:

$$\frac{d{x_T}^l}{d\alpha} = - \frac{1}{2\gamma} < 0. \qquad (47)$$

From the equation (1) we get

$$\frac{d{x_N}^l}{d\alpha} = \frac{d{l_N}^l}{d\alpha}. \qquad (48)$$

From the equations (46) and (48) we get

$$\frac{d{x_N}^l}{d\alpha} = \frac{\alpha}{2\gamma} > 0. \qquad (49)$$

The equation above shows that the boom in the energy sector decreases the output in the services sector.

Let $Y^l = {x_T}^l + {x_N}^l$ be the total output of the rent seeking monopoly case with given world prices (Hindricks and Myles, 2013). The reason why we use this definition of total output is that the only change will occur in ${x_N}^l$ due to rent-seeking activity. By summing up the equations (47) and (49) we will see that total output will decrease depending on the value of α

$$\frac{dY^l}{d\alpha} = \frac{\alpha - 1}{2\gamma}. \qquad (50)$$

The equations (45), (46) and (50) give the following proposition:

Proposition

When there is a rent seeking monopoly in the energy sector:

i. The boom induces labor inputs to move from the services sector to the energy sector meaning that the resource movement effect will definitely occur.

ii. The boom facilitates rent-seeking activities.

iii. If the marginal cost is sufficiently large, then the boom decreases total output.

After checking the results of the analysis in the case of monopoly with rent-seeking activities, it is clear that the resource movement effect will definitely occur and the output of the services sector will decrease (Dutch disease phenomenon). This conclusion is supported by referring to the equations (46) and (49). Workers will certainly move from the services sector to the energy sector in order to engage in rent-seeking and production of energy. The rent seeking monopoly in the energy sector needs labor inputs for generating monopoly profits, and some of these inputs will be used for rent-seeking activities. The monopoly without rent-seeking mitigates the resource movement effect problem. However, in the rent seeking monopoly case this kind of mitigation decreases and changes the outcome.

In order to support the first argument of the proposition, the equation (46) is used which shows that the resource movement effect does not depend on the parameter values in the rent seeking monopoly case, and labor inputs will move from the services sector to the energy sector by participating in either in rent-seeking activities or production of energy. The production of energy will depend on the degree of the technological advancement $(\alpha > \frac{\beta}{2})$.

For supporting the second argument of the proposition, the equation (45) is a variable of degree $({l_L}^l)$ of rent-seeking activities in the model because the boom facilitates workers to engage in rent-seeking in the energy sector. Unlike profit-seeking activities, this variable will induce the wastage of resources within an economy without participating in production. The rent-seeking variable will contribute more to the Dutch disease phenomenon because it will demand more labor inputs from the services sector by worsening the situation (through dissipation).

As for the support of the third argument of the proposition, the equation (50) is used. It depends only on the parameter value of α. Hence, total output will decrease under the condition of $\alpha > 1$. So, if the marginal cost is sufficiently large, then the boom decreases total output. In the case of $0 < \alpha < 1$ total output will increase. The decline of the total output will be partly related to the dissipation of the resources. Rent-seeking actually negatively affects the services sector along with the overall economy. This effect is unambigous on the outputs (services), labor inputs and total output (under certain parameters) by adding the variable of degree $(l_L{}^l)$ of rent-seeking into the monopoly case. Overall, the rent-seeking variable impacts all aspects of the model, and rent-seeking as a political issue results in more findings under the context of Dutch disease by contributing to the literature of political economy

3. Conclusion

This chapter concentrates on the rent seeking monopoly in the energy sector and shows how the incomes and labor inputs are affected. It is demonstrated that under the natural resource boom, the resource movement effect will definitely occur when there is a rent seeking monopoly in the energy sector, which means that labor inputs will move to the energy sector from the services sector, and the boom will unambiguously facilitate rent-seeking activities. The effect of boom on the total output under the rent seeking monopoly case depends on the parameter value. It is also concluded that there is an indication of the Dutch disease under the rent seeking monopoly case due to the resource movement effect and the decline of the output in the services sector.

The key difference between the model in this chapter and the previous studies (Lane and Tornell, 1996; Tornell and Lane, 1999; Baland and Francois, 2000; Torvik, 2002) is the formulation of rent-seeking activity and number of firms in different sectors. This chapter concentrates on a single firm in the energy sector, and it is important to keep in mind that this model does not dispute the results achieved in past studies but explains the rent-seeking from a monopoly perspective through different formulation (difference of profits between monopoly and social optimum cases).

Chapter 2

Rent Seeking Duopoly Collusion Analysis in Energy Sector

1. Introduction

In order to explain how this chapter differs from the previous chapter of monopoly case, Cournot (1838) duopoly and collusion model will be used here. Major difference is related to the formulation of rent-seeking in this chapter. The rent is formulated as the difference between profits in collusion and no collusion cases. Here, the model will show how colluding duopoly with rent-seeking activities in energy sector will affect labor inputs and total output by focusing on two sectors (energy and services). The reason is that collusion and rent-seeking in energy sector is widespread in several countries according to past studies (Ogbuabor et al., 2018, Ogbuabor and Onuigbo, 2018, 2019; Gillies, 2020; Li et al., 2020; Ogbuabor et al., 2020). Additionally, rent seeking duopoly collusion (with different rent formulation as well) analyzing the Dutch disease is not mentioned in previous studies to the best knowledge of the author and, thus, it will be another contribution to the literature of Dutch disease and rent-seeking.

Furthermore, this chapter also focuses only on the resource movement effect and removes the spending effect for simplicity under an assumption of the fixed consumer behavior (fixed demand). Hence, consumers have fixed behavior and they do not assume the level of income. Demand curve does not depend on boom because then the spending effect occurs in the contrary. Thus, the research focus only on the resource movement effect (first part of Dutch disease) for determining rent-seeking. The rent-seeking activities of colluding firms will be analyzed, and it will be shown how they affect the resource movement effect and total output. The model will demonstrate that depending on the degree of the boom the resource movement effect may occur if there is a colluding duopoly with rent-seeking activities in the energy sector. Rent-seeking may be facilitated and total output may decrease, and this also depends on the degree of the boom because in Cournot competition, firms move from competition case to collusion case under rent-seeking activities. Due to the formulation of the rent as the difference of profits between collusion and no collusion cases, some resources (labor inputs in the model) are dissipated to capture rents for gaining collusion position and other parts of resources are used for production. Most importantly, previous chapter shows that rent-seeking is definitely facilitated and total output certainly decreases under the rent seeking monopoly model. However, rent-seeking may be facilitated and total output may decrease, and this depends on the degree of the boom in this chapter because in Cournot competition, firms move from competition case to collusion case under rent-seeking activities. Moreover, in the rent seeking monopoly case, the rent is higher than the collusion case because monopoly has no competitors and the rent is formulated as the difference between the profits of monopoly and social optimum cases in the previous chapter. This paper formulates the rent under Cournot competition as the difference of profits between collusion and no collusion cases. So, monopoly dissipates more resources (labor inputs in this model) to capture larger rents for gaining monopoly position. Nonetheless, in the collusion case, the rent is smaller than the previous case meaning that less resources are wasted in order to achieve collusion. As a result, total output definitely decreases under the monopoly during the boom unlike this chapter.

2. The Model

In this chapter also it is assumed that there are two sectors such as services and energy sectors with constant return to scale production. The input in each sector is labor and a quantity of labor is supplied in-elastically by workers. This is divided between production of the two goods in two sector and labor is perfectly mobile between sectors. For clear results, the skill categories for labor is not considered here and full employment is maintained (no distortions in commodity or labor markets). The effects of asymmetric growth between energy and services on resource allocation is analyzed (by ignoring monetary considerations (implications for real variables, not the nominal ones). The model also shuts down the possibility of real exchange rate appreciation by assuming a closed economy. The cost function $C_N(x_N)$ in the services sector is given as

$$C_N(x_N) = x_N, \tag{51}$$

where x_N is the output level of production in the services sector. Profit maximization is given as

$$\max_{x_N} P_N x_N - C_N(x_N), \tag{52}$$

where P_N is the price of good in the services sector.

Let's assume there are two firms also producing homogeneous product in the energy sector with following cost functions:

$$C_{T1}(x_{T1}) = \alpha x_{T1}, \tag{53}$$

and

$$C_{T2}(x_{T2}) = \alpha x_{T2}, \tag{54}$$

where x_{T1} and x_{T2} are the output levels of production in the energy sector and α is the parameter about resource boom. Linear cost functions are taken for simplicity and obtaining clear results in terms of rent-seeking and resource movement effect. Applying other cost functions makes results difficult for comparison among chapters. So, this chapter's cost functions (1 and 3) are useful in terms of rent-seeking calculation and its distinct impact. Profit maximization in this sector is

$$\max_{x_{T1}} P_{T1}x_{T1} - C_{T1}(x_{T1}), \tag{55}$$

and

$$\max_{x_{T2}} P_{T2}x_{T2} - C_{T2}(x_{T2}), \tag{56}$$

where P_T is the price of good in the energy sector.

Let's assume that all of the output of the firms is sold on the domestic market. The inverse demand function in the energy sector is given by

$$P(x_{T1} + x_{T2}) = \beta - \gamma x_T$$

$$= \beta - \gamma x_{T1} - \gamma x_{T2} \,, \tag{57}$$

where x_T is quantity of demand in the energy sector. β and γ are the positive parameters. Also, we assume $\beta>1$ for reaching the solid conclusion.

2.1 Cournot duopoly case

Commodity market in the energy sector

In Cournot competition, the firms (with non-negative quantities) compete by choosing their quantity levels simultaneously in order to maximize their profits. Each firm (with full knowledge of the market) choses its quantity by assuming rival's quantities as given. The resulting equilibrium will be called Cournot equilibrium (in terms of quantities). It is possible to compute the Cournot equilibrium by solving reaction functions simultaneously. Let (${x_{T1}}^C$, ${x_{T2}}^C$, ${P_T}^C$) be an allocation of commodity markets of the energy sector at equilibrium under Cournot competition. Under profit maximization conditions (where marginal cost is equal to marginal revenue for each firm) from the equations (55) and (56) it gives

$$\frac{d\Pi_{T1}{}^{C}}{dx_{T1}{}^{C}} = \beta - 2\gamma x_{T1}{}^{C} - \gamma x_{T2}{}^{C} - \alpha$$

$$= 0, \tag{58}$$

and

$$\frac{d\Pi_{T2}{}^{C}}{dx_{T2}{}^{C}} = \beta - 2\gamma x_{T2}{}^{C} - \gamma x_{T1}{}^{C} - \alpha$$

$$= 0. \tag{59}$$

Solving these equations yields the following quantities with reaction functions

$$x_{T1}{}^{C} = r_1(\,x_{T2}{}^{C})$$

$$= \frac{\beta - \alpha - \gamma x_{T2}{}^{C}}{2\gamma}$$

$$= \frac{\beta - \alpha}{3\gamma}, \tag{60}$$

$$x_{T2}{}^{C} = r_2(x_{T1}{}^{C})$$

$$= \frac{\beta - \alpha - \gamma x_{T1}{}^{C}}{2\gamma}$$

$$= \frac{\beta - \alpha}{3\gamma}, \tag{61}$$

and

$$x_{T}{}^{C} = x_{T1}{}^{C} + x_{T2}{}^{C}$$

$$= \frac{2\beta - 2\alpha}{3\gamma}. \tag{62}$$

We plug the equations (60) and (61) into the equations (58) and (59). The profits of the firms under Cournot competition in the energy sector will be

$$\Pi_{T1}{}^{C} = \Pi_{T2}{}^{C}$$

$$= \frac{(\beta - \alpha)^2}{9\gamma}, \tag{63}$$

and

$$\Pi_T{}^C = \Pi_{T1}{}^C + \Pi_{T2}{}^C$$

$$= \frac{2(\beta-\alpha)^2}{9\gamma}. \tag{64}$$

Labor market

Suppose that the total number of workers is unity. Let $(l_{T1}{}^C,\ l_{T2}{}^C,\ l_N{}^C)$ be the labor at equilibrium in each sector. An equilibrium condition of labor market is

$$l_{T1}{}^C + l_{T2}{}^C + l_N{}^C = 1. \tag{65}$$

The cost of production in this model also is the product of wage rate and the use of labor. By using the equations (53), (54), (60) and (61) the labor in the energy sector is determined as follows:

$$l_{T1}{}^C = l_{T2}{}^C$$

$$= \alpha x_{T1}{}^C$$

$$= \alpha x_{T2}{}^C$$

$$= \frac{\alpha(\beta-\alpha)}{3\gamma}, \tag{66}$$

and

$$l_T{}^C = l_{T1}{}^C + l_{T2}{}^C$$

$$= \frac{2\alpha(\beta-\alpha)}{3\gamma}. \tag{67}$$

From the equilibrium condition of labor market, the labor in the services sector:

$$l_N{}^C = 1 - l_{T1}{}^C - l_{T2}{}^C$$

$$= \frac{3\gamma-2\alpha\beta+2\alpha^2}{3\gamma}. \tag{68}$$

Commodity market in the services sector

Let $(x_N{}^C, P_N{}^C)$ be an allocation of commodity markets of the services sector at equilibrium. As it is mentioned in the previous chapter, services are the numeraire of the economy and all prices are in terms of units of the service good, whose price is normalized to one. This chapter also only considers equilibriums where the economy produces some output of the numeraire sector. In this sector, the equilibrium is determined in the same logic as in chapter 1. There are two big energy firms. They reach the Cournot equilibrium. Hence, they employ the amount of workers as in the equation (67). $l_N{}^C$ is the rest of the workers in the economy. They must be employed in the service sector. There is an assumption that $\alpha > 1$, because of the constant marginal cost (one) in this sector, the equilibrium price of the product must be one in the same logic as in chapter 1. The equation (51) and first order condition from the equation of (52) gives

$$P_N{}^C = 1, \tag{69}$$

and

$$x_N{}^C = l_N{}^C. \tag{70}$$

From the equations (68) and (70) we get

$$x_N{}^C = \frac{3\gamma - 2\alpha\beta + 2\alpha^2}{3\gamma}. \tag{71}$$

2.1.1 Analysis of the Cournot duopoly case

The effect of the boom on the labor markets

By referring to Corden and Neary (1982), the boom is considered as an improvement in technological productivity. Here, decreasing α is also taken as the boom because it implies decreasing costs due to technological improvement. Differentiating the equations (67) and (68) with respect to α gives

$$\frac{dl_N{}^C}{d\alpha} = \frac{4\alpha - 2\beta}{3\gamma}, \tag{72}$$

and

$$\frac{dl_T{}^C}{d\alpha} = \frac{2\beta - 4\alpha}{3\gamma}. \tag{73}$$

If $\alpha > \frac{\beta}{2}$, then the equation (72) is positive, and the equation (73) is negative. It implies that when the degree of technological advancement is sufficiently large, the boom in the energy sector induces the labor inputs to move from the services sector to the energy sector.

The effect of the boom on the commodity markets

The effect of the boom on outputs will be determined by following the above mentioned study (Corden and Neary, 1982). The boom in the energy sector increases the output in this sector. After differentiating the equation (62) with respect to α:

$$\frac{dx_T{}^C}{d\alpha} = -\frac{2}{3\gamma} < 0. \tag{74}$$

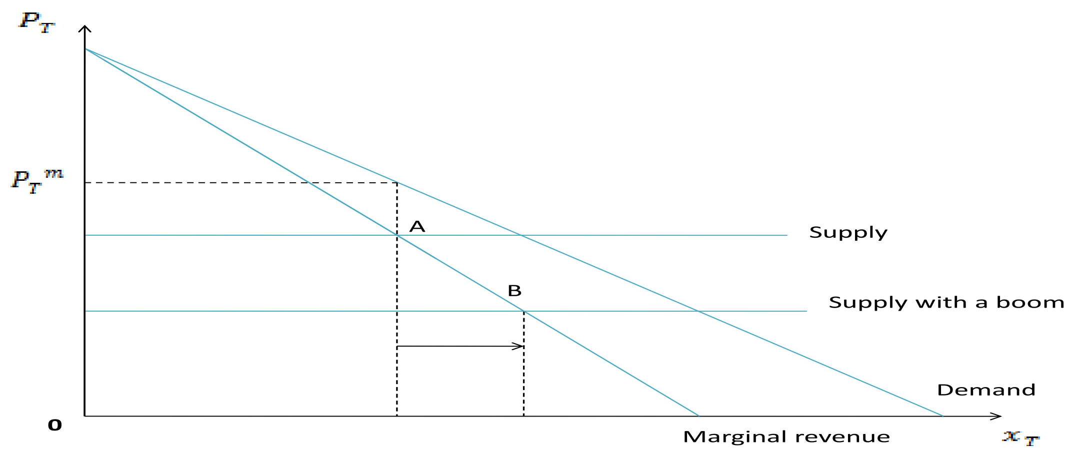

Figure 2. Firms in Cournot duopoly

Figure 2 describes the inverse demand curve and supply curve for each identical firm producing homogeneous products with identical cost function in the energy sector. The boom as a technological advancement induces the inverse supply curve to shift down by increasing the equilibrium quantity as a result, and it is consistent with the equation (74). The profit maximization *(MR = MC)* point moves from the point A to the point B.

A marginal effect of the boom on the output in the services sector depends on parameter values. After differentiating the equation (71) with respect to α:

$$\frac{dx_N{}^C}{d\alpha} = \frac{4\alpha-2\beta}{3\gamma}. \tag{75}$$

Let $Y^C = x_T{}^C + x_N{}^C$ be the total output in the Cournot duopoly case with given world prices (Hindricks and Myles, 2013). From the equations (62) and (71), a marginal effect of the boom on the total output is

$$\frac{dY^C}{d\alpha} = \frac{4\alpha-2\beta-2}{3\gamma}. \tag{76}$$

The sign of the equation (76) is negative (positive) if

$\beta > (<) 2\alpha - 1$ or $\alpha < (>) \frac{\beta}{2} + \frac{1}{2}$.

This means that if the boom is sufficiently large ($\alpha > \frac{\beta}{2} + \frac{1}{2}$), then total output will decrease because the equation (76) will be positive. Hence, degree of the boom affects the resource movement effect together with total output, and this is same as the lemma 1 due to the cost functions. Dutch disease will also occur under the condition of $\alpha > \frac{\beta}{2}$.

2.2 Collusion case

Collusion is usually illegal, and firms might tacitly collide by reducing output, which in turn will hike the price by increasing the profits of monopolies. According to Cournot (1838) the firms are motivated to create a cartel by changing Cournot model into a monopoly. In this section, the colluding firms will be analyzed for determining commodity market and labor market differences from the Cournot duopoly case. Furthermore, previous studies also mention tacit collusion (Bella and Cavero, 2008; Contı´n et al., 2008, 2009; Garcia, 2010; Luis et al., 2020) by describing Spanish retail gasoline market under colluding monopolies (Repsol and Cepsa), where they charge higher fuel prices for consumers. Although the energy market was liberalized in Spain, high market quotas facilitated collusive price equilibrium because the Repsol is vertically integrated company with huge market share (Garcia, 2010). So, liberalization of the Spanish oil market did not achieve its effective competition goals. This result in Spanish retail fuel market is similar to previous empirical study (Contı´n et al., 2008, 2009) analyzing the pricing behavior of the monopolies.

The collusion case is studied here because it is necessary to compare it with the previous studies mentioned above and, the collusion case also is not mentioned previously in the context of Dutch disease under Corden and Neary (1982) model.

Commodity market in the energy sector

Let $({x_{T1}}^{cl}, {x_{T2}}^{cl}, {P_T}^{cl})$ be an allocation of commodity markets of energy sector at equilibrium with collusion case. In this case, the costs will be summed up $(C_{T1}(y_{T1})+C_{T2}(y_{T2}))$ together with quantities $({x_{T1}}^{cl} + {x_{T2}}^{cl})$ under profit maximization condition. The reason is that they will share both of the costs together with quantities and it gives joint profits:

$$ {\Pi_T}^{cl}({x_{T1}}^{cl},\ {x_{T2}}^{cl}) = (\beta - \gamma {x_{T1}}^{cl} - \gamma {x_{T2}}^{cl})({x_{T1}}^{cl} + {x_{T2}}^{cl}) - \alpha {x_{T1}}^{cl} - \alpha {x_{T2}}^{cl}. \tag{77} $$

Taking partial derivatives with respect to ${x_{T1}}^{cl}$ and ${x_{T2}}^{cl}$ we get

$$ \frac{\partial {\Pi_{T1}}^{cl}}{\partial {x_{T1}}^{cl}} = \beta - 2\gamma {x_{T1}}^{cl} - 2\gamma {x_{T2}}^{cl} - \alpha $$

$$ = 0, \tag{78} $$

and

$$ \frac{\partial {\Pi_{T2}}^{cl}}{\partial {x_{T2}}^{cl}} = \beta - 2\gamma {x_{T2}}^{cl} - 2\gamma {x_{T1}}^{cl} - \alpha $$

$$ = 0. \tag{79} $$

The first order conditions for joint profit maximization is identical due to fact that the colluding firms in the model have the same cost curves and, hence, joint profit maximization requires ${x_T}^{cl} = {x_{T1}}^{cl} + {x_{T2}}^{cl}$, and from the equations (78) and (79) we get

$$ {x_T}^{cl} = \frac{\beta - \alpha}{2\gamma}. \tag{80} $$

We insert the equations (78) and (79) into the equation (77). The joint profits of the firms under collusion in the energy sector will be

$$ {\Pi_T}^{cl} = {\Pi_{T1}}^{cl} + {\Pi_{T2}}^{cl} $$

$$ = \frac{(\beta - \alpha)^2}{4\gamma}. \tag{81} $$

Labor market

Let $({l_{T1}}^{cl}, {l_{T2}}^{cl}, {l_N}^{cl})$ be the labor at equilibrium in each sector in the energy sector under the collusion case $({l_T}^{cl} = {l_{T1}}^{cl} + {l_{T2}}^{cl})$. From the equations (53), (54) and (80) the labor in the energy sector will be

$${l_T}^{cl} = {l_{T1}}^{cl} + {l_{T2}}^{cl}$$

$$= \frac{\alpha(\beta-\alpha)}{2\gamma}. \tag{82}$$

From the equations (67) and (82) we get

$${l_T}^{cl} < {l_T}^{C}.$$

It means labor inputs in duopoly case is larger than the ones in the collusion case. Intuitively, in no collusion case, more quantities of goods are produced for a society by using more labor compared to the collusion case.

From the equilibrium condition of labor market (65) and the equation (82), the labor in the services sector:

$${l_N}^{cl} = 1 - {l_{T1}}^{cl} - {l_{T2}}^{cl}$$

$$= \frac{2\gamma-\alpha\beta+\alpha^2}{2\gamma}. \tag{83}$$

Commodity market in the services sector

Let $({x_N}^{cl}, {P_N}^{cl})$ be an allocation of commodity markets of the services sector at equilibrium. The equation (51) and first order condition from the equation of (52) gives

$${P_N}^{cl} = 1, \tag{84}$$

and

$${x_N}^{cl} = {l_N}^{cl}. \tag{85}$$

From the equations (83) and (85) we get

$$x_N{}^{cl} = \frac{3\gamma - 2\alpha\beta + 2\alpha^2}{3\gamma}. \tag{86}$$

2.2.1 Analysis of the collusion case

The effect of the boom on the labor markets

Differentiating the labor input equations (82) and (83) with respect to α gives

$$\frac{dl_N{}^{cl}}{d\alpha} = \frac{2\alpha - \beta}{2\gamma}, \tag{87}$$

and

$$\frac{dl_T{}^{cl}}{d\alpha} = \frac{\beta - 2\alpha}{2\gamma}. \tag{88}$$

Here also if $\alpha > \frac{\beta}{2}$, then the equation (87) is positive, and the equation (88) is negative, which means that the resource movement effect occurs when the degree of technological advancement is sufficiently large. The results in the previous lemma can be applied here as well.

The effect of the boom on the commodity markets

From the equation (80) the boom in the energy sector increases the output in this sector:

$$\frac{dx_T{}^{cl}}{d\alpha} = -\frac{1}{2\gamma} < 0. \tag{89}$$

A marginal effect of the boom on the output in the services sector depends on parameter values from the equation (86):

$$\frac{dx_N{}^{cl}}{d\alpha} = \frac{2\alpha - \beta}{2\gamma}. \tag{90}$$

Let $Y^{cl} = x_T{}^{cl} + x_N{}^{cl}$ be the total output of the collusion case with given world prices

(Hindricks and Myles, 2013). And plugging the equations (80) and (86) into this we get a marginal effect of the boom on the total output as

$$\frac{dY^{cl}}{d\alpha} = \frac{2\alpha-\beta-1}{2\gamma}. \tag{91}$$

The sign of the equation (91) is negative (positive) if

$\beta > (<) 2\alpha - 1$ or $\alpha < (>) \frac{\beta}{2} + \frac{1}{2}$.

Generally, both cases show the same results in the analysis of labor and commodity markets because of the production function for firms. So, from the equation (87) the resource movement effect (as well as Dutch disease) will occur under the condition of $\alpha > \frac{\beta}{2}$, and from the equation (91) total output will decrease under the condition of $\alpha > \frac{\beta}{2} + \frac{1}{2}$.

2.3 Collusion case with rent-seeking

This chapter's main objective is to figure out how colluding firms with rent-seeking activities in the energy sector impact labor inputs and total output. Previous studies also do not mention this type of model under Corden and Neary's (1982) model. Past studies (Ogbuabor et al., 2018; Ogbuabor and Onuigbo, 2018, 2019) about Eurozone, Spanish and Italian cases show that collusion and rent-seeking behavior has clear signs in the energy markets of these regions. In case of Eurozone (Ogbuabor et al., 2018), colluding firms in road fuel markets manipulate the tax system for hiding long term rent-seeking behavior and gaining excess profits through collusive pricing, which is shown under the analysis of the years of 2004-2016. Rent-seeking and uncompetitive pricing is also rampant in Spanish diesel market between the years of 2005-2015 (Ogbuabor and Onuigbo, 2018). The firms practicing collusive behavior in Spanish automotive diesel market also exploit tax system for concealing their profitable rent-seeking activities and charge higher prices in the energy market. In the case of Italy, results indicate that after changes in crude oil costs, short-run collusion and rent-seeking was witnessed from the data analysis (2005-2015) (Ogbuabor and Onuigbo, 2019). Although actions of large firms (Eni and Agip) in oil retail market does show the problem in a short-term period, their dominant positions might lead to long-run rent-seeking acitivites combined with collusion, because the industry is deregulated and prices, imports and exports are determined by the firms in the Italian market. In addition, anticompetitive behavior of monopolies are widespread in global retail energy markets according to one study (between 2004-2016) (Ogbuabor et al., 2020). This paper shows that there is more likelihood of rent-seeking and collusive behavior in oil markets because the firms in the market also utilize tax system for hiding their rent-seeking activities and, hence, competition is negatively affected due to irregularities in firms' pricing strategies. In the case of Africa's oil boom, corruption was quite rampant in oil industry between the years of 2005-2014. National and private oil companies through illicit tactics engaged in corruption for capturing natural resource rents (Gillies, 2020). Oil companies hampered competition and government officials strengthened their political positions through rent-seeking activies in African natural resource industry.

Labor market

By referring to the rent formulation in the chapter 1, it is possible to apply similar strategy and determine the amount of rent-seeking in this model. Previous chapter concentrates on Hindricks and Myles (2013, p. 389) by stating that "… the level of resources (labor) wasted in the rent-seeking process, a time. Rent seekers utilize discussion opportunity with politicians for rent-seeking activities". Firms can collude and gain the profit which is mentioned in the equation (81). In the previous chapter, "…the value of having a monopoly position that is, a rent which is the extra profit generated by a monopoly position, and it will be the difference between the profits in monopoly and social optimum cases". However, in this model, the value of collusion will be a rent, which is considered as additional profit made by collusion. The difference between the profits of collusion and no collusion cases will be equal to the rent. For one thing, this profit will be attractive for them through rent-seeking, because they can receive it by removing others from the market by lobbying. Hence, rent-seeking (collusion) is advantageous for firms in order to create barriers to entry in the beginning and to become only firms in the energy market which is evident in previous studies (Ogbuabor and Onuigbo, 2018, 2019). Colluding firms in the energy sector which are under identical and risk-neutral assumptions, simultaneously offer how much money they will burn. Potential firms which will burn the most money will be colluding firms in the energy sector. Whole value of the rent will be dissipated under the equation (93), and according to Hindricks and Myles (2013, p. 393), it is known as complete dissipation theorem. Colluding firms in the model burns labor which corresponds to money mentioned above. Let ${l_L}^l$ be the labor burned for rent-seeking activities in the energy sector. An equilibrium condition of labor market will be

$$ {l_{Tcl}}^l + {l_N}^l + {l_L}^l = 1, \quad (92) $$

where superscript l indicates the collusion under rent-seeking case.

The prize for the colluding firms is the rent, and it is the difference between the profits with collusion $\left({\Pi_T}^{cl}\right)$ and without collusion cases $({\Pi_T}^C)$, because profits in collusion case is higher than the one without collusion case. The rent and the power in the market will induce them to collude (through rent-seeking) in order to get all the benefits by removing competitors from the market. The labor which is spent for rent-seeking can be figured out by applying the complete dissipation theorem, which means that "…labor inputs that are used for rent-seeking activities up to the point where additional profit is exactly equal to the resource cost" (Hindricks and Myles, 2013, p. 405). So, from the equation (64) and (81) the value of labor that colluding firms will spend for rent-seeking is

$$l_L{}^l = \Pi_T{}^{cl} - \Pi_T{}^C$$

$$= \frac{(\beta-\alpha)^2}{36\gamma}. \quad (93)$$

From the equilibrium condition of labor market, the labor in the services sector:

$$l_N{}^l = 1 - l_{Tcl}{}^l - l_L{}^l. \quad (94)$$

The labor inputs in the services sector is obtained by using the equations (82) and (93) as

$$l_N{}^l = \frac{36\gamma+17\alpha^2-16\alpha\beta-\beta^2}{36\gamma}. \quad (95)$$

Commodity market in the services sector

Let *($x_N{}^l$, $P_N{}^l$)* be a pair of commodity markets of the services sector at equilibrium. The equation (51) and the first order condition from the equation of (52) gives

$$P_N{}^l = 1, \quad (96)$$

and

$$x_N{}^l = l_N{}^l. \quad (97)$$

From the equations (95) and (97) we get

$$x_N{}^l = \frac{36\gamma+17\alpha^2-16\alpha\beta-\beta^2}{36\gamma}. \quad (98)$$

2.3.1 Analysis of the collusion with rent-seeking case

The effect of the boom on the labor markets

Differentiating the labor inputs in the equations (82), (93) and (95) with respect to α gives

$$\frac{dl_{Tcl}{}^{l}}{d\alpha} = \frac{\beta - 2\alpha}{2\gamma}, \tag{99}$$

$$\frac{dl_{L}{}^{l}}{d\alpha} = \frac{\alpha - \beta}{18\gamma}, \tag{100}$$

and

$$\frac{dl_{N}{}^{l}}{d\alpha} = \frac{17\alpha - 8\beta}{18\gamma}. \tag{101}$$

The equation (99) is negative when $\alpha > \frac{\beta}{2}$. It means when the degree of the boom is sufficiently large, the labor in the energy sector will increase. The equation (100) indicates that during the boom, the labor inputs spent for rent-seeking activities increases under the condition of $\alpha < \beta$. The model is analyzed under two sectors, and the resource movement effect may happen under the equation (101) in the case of $\alpha > \frac{8\beta}{17}$, which means that the adequate degree of the boom is necessary. Labor from the services sector will join rent-seeking activities (100) ($\alpha < \beta$) or energy production (99). Sufficient degree of the boom ($\alpha > \frac{\beta}{2}$) is needed for the production of energy to happen.

The effect of the boom on the commodity markets

By differentiating the equation (80) with respect to α gives

$$\frac{dx_{Tcl}{}^{l}}{d\alpha} = -\frac{1}{2\gamma} < 0. \tag{102}$$

The energy sector output increases under the boom.

By differentiating the equation (98) with respect to α we get

$$\frac{d{x_N}^l}{d\alpha} = \frac{17\alpha - 8\beta}{18\gamma}. \tag{103}$$

The effect of the boom on the output in the services sector depends on parameter values.

Let $Y^l = {x_{Tcl}}^l + {x_N}^l$ be the total output of collusion with rent-seeking case with given world prices (Hindricks and Myles, 2013). The reason why we use this definition of total output is that the only change will occur in ${x_N}^l$ due to rent-seeking activity. From the equation (102) and (103) a marginal effect of the boom on the total output is

$$\frac{dY^l}{d\alpha} = \frac{17\alpha - 8\beta - 9}{18\gamma}. \tag{104}$$

The equation (104) is negative (positive) if

$$\alpha < (>) \frac{8\beta + 9}{17}.$$

The equations (100), (101) and (104) give the following proposition:

Proposition

Under rent seeking duopoly collusion in the energy sector:

i. The resource movement effect occurrence depends on the degree of the boom ($\alpha > \frac{8\beta}{17}$).

ii. Rent-seeking activities are facilitated.

iii. The effect of the boom on the total output depends on parameter values. Total output may decrease if $\alpha > \frac{8\beta+9}{17}$.

In order to support the first argument of the proposition, the equation (101) is used which shows that the resource movement effect depends on the parameter values in the rent seeking case (Figure 3), and labor inputs may move from the services sector to the energy sector by joining rent-seeking activities or energy production. The production of energy will depend on the degree of the boom ($\alpha > \frac{\beta}{2}$), and it is preferable for an economy because firms will join profit-seeking activities without wasting the resources. The firms will be inclined to production of energy if the boom is sufficiently large. More natural resources will induce them to mazimize their profits through production. Furthermore, rent-seeking is considered as an influential factor which induces resource movement effect in the energy sector. The reason is that the firms need labor inputs either for production of energy or rent-seeking activities. This model differs from the previous chapter because of the differences in the facilitation of resource movement effect as well as rent-seeking. The firms under Cournot competition (without collusion) with the absence of rent-seeking mitigates the phenomenon of Dutch disease. On the other hand, the rent seeking duopoly (with collusion) reduces this mitigation and affects the outcome (facilitates Dutch disease occurrence).

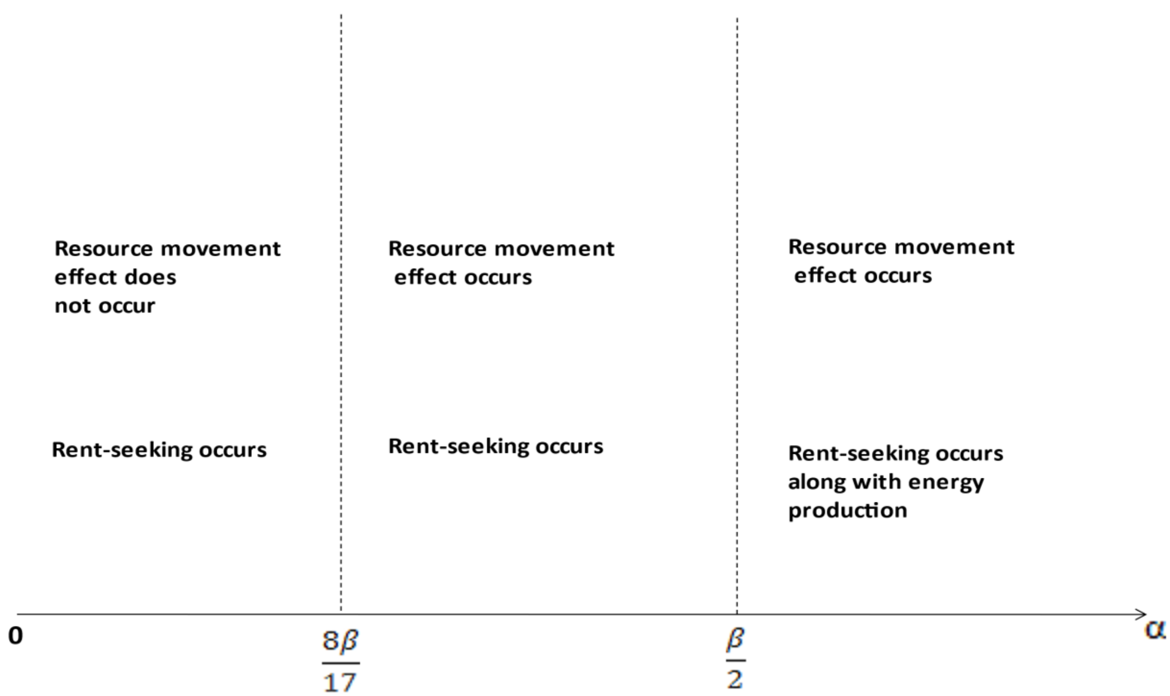

Figure 3. Proposition (rent seeking duopoly collusion)

For supporting the second argument of the proposition, the equation (100) is a variable of degree $(l_L{}^l)$ of rent-seeking activities in the model because the boom facilitates workers to engage in rent-seeking in the energy sector under the condition of $\alpha < \beta$ (Figure 3). It means that if the boom is sufficiently small, then colluding firms will prefer to join rent-seeking because it is more profitable for them. If the boom is sufficiently large then the production will be more attractive for firms. Unlike profit-seeking activities, rent-seeking variable will induce the wastage of resources within an economy without participating in production. Thus, it will contribute more to the Dutch disease occurrence because it will demand more labor inputs from the services sector by worsening the situation (through dissipation). If the boom is small, then it will not be profitable for the firms. Hence, they will join rent-seeking activities in order to get the rent which is available within the energy market. Finally, the resources which the firms will expend for gaining the rent (difference of profits between the collusion and no collusion case) will be completely dissipated according to the complete dissipation theorem.

As for the support of the third argument of the proposition, the equation (104) is used. It depends on the parameter values of α and β. If there is a sufficient degree of the boom ($\alpha > \frac{8\beta+9}{17}$), then total output will decrease in the case of collusion with rent-seeking activities. The decline of the output will be partly related to the dissipation of the resources. Rent-seeking actually negatively affects the services sector along with the overall economy. In the rent seeking monopoly case, total output reduction depends on the degree of the boom (*$\alpha>1$)*. The reason is related to the differences in sizes of the rent. First chapter calculates the rent as the difference of profits between monopoly and social optimum cases. This chapter formulates the rent as the difference of profits between collusion and no collusion cases under Cournot competition. The profit difference between monopoly and social optimum cases is actually larger than the one between collusion and no collusion cases. The rent in the monopoly case will be larger than the one in the collusion case because there are no competitors for the monopoly, and resources (labor inputs) dissipated by the rent seeking monopoly will be larger than the ones under the colluding firms with rent-seeking activities. It is important to mention that this model does not dispute the result of the previous chapter. It just formulates the rent under colluding firms in the context of Cournot competition and adds more to the literature of Dutch disease together with political economy.

3. Conclusion

The model in this chapter analyzes colluding firms with rent-seeking activities (under the Dutch disease context) in the energy sector, and it demonstrates how the resource boom impacts total output and movement of labor inputs (resource movement effect). The resource movement effect occurrence or the movement of labor inputs from the services to the energy sector depends on the degree of the boom. The boom may also facilitate rent-seeking depending on its degree, and sufficiently small degree of the boom is needed for the rent-seeking facilitation. The total output may decrease depending on the parameter values.

The impact of the boom on the total output and rent-seeking is different from the previous chapter. The reason is that the first chapter focuses on the monopoly and formulates the rent as the difference of profits between monopoly and social optimum cases. However, this chapter formulates it as the difference of profits between collusion and no collusion cases under Cournot competition. So, compared to this model, the size of the rent in the monopoly case (with no competitors) is larger than the colluding firms case, which means that the monopoly wastes more resources (labor inputs) for rent-seeking activities to gain a monopoly position. As a result, rent-seeking is definitely facilitated in the monopoly case compared to this model. In addition, rent-seeking activities of rent seeking duopoly (under small amount of boom) will dissipate the resources (by attracting labor inputs from the services sector), and it corresponds to Dutch disease outcome because of resource movement effect along with the reduction of outputs in the services sector. The production of energy occurs when there is sufficiently large degree of the boom. In this case, the firms will join profit-seeking activities (production).This chapter is not the alternative to the previous chapter; it just analyzes the effect of the boom on labor inputs and output total under the colluding firms with rent-seeking activities.

Previous studies (Ogbuabor et al., 2018; 2019, 2020) about Eurozone, Spanish and Italian cases demostrate that collusion and rent-seeking is rampant in those countries. Usually colluding firms in those regions manipulate the tax system and hide long term rent-seeking behavior because it is profitable under collusive pricing. Rent-seeking and uncompetitive pricing through collusive behavior allow the firms to charge higher prices for consumers.

Chapter 3

Vertical Mergers and Rent-seeking During Natural Resource Boom

1. Introduction

Vertical merger of rent seeking firms (upstream and downstream) is analyzed in this chapter for describing the differences from the previous chapters. In addition, the chapter refers to the previous study (Pepall et. al, 2014, pp. 427-459) but it will analyze the vertical M&As (mergers and acquisitions) through rent-seeking perspective. In this chapter, a rent is formulated as the difference between profits in merger and no merger cases. The model in this chapter clarifies how merging rent seeking upstream and downstream firms in energy sector impacts resource movement effect (movement of labor inputs) and total output. This is because of previous studies of M&As and rent-seeking in extractive economies (Ghauri, 2004; Pomfret, 2011; Palazuelos and Fernandes, 2012; Vuving, 2013; Zhu et al., 2017; Chernova and Razmanova, 2018; Wilson and Vencatachellum, 2019). Merger of rent seeking firms in the energy sector with the rent formulation which is mentioned above is not mentioned in previous studies under the literature of Dutch disease and rent-seeking and, thus, the chapter will be the new contribution to the theory concerning the natural resources.

By referring to the previous chapters the new model in this chapter will also concentrate on the resource movement effect with fixed demand assumption (demand does not depend on the boom because removal of spending effect). We assume fixed consumer behavior (they do not assume the level of income). Moreover, the integration of upstream and downstream firms (as a monopoly) is desirable rather than the case with transactions between upstream and downstream due to the profitability and, hence, the monopoly will engage in rent-seeking in order to capture the profits through integration. The chapter will provide implications about the desirability of integration due to higher profits. It will be clarified that how merging firms in energy sector impact the resource movement effect and total output. The resource movement effect occurrence and the reduction in total output depends on parameter values during the resource abundance in rent-seeking merger case. Additionally, the boom will definitely facilitate rent-seeking in this model.

2. The Model

Let's assume that there are two sectors such as services and energy sectors. Labor is the only input in each sector. A quantity of labor is supplied in-elastically by workers, and it is divided between production of two goods in services and energy sectors. Labor is perfectly mobile between sectors. The skill categories for labor is not considered here as well and full employment is maintained (no distortions in commodity or labor markets). The effects of asymmetric growth between energy and services on resource allocation is analyzed (ignore monetary considerations (implications for real variables). The model also shuts down the possibility of real exchange rate appreciation by assuming a closed economy. There is an assumption of constant return to scale production for services sector which means that one unit of labor can produce one unit of output. The cost function $C_N(x_N)$ in the services sector is

$$C_N(x_N) = x_N, \tag{105}$$

where x_N is the output level of production. Profit maximization in the services sector is

$$\max_{x_N} P_N x_N - C_N(x_N), \tag{106}$$

where P_N is the price of good.

Let's assume there are two firms such as upstream and downstream firms in the energy sector. The upstream one (manufacturer) sells unique product to the downstream one (retailer). For simplicity and clear results the cost function of the upstream firm is assumed to be

$$C_T(x_T) = \alpha x_T, \tag{107}$$

where x_T is the output level of production and $\alpha(\alpha>0)$ is a resource boom or technological improvement (Corden and Neary, 1982). Here also linear cost functions are taken for getting specific results in terms of rent-seeking and resource movement effect. The reason is that the results's comparison with other chapters will be complicated on the contrary. So, this chapter's cost functions (1 and 3) are also efficient in terms of rent-seeking and its effects. All of the output of the firm is sold on the domestic market as an assumption, and the inverse demand function in the energy sector is

$$P(x_T) = \beta - \gamma x_T, \tag{108}$$

where x_T is quantity of demand. $\beta>1$ and γ is the positive parameter.

2.1 No merger case

Commodity market in the energy sector

Profit maximization for the downstream and upstream firms

The downstream firm in the energy sector purchases a unit of the good at whole price $R_T{}^U$ and then sells it at price $P_T{}^D$ and, hence, the downstream firm's profit is given as

$$\Pi_T{}^D\left(P_T{}^D,\ R_T{}^U\right) = \left(P_T{}^D - R_T{}^U\right)x_T. \tag{109}$$

Using the equation (108) the equation (109) will be rewritten as

$$\Pi_T{}^D\left(P_T{}^D,\ R_T{}^U\right) = (\beta - \gamma x_T)x_T - \ R_T{}^U x_T. \tag{110}$$

From first order condition of profit maximization we get

$$\frac{d\Pi_T{}^D}{dx_T} = \beta - 2\gamma x_T - R_T{}^U = 0. \tag{111}$$

Solving the equation gives

$$x_T{}^D = \frac{\beta - R_T{}^U}{2\gamma}. \tag{112}$$

After substituting this into the demand equation (108) we get

$$P_T{}^D = \frac{\beta + R_T{}^U}{2}. \tag{113}$$

After plugging the equation (113) into the equation (109) the profit of the downstream firm from will be

$$\Pi_T{}^D = \frac{(\beta - R_T{}^U)^2}{4\gamma}. \tag{114}$$

The marginal revenue curve will be the demand curve for the product of the upstream firm (Pepall et. al, 2014, pp. 427-459). For different values of $R_T{}^U$, different amounts of the input will be demanded. Hence, the quantity sold in the final products market by the downstream firm is also the quantity that must be supplied by the upstream firm (Figure 4).

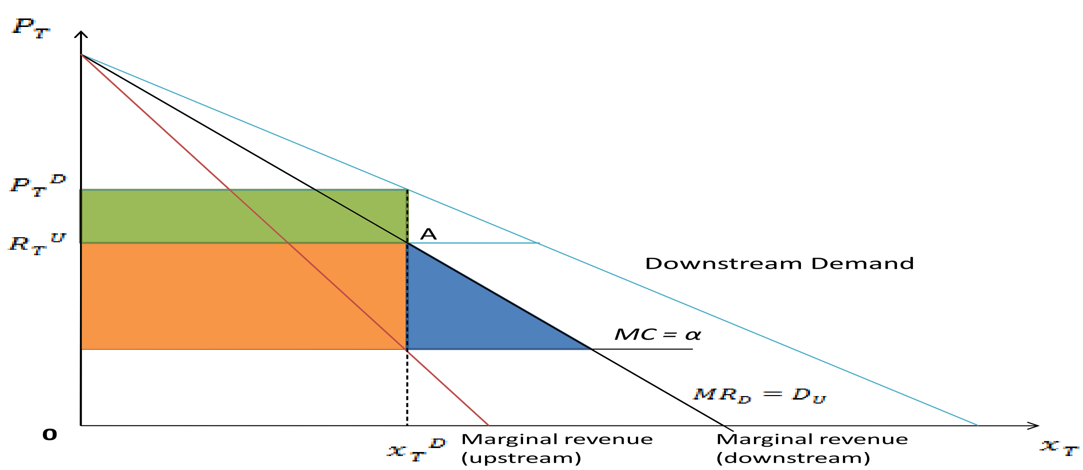

Figure 4. Downstream firm

The quantity at the equation (112) is the amount of the product that the upstream firm will sell to the downstream firm at price ${R_T}^U$. By solving this equation for the inverse demand curve:

$$ {R_T}^U = \beta - 2\gamma {x_T}^U, \tag{115} $$

where ${x_T}^U$ is the quantity supplied by the upstream firm. This will be shown as a black line in Figure 4. The inverse demand facing the upstream firm at the equation (115) is also the marginal revenue function for the downstream firm (Pepall et. al, 2014, pp. 427-459). Thus, it is possible to formally write the downstream firm's marginal revenue as the equation (115). Using this it is possible to derive the profit-maximizing price that the upstream firm will set for its product. The optimal level of ${x_T}^U$ is obtained through profit and profit maximization for the upstream firm:

$$ {\Pi_T}^U\left(C_T(x_T), {R_T}^U\right) = \left(\beta - 2\gamma {x_T}^U\right){x_T}^U - \alpha {x_T}^U, \tag{116} $$

and

$$ \frac{d{\Pi_T}^U}{d{x_T}^U} = \beta - 4\gamma {x_T}^U - \alpha = 0. \tag{117} $$

Solving the equation we get

$$ {x_T}^U = \frac{\beta - \alpha}{4\gamma}. \tag{118} $$

From the equations (118) and (115) it is possible to get

$$ {R_T}^U = \frac{\beta + \alpha}{2}. \tag{119} $$

When the upstream firm sets the price which is mentioned at (119) for the downstream firm, then by using the equations (113) and (114) the downstream firm's price and profit will be

$$ \begin{aligned} {P_T}^D &= \frac{\beta + {R_T}^U}{2} \\ &= \frac{3\beta + \alpha}{4\gamma}, \end{aligned} \tag{120} $$

and

$$\Pi_T{}^D = \frac{(\beta-\alpha)^2}{16\gamma}. \tag{121}$$

The profit of the downstream firm is shown in Figure 4 (green color square), and it is consistent with equation (121). The downstream firm sells as it is mentioned in the equation (120), and by inserting the (119) into the equation (112)

$$x_T{}^D = \frac{\beta - R_T{}^U}{2\gamma}$$

$$= \frac{\beta-\alpha}{4\gamma}. \tag{122}$$

From the equations (118) and (122) we get

$$x_T{}^D = x_T{}^U.$$

Let ($x_T{}^U = x_T{}^D = x_T{}^{UD}$, $R_T{}^U$) be an allocation of commodity markets of the energy sector at equilibrium. This is the quantity the upstream firm predicted when it sets the price mentioned in the equation (118). From the equation (115) the upstream firm's profit at this optimal price and quantity will be

$$\Pi_T{}^U = \frac{(\beta-\alpha)^2}{8\gamma}. \tag{123}$$

The profit of the upstream firm is shown in Figure 4 (orange color square), and it is consistent with equation (123). From the equations (121) and (123) the sum of profits will be

$$\Pi_T{}^{UD} = \Pi_T{}^D + \Pi_T{}^U$$

$$= \frac{3(\beta-\alpha)^2}{16\gamma}. \tag{124}$$

Labor market

Suppose that the total number of workers is unity. Let $({l_T}^{UD}, {l_N}^{UD})$ be the labor at equilibrium in each sector. An equilibrium condition of labor market is

$${l_T}^{UD} + {l_N}^{UD} = 1. \tag{125}$$

The wage rate at equilibrium is unity because of the assumption that one unit of labor produces one unit of services. Services are the numeraire of the economy and all prices are in terms of units of the service good, whose price is normalized to one. This chapter also only considers equilibriums where the economy produces some output of the numeraire sector. The cost of production in the model is the product of wage rate and the use of labor as well. By referring to the previous chapters and using the equations (107) and (122) the labor in the energy sector is determined as follows:

$$\begin{aligned} {l_T}^{UD} &= \alpha {x_T}^{UD} \\ &= \frac{\alpha(\beta-\alpha)}{4\gamma}. \end{aligned} \tag{126}$$

From equilibrium condition of labor market in the equation (125), the labor in the services sector:

$${l_N}^{UD} = 1 - \frac{\alpha(\beta-\alpha)}{4\gamma}. \tag{127}$$

Commodity market in the services sector

Let $({x_N}^{UD}, {P_N}^{UD})$ be an allocation of commodity markets of the services sector at equilibrium. From the equation (105) and first order condition from the equation (106) we get

$${P_N}^{UD} = 1, \tag{128}$$

and

$$x_N{}^{UD} = l_N{}^{UD}. \tag{129}$$

From the equations (127) and (129) we get

$$x_N{}^{UD} = 1 - \frac{\alpha(\beta-\alpha)}{4\gamma}. \tag{130}$$

The formulation of this model also does not depend on the services sector. The price in services sector is equal to unity as in the previous chapters.

2.1.1 Analysis of the no merger case

The effect of the boom on the labor markets

By referring to previous chapters we apply the same analysis in this model. The boom will be the advancement in technological, and decreasing α will be taken as the boom because it implies decreasing costs due to technological improvement. Differentiating the equations (126) and (127) with respect to α we get

$$\frac{dl_N{}^{UD}}{d\alpha} = \frac{2\alpha-\beta}{4\gamma}, \tag{131}$$

and

$$\frac{dl_T{}^{UD}}{d\alpha} = \frac{\beta-2\alpha}{4\gamma}. \tag{132}$$

Here also if $\alpha > \frac{\beta}{2}$, then the equation (131) is positive, and the equation (132) is negative, which means that the resource movement effect occurs when the degree of technological advancement is sufficiently large. The results in the previous lemma can be applied here as well.

The effect of the boom on the commodity markets

The effect of the boom on outputs will be analyzed. After differentiating the equation (118) with respect to α we see that the boom increases the output in the energy sector:

$$\frac{dx_T{}^{UD}}{d\alpha} = -\frac{1}{4\gamma} < 0. \tag{133}$$

We differentiate the equation (130) with respect to α, and the marginal effect of the boom on the output in the services sector depends on parameter values:

$$\frac{dx_N{}^{UD}}{d\alpha} = \frac{2\alpha-\beta}{4\gamma}. \tag{134}$$

Let $Y^{UD} = x_T{}^{UD} + x_N{}^{UD}$ be the total output in the no merger case with given world prices (Hindricks and Myles, 2013). This is the sum of the equations (118) and (130). The marginal effect of boom on the total output depends on parameter values

$$\frac{dY^{UD}}{d\alpha} = \frac{2\alpha-\beta-1}{4\gamma}. \tag{135}$$

2.2 Merger case

Vertical merger can be illegal depending on whether it lessens the competition in a market (U.S. Department of Justice and the Federal Trade Commission, 2020). The firms can gain monopoly power through merger by negatively affecting the competition, and this is illegal according to antitrust laws. Afterwards, vertical merger will motivate firms to avoid regulations, collude and create barriers of entry for the new entrants into markets. Vertical integration may also facilitate upstream collusion (Volker and White, 2007). Here, the merging firms will be examined in order to figure out the differences from the no merger case. There are previous studies which also support the fact the the mergers in the oil industry is rampant (Weston et al., 1999; Gracia et al., 2017; Gupta et al., 2018; Xin et al., 2020; Yang et al., 2021). M&As

(Mergers and Acquisitions) are accelerated worldwide due to technology, globalization, deregulation, and etc. (Weston et al., 1999). This was beneficial for the US economy since 1980’s. The increase of WTI (West Texas Intermediate) crude oil prices induced the surge in M&As in the US between 1990’s-2000’s (Gracia et al., 2017). The widespread presence of M&As in the oil industry have anticipatory power over oil returns and volatility of future prices (Gupta et al., 2018). M&As also have positive direct and indirect effects on technology learning in terms of learning-by-doing and learning-by-researching (Xin et al., 2020). Moreover, Europe and North America are the main regions for active M&As in the oil industry, and the acquisitions of international oil companies are more rampant than the national ones (Yang et al., 2021).

The merger case is also studied here due to the necessity of comparison with the above mentioned preceding studies and, to the best knowledge of the author, the merger case is not present in the Dutch disease literature under the Corden and Neary’s (1982) model.

Commodity market in the energy sector

If the two firms merge, then the upstream firm will not be independent anymore. However, it will be the upstream part of the integrated firm by supplying the commodity to the downstream part of the same parent company. The commodity will still be produced with the cost which is mentioned at the equation (107). In the merger case, integrated firm will become a monopoly which maximizes its profit. Let $({x_T}^M,\ {P_T}^M)$ be an allocation of commodity markets of energy sector at equilibrium with merger case. The profit and profit maximization will be

$$\mathit{\Pi_T}^M\left({P_T}^M, C_T(x_T)\right) = (\beta - \gamma {x_T}^M){x_T}^M - \alpha {x_T}^M, \tag{136}$$

and

$$\frac{d\mathit{\Pi_T}^M}{d{x_T}^M} = \beta - 2\gamma {x_T}^M - \alpha = 0. \tag{137}$$

Solving these equations yields quantity, price and profit

$$x_T{}^M = \frac{\beta-\alpha}{2\gamma}, \tag{138}$$

$$P_T{}^M = \beta - \gamma x_T{}^M$$

$$= \frac{\beta+\alpha}{2}, \tag{139}$$

and

$$\Pi_T{}^M = \frac{(\beta-\alpha)^2}{4\gamma}. \tag{140}$$

This profit is also shown in Figure 6 (sum of orange and blue color squares).

Labor market

Let $(l_T{}^M, l_N{}^M)$ be the labor at equilibrium in each sector under the merger case. From the equations (107) and (138) the labor in the energy sector will be

$$l_T{}^M = \frac{\alpha(\beta-\alpha)}{2\gamma}. \tag{141}$$

From the equation (126) we get the following inequality

$$l_T{}^M > l_T{}^{UD}.$$

It means labor input in merger case is larger than the one without merger case. From a viewpoint of society, integrating the upstream and downstream firms improves welfare. Total profit increases along with consumer surplus because more commodities are sold at a lower price.

From the equilibrium condition of labor market in the equation (125), the labor in the services sector:

$$l_N{}^M = 1 - \frac{\alpha(\beta-\alpha)}{2\gamma}. \tag{142}$$

Commodity market in the services sector

Let $(x_N{}^M, P_N{}^M)$ be an allocation of commodity markets of the services sector at equilibrium. From the equation (105) and the first order condition from the equation (106) we get

$$P_N{}^M = 1, \tag{143}$$

and

$$x_N{}^M = l_N{}^M. \tag{144}$$

From the equations (142) and (144) we get

$$x_N{}^M = 1 - \frac{\alpha(\beta-\alpha)}{2\gamma}. \tag{145}$$

2.2.1 Analysis of the merger case

The effect of the boom on the labor markets

Differentiating the sectors' labor inputs in the equations (141) and (142) with respect to α

$$\frac{dl_N{}^M}{d\alpha} = \frac{2\alpha-\beta}{2\gamma}, \tag{146}$$

and

$$\frac{dl_T{}^M}{d\alpha} = \frac{\beta-2\alpha}{2\gamma}. \tag{147}$$

If $\alpha > \frac{\beta}{2}$, then the equation (146) is positive, and the equation (137) is negative, which means that the resource movement effect occurs when the degree of technological advancement is sufficiently large.

The effect of the boom on the commodity markets

The boom increases the output in in the energy sector after differentiating the equation (138) with respect to α:

$$\frac{dx_T{}^M}{d\alpha} = -\frac{1}{2\gamma} < 0. \tag{148}$$

The marginal effect of the boom on the output in the services sector depends on parameter values after differentiating the equation (145) with respect to α:

$$\frac{dx_N{}^M}{d\alpha} = \frac{2\alpha - \beta}{2\gamma}. \tag{149}$$

Let $Y^M = x_T{}^M + x_N{}^M$ be the total output of the merger case with given world prices (Hindricks and Myles, 2013). It is the sum of the equations (138) and (145). The marginal effect of the boom on the total output depends on parameter values

$$\frac{dY^M}{d\alpha} = \frac{2\alpha - \beta - 1}{2\gamma}. \tag{150}$$

2.3 Merger case with rent-seeking

In this chapter the important objective is to determine how energy sector's rent seeking merging firms affect the movement of labor inputs and total output. Previously, this kind of theoretical model under Corden and Neary's (1982) model was not raised and analyzed. Earlier studies also state that mainly the developing resource-rich economies face market deregulation and M&As through rent-seeking activities (due to institutional weaknesses of these countries) of multinational and national oil companies in order to lessen competition and have significant market share by blocking others to enter the market (Montojo, 1999; Ghauri, 2004; Pomfret, 2011; Palazuelos and Fernandes, 2012; Vuving, 2013; Chernova and Ramzanova, 2018). Between 1970's and 1990's Philippine's oil industry was less cost effective due to the deregulation policies affected by patrimonialism and government legitimacy (Montojo, 1999). Furthermore, rent seeking multinational enterprises have bargaining powers over states, which in turn negatively affect competition in the developing countries and, hence, these are the new type of emerging strategies by these corporations during globalization (Ghauri, 2004). In the cases of Russia and Kazakhstan, local corporations have significant powers due to the connection to their governments, and in different years and projects the foreign oil operators had no choice but sell their huge shares to the local ones under the pressure from the governments in the forms of licences, environmental regulations and so forth (Pomfret, 2011). Moreover, Kazakhstan imposed revision of former natural resource agreements on international corporations and, thus, this motivates national oil corporation and government to engage in rent-seeking activities and control oil cycle from upstream to downstream firms despite the difficulties in the expansion of their powers within the industry (Palazuelos and Fernandes, 2012). In Vietnam, rent-seeking has deep roots within the government by making rent-seekers as dominant forces, and state companies' (including national oil company) concentration in a resource market creates problems for the competition due to the creation of barriers and extraction of attractive rents (Vuving, 2013). Recently, Russia's oil industry is controlled by vertically integrated oil companies (Rosneft, Lukoil, Surgutneftegas, GazpromNeft) (Chernova and Razmanova, 2018). New competitors cannot easily enter the Russian crude oil market due to complications. Most importantly, the transparency is limited in terms of M&A deals, and in spite of several antitrust violations between 2007-2015, the above mentioned companies created barriers of entry and still possessed more than 69% shares of oil extraction in the Russian Federation according to 2015 statistics.

Labor market

Rent-seeking firms generate profitable opportunities by wasting the resources and negatively impacting the welfare (Hindricks and Myles (2013, p. 389)). Also in this chapter the level of wasted resources (labor inputs) under rent-seeking is considered as a “time”. Upstream and downstream firms that engage in rent-seeking utilize the opportunity of lobbying and contacting government officials in order to gain rents during the boom. Thus, it creates opportunity cost, and these wasted resources could have been used in production by making the society better off.

Assuming that there are several potential firms and they can integrate (vertically merge) by becoming a monopoly in order to receive the profits in the equation (140). A rent will be the value of merging, and it is considered as extra profit made by merger. The rent will be equal to the difference between the profits of merger and no merger cases. Merging firms are assumed to be under identical and risk-neutral assumptions, and they simultaneously offer how much money they will burn. Potential firms which will burn the most money will be merging firms and, the total value of the rent is dissipated under the equation (152), and it is known as complete dissipation theorem (Hindricks and Myles, 2013, p. 393). Merging firms burn labor which equals the money mentioned above. Let ${l_L}^l$ be the labor burned for rent-seeking. An equilibrium condition of labor market will be

$${l_{TM}}^l + {l_N}^l + {l_L}^l = 1. \tag{151}$$

where superscript l indicates the merger under rent-seeking case.

The prize for the merging firms is the rent, and it is the difference between profits with merger (${\Pi_T}^M$) and without merger cases (${\Pi_T}^{UD}$), because the profits in merger case is higher than the one without merger case. The labor spent for rent-seeking is determined under the application of the complete dissipation theorem which means “…labor inputs that are used for rent-seeking activities up to the point where additional profit is exactly equal to the resource cost” (Hindricks and Myles, 2013, p. 405). So, the value of labor that merging firms spend for rent-seeking

$$l_L{}^l = \Pi_T{}^M - \Pi_T{}^{UD}$$

$$= \frac{(\beta-\alpha)^2}{16\gamma}. \tag{152}$$

From the equations (141), (151) and (152) the labor in the services sector under the equilibrium condition of labor market:

$$l_N{}^l = 1 - \frac{\beta-\alpha}{2\gamma} - \frac{(\beta-\alpha)^2}{16\gamma}. \tag{153}$$

Commodity market in the services sector

Let $(x_N{}^l, P_N{}^l)$ be a pair of commodity markets of the services sector at equilibrium. From the equation (105) and the first order condition from the equation (106) we get

$$P_N{}^M = 1, \tag{154}$$

and

$$x_N{}^l = l_N{}^l. \tag{155}$$

From the equations (153) and (155) we get

$$x_N{}^l = 1 - \frac{\beta-\alpha}{2\gamma} - \frac{(\beta-\alpha)^2}{16\gamma}. \tag{156}$$

3.3.1 Analysis of the merger with rent-seeking case

The effect of the boom on the labor markets

Differentiating labor inputs in the equations (141), (152) and (153) with respect to α gives

$$\frac{dl_{TM}{}^{l}}{d\alpha} = -\frac{1}{2\gamma} < 0, \tag{157}$$

$$\frac{dl_{L}{}^{l}}{d\alpha} = \frac{\alpha-\beta}{8\gamma}, \tag{158}$$

and

$$\frac{dl_{N}{}^{l}}{d\alpha} = \frac{4-\alpha+\beta}{8\gamma}. \tag{159}$$

The equation (157) is negative, and it means that the labor in the energy sector increases. The equation (158) indicates that during the boom the labor inputs spent for rent-seeking activities increases under the condition of $\alpha < \beta$. The resource movement effect occurrence depends on parameter values according to the equation (159) ($\alpha < 4 + \beta$). Sufficiently small degree of the boom is necessary for rent-seeking and resource movement effect to occur. Also, according to the figure 4, the intercept is larger than the marginal cost ($\beta > \alpha$). It means, resource movement effect will occur in this case.

The effect of the boom on the commodity markets

Under the boom, the energy sector's output increases after differentiating the equation (138) with respect to α:

$$\frac{dx_{TM}{}^{l}}{d\alpha} = -\frac{1}{2\gamma} < 0. \tag{160}$$

The marginal effect of the boom on the output in the services sector depends on parameter values after differentiating the equation (156) with respect to α:

$$\frac{dx_{N}{}^{l}}{d\alpha} = \frac{4-\alpha+\beta}{8\gamma}. \tag{161}$$

Let $Y^l = x_{TM}{}^l + x_N{}^l$ be the total output of merger with rent-seeking case with given world prices (Hindricks and Myles, 2013). The reason why we use this definition of total output is that the only change will occur in $x_N{}^l$ due to rent-seeking activity. This is the sum of the equations (138) and (156). A marginal effect of the boom on the total output depends on parameter values:

$$\frac{dY^l}{d\alpha} = \frac{\beta - \alpha}{8\gamma}. \quad (162)$$

The equations (158), (159) and (162) give the following proposition:

Proposition

Under rent seeking merging firms in the energy sector:

i. The resource movement effect occurs with sufficiently small degree of the boom.

ii. Rent-seeking is facilitated with sufficiently small degree of the boom.

iii. The total output decreases during the boom.

In order to support the first argument of the proposition, the equation (159) is used along with the figure 4 which shows that the resource movement effect happens during the boom. It will be attractive for the merging firms to engage in rent-seeking in the energy sector with sufficiently small degree of the boom, and they will need some labor inputs for rent-seeking activities (158). The production of energy will be attractive for the merging firms due to the equation (157), because labor inputs increase in the energy sector. Energy production becomes a predominant aspect in the rent-seeking model. In the merger and no merger cases, the Dutch disease phenomenon (resource movement effect as well) happens under parameter values. In the rent-seeking case, the sign of Dutch disease is possible because resource movemenet effect (also reduction of outputs in the services sector) occurs.

In the case of second argument of support, the equation (158) will be a variable of degree $(l_L{}^l)$ of rent-seeking, and the boom facilitates rent-seeking activities in the energy sector under parameter values $(\alpha < \beta)$. In the monopoly model, the production of energy happens depending on parameter values, but in merger case it is attractive for the merging firms to participate in production due to the equation (157). In this model, two rent-seeking firms (upstream and downstream) merge with the participation of only upstream firm in production. Hence, merging firms will use their resources mostly for production and some inputs for rent-seeking activities $(\alpha < \beta)$. Rent seeking monopoly case is more harmful from the perspective of a society because resources are mostly expended for dissipation by damaging profit-seeking activities (production).

The equation (162) is used for supporting of the third argument of the proposition. The marginal effect of the boom on the total output depends on the parameter values. In no merger and merger cases, the total output definitely decreases by depending on parameter values, and in the rent seeking merger case, the effect of the boom on the total output also depends on parameter values due to the fact that the resources are dissipated for the rent-seeking activities by the integrated firms in order to gain the attractive rents in the energy sector $(\alpha < \beta)$. In the first and second chapters, the total output also decreases under the boom depending on different parameter values. The only differences emanate from the formulation of the rent and number of firms (in production) in the energy sector. Most importantly, this chapter actually does not argue with the results of the preceding chapters with the rent seeking monopoly and collusion cases because it formulates the rent differently (difference of profits between merger and no merger cases) under rent-seeking merging firms by contributing to the literature of Dutch disease rent-seeking.

3. Conclusion

The new model in this chapter clarifies how energy sector's rent seeking and merging firms (upstream and downstream) affect total output and resource movement effect (movement of labor inputs from the services sector to the energy sector) during the resource abundance (or the boom). The marginal effect of the boom on the resource movement effect or the total output depends on parameter values. Also, the boom facilitates rent-seeking activities in the energy sector depending on the parameter values under the rent-seeking merger case.

The impact of the boom on the total output and resource movement effect is different from the previous chapters due to the differences in formulation of the rent. In the first case, only the rent seeking monopoly exists in the energy sector, but in this model upstream and downstream firms are present in energy sector with the production happening only in the upstream level. The important difference is related to the rent formulation, which is the difference between profits between social optimum and monopoly cases in the first chapter. Second chapter formulates the rent as the differences of profits between collusion and no collusion cases. However, this chapter formulates the rent as the difference between profits in merger and no merger cases. Additionaly, this chapter does not dispute other chapter results, and it clarifies the marginal effect of the resource abundance on the resource movement effect and the total output along with rent-seeking under the rent-seeking merging firms with the different rent calculation.

Previous studies describe that the developing mineral extracting economies have market deregulation and M&As (merger and acquisitions) in the market via rent-seeking activities (due to the institutional weaknesses) of oil companies for decreasing competition and blocking others to enter the market (Montojo, 1999; Ghauri, 2004; Pomfret, 2011; Palazuelos and Fernandes, 2012; Vuving, 2013; Chernova and Ramzanova, 2018). It is clearly seen in the oil markets of countries with former communist institutions (such as Russia, Kazakhstan, Vietnam). Although Philippines does not share similar institutions with former communist states, rent-seeking (corruption, lobbying) and deregulation policies negatively affected the economy.

Chapter 4

Natural Resource Abundance under Stackelberg Rent-seeking

1. Introduction

This chapter proposes a new model which will be analyzed under Stackelberg competition for clarifying the differences from the previous chapters. Rent-seeking activities of dominant and follower firms in energy sector will be studied in order to determine how these firms impact labor inputs and total output. This is because rent seeking dominant monopolies are common in past studies (Vicente, 2010; Caselli and Michaels, 2013; Billo, 2015; Lima-de-Oliveira, 2020). To the best of the knowledge of the author, Stackelberg rent seeking model along with different rent formulation in the context of Dutch disease was not studied in past studies, which makes it another contribution to the literature of Dutch disease and political economy.

The assumption of fixed demand is also applied here by omitting the spending effect for simplicity, because the model only concentrates on the resource movement effect as in previous chapters. So, demand curve is not dependent on the resource boom due to the fixed spending effect (consumers do not assume level of income due to fixed consumer behaviour). As it is mentioned in previous chapters, this chapter also analyzes the resource movement effect separately for rent-seeking facilitation (as first part Dutch disease). Dominant firm's rent-seeking activity is analyzed for figuring out how it impacts the resource movement effect along with total output. The model will show that during the boom, rent-seeking, the occurrence of the resource movement effect and the reduction of total output depend on parameter values. This result is different from the previous chapters. The reason is that only leader firm will engage in rent-seeking in order to gain dominant position due to attractive rents in the energy sector, and it is more profitable for the firm to be in that position. On the other hand, follower firm will not join rent-seeking activities because it is more profitable for this firm to stay in competition or collude with other firm. The resources dissipated for capturing the rents in Stackelberg rent-seeking case will be less than the previous cases, which shows that the firms under Stackelberg competition are less harmful to the resource-rich economies compared to monopoly or colluding firms' cases.

2. The Model

The model also assumes two sectors, such as services and energy sectors by taking the labor as the only input in each sector. Labor quantity is supplied in-elastically by workers, and it is divided between the production of goods in services and energy sectors. Labor is perfectly mobile between sectors. The skill categories for labor is omiited here and full employment is maintained (no distortions in commodity or labor markets). The effects of asymmetric growth between energy and services on resource allocation is analyzed (by ignoring monetary considerations (implications for real variables only). The model also closes the possibility of real exchange rate appreciation by assuming a closed economy. Services has constant return to scale production function, which means one unit of labor produces one unit of output. The cost function $C_N(x_N)$ in the services sector will be

$$C_N(x_N) = x_N, \tag{163}$$

where x_N is the output level of production. Profit maximization is

$$\max_{x_N} P_N x_N - C_N(x_N), \tag{164}$$

where P_N is the price of good in the services sector.

Energy sector has two firms with following cost functions

$$C_{T1}(x_{T1}) = \alpha x_{T1}, \quad (165)$$

and

$$C_{T2}(x_{T2}) = \alpha x_{T2}, \quad (166)$$

where x_T is the output level of production, and $\alpha(\alpha>0)$ is the productivity parameter. The parameter α is seen as a technological improvement or natural resource abundance (the boom) (Corden and Neary, 1982). In this chapter we also chose linear cost functions for distinct results in terms of rent-seeking and resource movement effect because results will depend only on parameter values with other functions (difficult to define rent-seeking). Profit maximization is

$$\max_{x_{T1}} P_{T1} x_{T1} - C_{T1}(x_{T1}), \quad (167)$$

and

$$\max_{x_{T2}} P_{T2} x_{T2} - C_{T2}(x_{T2}), \quad (168)$$

where P_T is the price of good in the energy sector.

Let's assume that all of the output of the firms is sold on the domestic market. The inverse demand function in the energy sector is given by

$$P(x_{T1} + x_{T2}) = \beta - \gamma x_T$$

$$= \beta - \gamma x_{T1} - \gamma x_{T2}, \quad (169)$$

where x_T is quantity of demand in the energy sector. $\beta > 1$ and γ is the positive parameter.

2.1 Stackelberg competition case

Stackelberg competition is studied in this section for comparing it with previous chapters. Empirical papers support the existence of dominant monopolies in several resource-rich countries where they control huge market share by hindering others to enter the market (Ortiz et al., 2013; Balaquer and Ripolles, 2018, 2020; Chernova and Razmanova, 2018). In the Argentinian case, the nationalization of dominant energy company (Repsol) played an influential role in causing other multinationals to leave the market. In the Spanish case, the behavior of dominant monopolies (Repsol, Cepsa) are analyzed, and it is shown that they easily control and manipulate the fuel prices by inducing price dispersion due to their huge market share (Balaquer and Ripolles, 2018). In Russia's energy market, dominant monopolies actually control all segments of the market by blocking the access of other multinationals. Dominant monopolies are the main barriers for entry in the energy market (Chernova and Razmanova, 2018). Additionally, Spanish pre-tax fuel prices are one of the highest in Europe due to the fact the dominant firms increase the prices by having a control in the market (Balaquer and Ripolles, 2020).

Stackelberg competition case in the context of Dutch disease does not exist in literature and, hence, this chapter will contribute to the literature by explaining the behavior of dominant firms in the energy market.

Commodity market in the energy sector

In Stackelberg case, one of the firms (follower) will take dominant firm's quantity fixed. On the other hand, dominant firm will predict this behavior and maximize its profit. Unlike the Cournot case, the interaction between dominant and follower firms will be in two steps, sequentially. Firstly, the dominant firm figures out it's planned quantity. Afterwards, the follower firm figures out it's quantity. Let $({x_{T1}}^{SD},\ {x_{T2}}^{SF},\ {P_T}^{S})$ be an allocation of commodity markets of energy sector at equilibrium with Stackelberg competition case. ${x_{T1}}^{SD}$ is the quantity of the dominant firm, and ${x_{T2}}^{SF}$ is the quantity of the follower firm in Stackelberg case. The follower will act as a second firm, and as it is mentioned in Cournot case, the follower will behave by taking ${x_{T1}}^{SD}$ as given and determine its quantity (${x_{T2}}^{C} = r_2({x_{T1}}^{C})$). The dominant firm knows the follower firm's reaction function and moves first which is followed by the second firm. The dominant firm will use ${x_{T2}}^{C} = r_2({x_{T1}}^{C})$ in its profit function and get rid of ${x_{T2}}^{C}$ by making its profit as a function of ${x_{T1}}^{SD}$. The reaction function of the follower firm will be used from the equation (61) of the second chapter describing the Cournot competition case, and that will be added to the profit function of the dominant firm in the Stackelberg competition case. By doing so it is possible to separately calculate the following different quantities together with profits of dominant and follower firms:

$$ {\Pi_{T1}}^{SD}({x_{T1}}^{SD}) = \left(\beta - \gamma {x_{T1}}^{SD} - \gamma\left(\frac{\beta - \alpha - \gamma {x_{T1}}^{SD}}{2\gamma}\right)\right)({x_{T1}}^{SD}) - \alpha {x_{T1}}^{SD}. \tag{170} $$

From the first order condition of the equation (170) we get

$$ \frac{d{\Pi_{T1}}^{SD}}{d{x_{T1}}^{SD}} = \beta - 2\gamma {x_{T1}}^{C} - \alpha = 0. \tag{171} $$

By solving the equations (170) and (171) we get

$$ {x_{T1}}^{SD} = \frac{\beta - \alpha}{2\gamma}, \tag{172} $$

and

$$ {x_{T2}}^{SF} = \frac{\beta - \alpha}{4\gamma}. \tag{173} $$

The profits of the firms under Stackelberg competition in the energy sector will be

$$ {\Pi_{T1}}^{SD} = \frac{(\beta - \alpha)^2}{8\gamma}, \tag{174} $$

and

$$ {\Pi_{T2}}^{SF} = \frac{(\beta - \alpha)^2}{16\gamma}. \tag{175} $$

Labor market

$(l_{T1}{}^{SD},\ l_{T2}{}^{SF},\ l_N{}^{S})$ is the labor at equilibrium in each sector. Suppose that the total number of workers is unity. An equilibrium condition of labor market is

$$l_{T1}{}^{SD} + \ l_{T2}{}^{SF} + \ l_N{}^{S} = 1. \tag{176}$$

The wage rate at equilibrium is unity because of the assumption that one unit of labor produces one unit of services. Furthermore, services are the numeraire of the economy and all prices are in terms of units of the service good, whose price is normalized to one. This chapter also only takes into account the equilibriums where the economy produces some output of the numeraire sector. The cost of production in the model is also the product of wage rate and the use of labor.

In the Stackelberg case, from the equations (165), (166), (172) and (173) labor inputs in the energy sector will be

$$l_{T1}{}^{SD} = \frac{\alpha(\beta-\alpha)}{2\gamma}, \tag{177}$$

and

$$l_{T2}{}^{SF} = \frac{\alpha(\beta-\alpha)}{4\gamma}. \tag{178}$$

From the equations (66), (177) and (178) we get the following inequalities:

$$l_{T1}{}^{SD} > l_{T1}{}^{C},$$

and

$$l_{T2}{}^{SF} < l_{T2}{}^{C}.$$

Labor inputs of the dominant firm will be larger than the one in the Cournot competition case because it produces more quantitites by using more labor for capturing higher profits in Stackelberg competition. Labor inputs of the follower firm is smaller than the previous case because they produce less and use fewer labor inputs than before, which in turn gives them less profits due to being a follower firm.

From the equilibrium condition of labor market (176), and the equations (177) and (178) the labor in the services sector will be

$$l_N{}^S = \frac{4\gamma - 3\alpha\beta + 3\alpha^2}{4\gamma}. \quad (179)$$

Commodity market in the services sector

Let $(x_N{}^S, P_N{}^S)$ be an allocation of commodity markets of the services sector at equilibrium. From the equation (163) and first order condition from the equation (164) we get

$$P_N{}^S = 1, \quad (180)$$

and

$$x_N{}^S = l_N{}^S. \quad (181)$$

From the equations (179) and (181) we get

$$x_N{}^S = \frac{4\gamma - 3\alpha\beta + 3\alpha^2}{4\gamma}. \quad (182)$$

The formulation of this model does not depend on the services sector as well. The price in services sector is equal to unity as in the previous chapters.

2.1.1 Analysis of the Stackelberg competition case

The effect of the boom on the labor markets

Differentiating the labor inputs in the equations (177), (178) and (179) with respect to α gives

$$\frac{dl_N{}^S}{d\alpha} = \frac{6\alpha - 3\beta}{4\gamma}, \tag{183}$$

$$\frac{dl_T{}^{SD}}{d\alpha} = \frac{\beta - 2\alpha}{2\gamma}, \tag{184}$$

and

$$\frac{dl_T{}^{SF}}{d\alpha} = \frac{\beta - 2\alpha}{4\gamma}. \tag{185}$$

If $\alpha > \frac{\beta}{2}$, then the equation (183) is positive, and the equations (184) and (185) are negative. It implies that when the degree of technological advancement is sufficiently large, the labor inputs move from the services sector to the energy sector. The result is similar to the Cournot competition case (also in terms of Dutch disease occurrence) due to constant return to scale function of firms in the energy sector.

The effect of the boom on the commodity markets

We differentiate the equations (172) and (173) with respect to α. The boom in the energy sector increases the output in this sector:

$$\frac{dx_{T1}{}^{SD}}{d\alpha} = -\frac{1}{2\gamma} < 0, \tag{186}$$

and

$$\frac{dx_{T2}{}^{SF}}{d\alpha} = -\frac{1}{4\gamma} < 0. \tag{187}$$

A marginal effect of the boom on the output in the services sector depends on parameter values after differentiating the equation (182) with respect to α:

$$\frac{dx_N{}^S}{d\alpha} = \frac{6\alpha - 3\beta}{4\gamma}. \tag{188}$$

Let $Y^S = x_{T1}{}^{SD} + x_{T2}{}^{SF} + x_N{}^S$ be the total output in this case with given world prices (Hindricks and Myles, 2013). This is the sum of the equations (172), (173) and (182). A marginal effect of the boom on the total output is

$$\frac{dY^S}{d\alpha} = \frac{3\alpha - 3\beta}{4\gamma}. \tag{189}$$

The total output increases if $\alpha < \beta$ which means that the sufficiently small degree of the boom is necessary. There reason is that production (profit-seeking) will be facilitated in Stackelberg case.

The equations (183), (184), (185) and (189) give the following Lemma:

Lemma 1

i. If $\alpha > \frac{\beta}{2}$, then the boom generates resource movement effect and increases total output.

ii. If $\alpha < \frac{\beta}{2}$, then the boom does not generate the resource movement effect.

Figure 5 shows that the first argument of the lemma 1 is right side of vertical lines ($\frac{\beta}{2}$) which shows the increase in total output along with resource movement effect. The second argument is on the left side of the vertical line ($\frac{\beta}{2}$) which shows no sign of resource movement effect meaning that Dutch disease will not occur.

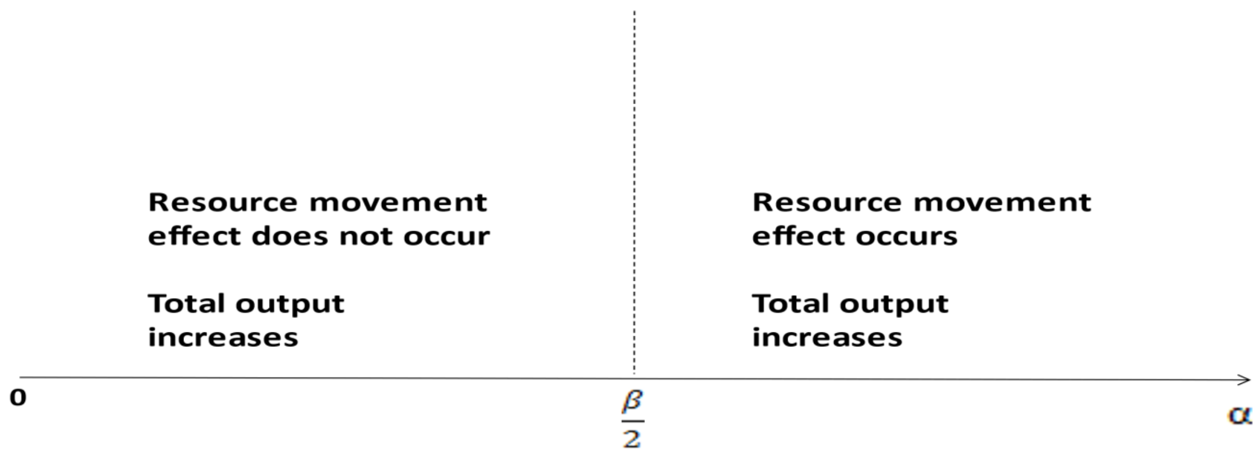

Figure 5. Lemma 1

In the Cournot competition with and without collusion cases, this degree of the boom which decreases output is $\alpha > \frac{\beta+1}{2}$. The reason is related to the follower firm, because the amounts of quantities were summed up, and the firms separately shared same quantities in the Cournot competition. However, in the Stackelberg case, the dominant and follower firms share different quantitites and this changes the outcome. Total output will be affected differently due to the size of the natural resource abundance. The Dutch disease phenomenon will show similar indication in the Stackelberg case due to the resource movement effect and output reduction (services sector) under the same parameter value ($\alpha > \frac{\beta}{2}$).

2.2 Stackelberg competition with rent-seeking case

This chapter's objective is to figure out how the rent seeking dominant firm in the energy sector impacts labor inputs and total output under Stackelberg competition. No study mentions dominant firm's rent-seeking activities under Stackelberg competition together with this model's rent formulation (as the difference of profits between Stackelberg dominant firm and Cournot firm) in the context of Corden and Neary (1982) model as an explanation for Dutch disease. Furthermore, previous studies demonstrate widespread rent-seeking activities of dominant monopolies in the energy sector (Vicente 2010; Caselli and Michaels, 2013; Billo, 2015; Lima-de-Oliveira, 2020). According to Vicente (2010), ExxonMobil's oil exploration rights (1998) in Sao-Tome and Principe gave rise to increasing corruption compared to previous years. In Brazil, oil industry is predominantly monopolistic and corruption is quite common in oil-rich municipalities in order to capture rents (Caselli and Michaels, 2013). In the case of Ecuador, Repsol continuously intervenes in social life through political processes for securing its oil territories (Billo, 2015). Lima-de-Oliveira (2020) also discusses Brazil's dominant monopoly (Petrobras), and it is shown that corruption issues in the oil industry has been rampant for gaining attractive rents especially after 2000's.

Labor market

This model also refers to Hindricks and Myles (2013, p. 389), and according to previous chapters: "…the level of resources (labor) wasted in the rent-seeking process, a time. Rent seekers utilize discussion opportunity with politicians for rent-seeking activities. This could have been used in some more productive activities (profit-seeking) and generates huge opportunity cost."

Supposing that the dominant firm can increase energy price and gain the profit in the equation (174). The value of having a dominant position is a rent in this model, and it is the extra profit created by a dominant position. This will be the difference between the profits in Stackelberg and Cournot competition cases. In the first chapter of rent seeking monopoly case the rent is the difference between profits of monopoly and social optimum cases. In the second chapter of collusion with rent-seeking case the rent is the difference of profits under Cournot competition between collusion and no collusion cases. According to previous chapters: "Potential monopolists enter the energy sector by simultaneously proposing how much money they will burn. It is assumed that potential monopolists are all identical and risk-neutral." By using the same assumptions and applying here it is seen that a potential dominant firm that burns the most money will have a leader position in the energy sector. The entire value of the rent will be dissipated (191) according to complete dissipation theorem (Hindrick and Myles, 2013, p. 393).

The money that a potential dominant firm burns corresponds to a labor. ${l_L}^l$ will the labor for rent-seeking activity. The equilibrium condition of labor market will be

$$ {l_{Tsd}}^l + {l_{Tfl}}^l + {l_N}^l + {l_L}^l = 1. \qquad (190) $$

where superscript l indicates Stackelberg competition under rent-seeking case.

The prize for the dominant firm will be a rent, which is the difference between profits in Stackelberg competition dominant firm case (${\Pi_{T1}}^{SD}$) and Cournot competition case (${\Pi_{T1}}^{C}$) because leader firm's profit is higher than the previous case. The difference between profits in Stackelberg's follower case $\left({\Pi_{T2}}^{fl}\right)$and Cournot case (${\Pi_{T2}}^{C}$) is not taken here because follower firm's profit is lower in this case, which means that the follower firm will not engage in rent-seeking activity in this model. For the follower firm, Cournot competition or collusion cases are more profitable. Hence, only dominant firm will engage in rent-seeking in this model. Under the complete dissipation theorem, the labor that is used for rent-seeking can be calculated, meaning that "…resources that are used in rent-seeking up to the point where additional profit is exactly equal to the resource cost" (Hindricks and Myles, 2013, p. 405). From the equations (174) and (63) the value of labor that the dominant firm will spend for rent-seeking is

$$l_L{}^l = \Pi_{T1}{}^{SD} - \Pi_{T1}{}^{C}$$

$$= \frac{(\beta-\alpha)^2}{72\gamma}. \tag{191}$$

From the equilibrium condition of labor market in the equation (190), and the equations (177), (178) and (191) the labor in the services sector will be

$$l_N{}^l = 1 - \ l_{Tsd}{}^l - l_{Tfl}{}^l - l_L{}^l$$

$$= \frac{72\gamma-52\alpha\beta+53\alpha^2-\beta^2}{72\gamma}. \tag{192}$$

Commodity market in the services sector

Let $(x_N{}^l, P_N{}^l)$ be an allocation of commodity markets of the services sector at equilibrium. From the equation (163) and the first order condition from the equation (164) we get

$$P_N{}^l = 1, \tag{193}$$

and

$$x_N{}^l = l_N{}^l. \tag{194}$$

From the equations (192) and (194) we get

$$x_N{}^l = \frac{72\gamma-52\alpha\beta+53\alpha^2-\beta^2}{72\gamma}. \tag{195}$$

2.2.1 Analysis of the Stackelberg competition with rent-seeking case

The effect of the boom on the labor markets

Differentiating the labor inputs in the equations (177), (178), (191) and (192) with respect to α gives

$$\frac{d{l_T}^{SD}}{d\alpha} = \frac{\beta - 2\alpha}{2\gamma}, \tag{196}$$

$$\frac{d{l_T}^{SF}}{d\alpha} = \frac{\beta - 2\alpha}{4\gamma}, \tag{197}$$

$$\frac{d{l_L}^{l}}{d\alpha} = \frac{\alpha - \beta}{36\gamma}, \tag{198}$$

and

$$\frac{d{l_N}^{l}}{d\alpha} = \frac{53\alpha - 26\beta}{36\gamma}. \tag{199}$$

The equations (196) and (197) are negative when $\alpha > \frac{\beta}{2}$. If the degree of technological advancement is sufficiently large, then the boom in the energy sector increases the labor inputs in this sector. The equation (198) shows that if $\alpha < \beta$, then the equation will be negative, which means that rent-seeking is facilitated in the energy sector. It means when the degree of the boom is sufficiently small, then rent-seeking is facilitated. If $\alpha > \frac{26\beta}{53}$, then the equation (199) is positive, and the labor inputs in the services sector decrease, meaning that the resource movement effect will occur under that condition. When workers move to the energy sector from the services sector ($\alpha > \frac{26\beta}{53}$), they will either engage in rent-seeking under the dominant firm ($\alpha < \beta$) or production of energy by both firms ($\alpha > \frac{\beta}{2}$), and these depend on the parameter values.

The effect of the boom on the commodity markets

Here also we differentiate the equations (172) and (173) with respect to α. The boom in the energy sector increases the output in this sector:

$$\frac{dx_{Tsd}{}^{l}}{d\alpha} = -\frac{1}{2\gamma} < 0, \tag{200}$$

and

$$\frac{x_{Tfl}{}^{l}}{d\alpha} = -\frac{1}{4\gamma} < 0. \tag{201}$$

A marginal effect of the boom on the output in the services sector depends on parameter values after differentiating the equation (195) with respect to α

$$\frac{dx_{N}{}^{l}}{d\alpha} = \frac{53\alpha - 26\beta}{36\gamma}. \tag{202}$$

Let Y^{l} = $x_{Tsd}{}^{l}$+$x_{Tfl}{}^{l}$+ $x_{N}{}^{l}$ be the total output of the Stackelberg rent-seeking case with given world prices (Hindricks and Myles, 2013). The reason why we use this definition of total output is that the only change will occur in $x_{N}{}^{l}$ due to rent-seeking activity. A marginal effect of the boom on the total output depends on parameter values:

$$\frac{dY^{l}}{d\alpha} = \frac{106\alpha - 52\beta - 54}{72\gamma}. \tag{203}$$

The equation (203) is negative (positive) if:

$$\alpha < (>) \frac{26\beta + 27}{53}.$$

The equations (198), (199) and (203) give the following proposition:

Proposition

Under the Stackelberg rent-seeking in the energy sector:

i. The boom induces resource movement effect with the condition of $\alpha > \frac{26\beta}{53}$.

ii. Rent-seeking is facilitated during the boom.

iii. The boom decreases the total output with the condition of $\alpha > \frac{26\beta+27}{53}$.

Figure 6 describes all of the arguments of the proposition. In all three arguments of the proposition, it is shown that the effect of the natural resource abundance on the resource movement effect, rent-seeking activities and total output depend on parameter values. Unlike the previous chapters, Stackelberg competition actually harms the economy less (also Dutch disease is less significant) than the cases of rent seeking monopoly, merger or collusion. The reason is that there is a competition under Stackelberg rent-seeking, and only dominant firm engages in rent-seeking (also under parameter values). For the follower firm, rent-seeking is not attractive because of less profits compared to previous cases and, hence, less resources are wasted in the economy for rent-seeking activities.

The first argument of the proposition is supported by the equation (199), and it shows that the resource movement effect depends on the parameter values ($\alpha > \frac{26\beta}{53}$), and labor inputs may move from the services sector to the energy sector for participating either in rent-seeking activities or production of energy ($\alpha > \frac{\beta}{2}$). In the rent seeking monopoly case, the resource movement effect certainly occurs under the boom. However, in the dominant firm's case under the Stackelberg rent-seeking, this is not so serious because there is a competition between two firms, and the follower firm only engages in production of energy without joining rent-seeking activities.

The second argument of the proposition is supported by the equation (198), and it is a variable of degree ($l_L{}^l$) of rent-seeking activities. In this case, rent-seeking is facilitated due to assumption of $\alpha < \beta$. The result is interesting because if we have assumption, then rent-seeking occurs. The reason is related to only the dominant firm's rent-seeking activity, and if $\alpha > \frac{\beta}{2}$, then both firms will engage in production of energy due to the Stackelberg competition in the energy sector. However, in the previous chapters of monopoly and merger cases, rent-seeking activities are definitely facilitated under the boom. In the monopoly case, there is no competitor in the energy sector, and the monopoly definitely joins rent-seeking. In the mergers case also similar result happens because together they (upstream and downstream firms) act as a monopoly by capturing the rents available in the energy sector.

The third argument of the proposition is supported by the equation (203). It depends on the parameter values of β and α. If $\alpha > \frac{26\beta+27}{53}$, then total output will decrease in the case of Stackelberg rent-seeking. In the rent seeking monopoly case, total output decreases under the condition of $\alpha > 1$. In the colluding firms with rent-seeking case, the reduction of total output depends on parameter values ($\alpha > \frac{8\beta+9}{17}$). In the Stackelberg rent-seeking case, only the dominant firm engages in rent-seeking, and the size of the rent is the smallest compared to the previous chapters. So, fewer resources are wasted for rent-seeking. Finally, Stackelberg rent-seeking is less harmful to the society compared to the previous chapters due to the fact that all arguments of the propositions depends on parameter values.

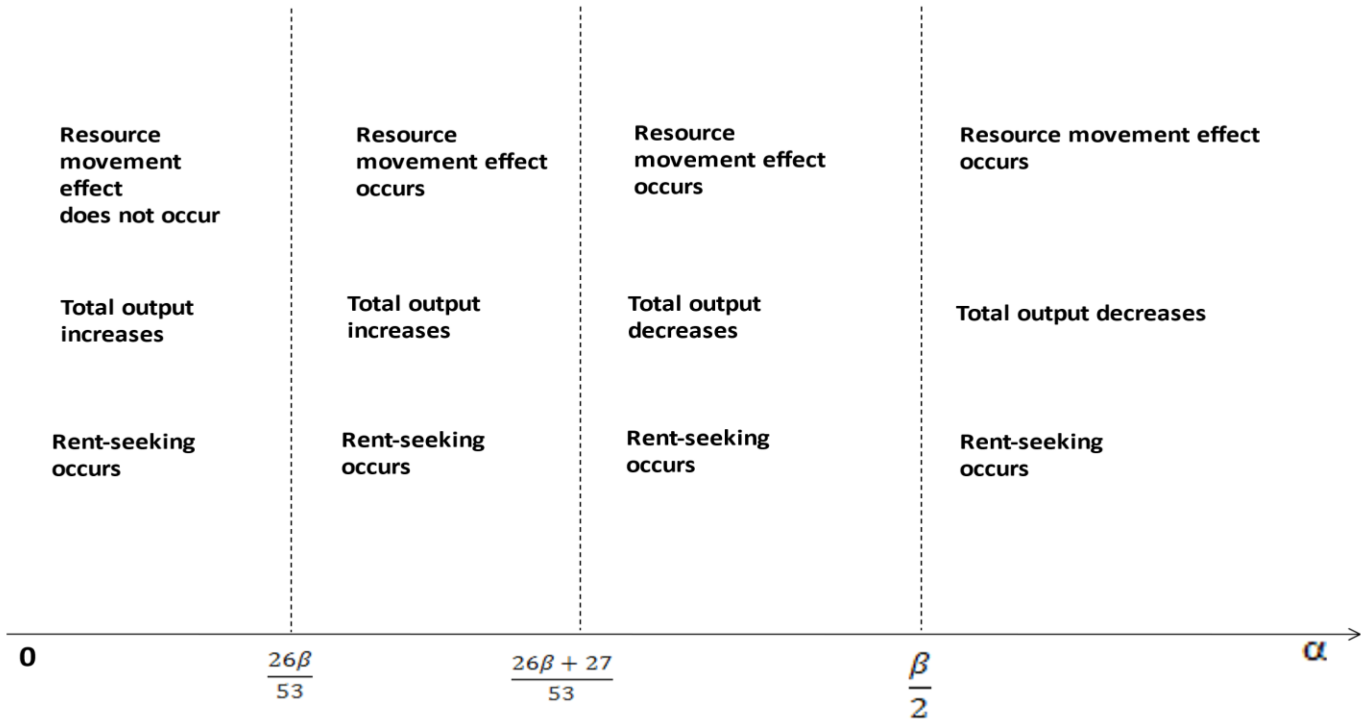

Figure 6. Proposition

3. Conclusion

The new model is developed in this chapter by concentrating on Stackelberg rent-seeking in order to explain the impact of the natural resource boom on total output, resource movement effect and rent-seeking activities in the energy sector. The model shows that under the boom, the resource movement effect may occur, meaning that labor inputs may move from the services sector to the energy sector depending on the parameter values. Rent-seeking may be facilitated and total output may decline under the boom depending on the parameter values as well.

The results are different between this chapter and the previous chapters. The reason is that in the rent seeking monopoly case, the rent is the highest (difference of profits between monopoly and social optimum cases) compared to Cournot and Stackelberg rent-seeking, and the most resources (labor inputs) are wasted for capturing this rent. In the collusion case under Cournot competition, the rent (difference between profits of collusion and no collusion under Cournot competition) is smaller than the rent seeking monopoly, and fewer resources are dissipated for gaining this rent. In the merger case, the difference between profits of merger and no merger cases was the rent. In the Stackelberg rent-seeking case, only the dominant firm engages in rent-seeking and the follower firm does not because the profit for the firm is lower than the Cournot competition or collusion. So, the rent is the smallest (difference between the profits of the dominant firm in the Stackelberg and Cournot cases), and the least resources are spent for rent-seeking compared to the previous chapters. The resource movement effect, rent-seeking and decline in total output depend on parameter values. This means that during the boom under Stackelberg rent-seeking, the economy is harmed less than the previous chapters.

Chapter 5

The Effect of Increasing Demand for Energy on Rent-seeking Analysis of Monopoly, Duopoly Collusion, Mergers and Stackelberg Cases

1. Introduction

This chapter will explain the models in the preceding chapters in order to analyze labor inputs and total output under increasing demand for energy. Thus, the chapter will analyze increasing demand for energy for determination of rent-seeking. The research will determine how labor inputs and total output will be affected under the increasing demand for energy. The extension of the models will be of another contributory research in the literature of political economy in order to explain the issues of rent-seeking in resource-rich countries. To the best of my knowledge, this study is the first to extend the previous chapters' models and examine labor inputs and total output under increasing consumption in the energy sector.

The relation between the increasing demand for energy and rent-seeking will be explained through the extension of the previously mentioned models. Previous chapters analyzes labor inputs and total output by differentiating the variables on the boom, while this chapter examines same variables by differentiating them on the increasing demand for energy in order to show how it impacts the above-mentioned variables under the cases of rent seeking monopoly, collusion, merger and Stackelberg competition. The research will demonstrate that the resource movement effect will definitely happen under a rent seeking monopoly, collusion, mergers and Stackelberg cases (Dutch disease occurrence). In the all cases, the rent-seeking facilitation will depend on parameter values. In all cases, the impact of increasing demand for energy on total output depends on parameter values.

2. The Rent-Seeking Models' Analyses under the Increasing Demand for Energy

As it is mentioned in the previously, the boom increases income which let consumers to purchase more commodities. Thus, in the research, consumption increases in the energy sector and the output level in the services sector decreases. By looking at the inverse demands and firms' cost functions in the energy sector in previous models, it is seen that inverse demand functions is parameterized and α (the boom or technological advancement) does not affect the behavior of consumers, but the effect of the rise in the parameter β (intercept) will provide predictive outlook on the analysis of the increasing demand for energy. Increasing β means that the demand curve for energy shifts to the right and upwards. By looking at the previous cases and taking the derivatives of the equations with respect to β, it is possible to conduct the analysis for the increasing demand for energy.

1) Analysis of the monopoly with rent-seeking case

The effect of the increasing demand for energy on the labor markets

Differentiating labor inputs in the equations (27), (38) and (40) with respect to β gives

$$\frac{\mathrm{d}{l_T}^l}{\mathrm{d}\beta} = \frac{\alpha}{2\gamma} > 0, \tag{204}$$

$$\frac{\mathrm{d}{l_L}^l}{\mathrm{d}\beta} = \frac{\beta-\alpha}{2\gamma}, \tag{205}$$

and

$$\frac{\mathrm{d}{l_N}^l}{\mathrm{d}\beta} = -\frac{\beta}{2\gamma} < 0. \tag{206}$$

The equation (204) is positive, meaning that increasing demand in the energy sector increases the labor in this sector. The equation (205) is positive in case of $\beta > \alpha$, meaning that if demand increases, the labor resource used in rent-seeking also increases. Increasing β increases the level of rent-seeking activity. In other words, increasing demand for energy will facilitate rent-seeking activities in the energy sector ($\beta > \alpha$). The equation (206) is strictly negative, and it implies that if demand in the energy sector increases, labor in the services sector will decrease.

The effect of the increasing demand for energy on the commodities markets

From the differentiations of the equations (25) and (33) with respect to β we get

$$\frac{\mathrm{d}{x_T}^l}{\mathrm{d}\beta} = \frac{1}{2\gamma} > 0, \tag{207}$$

and

$$\frac{\mathrm{d}{x_N}^l}{\mathrm{d}\beta} = -\frac{\beta}{2\gamma} < 0. \tag{208}$$

Increasing demand in the energy sector increases the output in this sector because the equation (207) is positive. The equation (208) is negative, and increasing demand for energy decreases output in this sector.

Here, a marginal effect of β on the total output is

$$\frac{\mathrm{d}Y^l}{\mathrm{d}\beta} = \frac{1-\beta}{2\gamma}. \tag{209}$$

This is the sum of the equations (207) and (208) as in the previous chapters. Here, total output is the sum of quantities in the energy and services sectors with given world prices (Hindricks, and Myles, 2013). Increasing demand for energy will contribute to the level of total output in the rent seeking monopoly case under certain parameter values.

The equations (205), (206) and (209) give the following proposition:

Proposition 1

When there is a rent seeking monopoly in the energy sector:

i. Due to increasing demand for energy the rent-seeking activities are facilitated with sufficiently small degree of the boom.

ii. The total output decreases due to rent-seeking activities.

The analysis in the case of monopoly with rent-seeking activities shows that the resource movement effect will definitely occur along with the output decline in the services sector (one of the Dutch disease phenomenon). Workers will certainly move from the services sector to the energy sector in order to engage in rent-seeking activities and production of energy. The production of energy also does not depend on any parameter values. The rent seeking monopoly uses labor inputs for making monopoly profits in the energy sector and, in addition, some portion of the inputs will be used for participating in rent-seeking activities. It is mentioned previously that the monopoly without rent-seeking mitigates the decline of total output. Furthermore, in the rent seeking monopoly case this kind of mitigation decreases more and changes the outcome. It means that increasing demand for energy is disadvantageous for evading the decline in the total output.

For the second argument of the proposition, the equation (205) is considered as a variable of degree (${l_L}^l$) of rent-seeking activities in the model, because the increasing demand for energy facilitates workers to engage in rent-seeking in the energy sector.

In order to support the third argument of the proposition, the equation (209) is used and, hence, total output decreases because of the size of the intercept in the case of the rent seeking monopoly.

2) Analysis of the collusion with rent-seeking case

The effect of the increasing demand for energy on the labor markets

Differentiating labor inputs in the equations (82), (93) and (95) with respect to β gives

$$\frac{\mathrm{d}{l_T}^l}{\mathrm{d}\beta} = \frac{\alpha}{2\gamma} > 0, \tag{210}$$

$$\frac{\mathrm{d}{l_L}^l}{\mathrm{d}\beta} = \frac{\beta-\alpha}{18\gamma}, \tag{211}$$

and

$$\frac{\mathrm{d}{l_N}^l}{\mathrm{d}\beta} = -\frac{(\beta+8\alpha)}{18\gamma} < 0. \tag{212}$$

The equation (210) is positive, and increasing demand in the energy sector increases the labor in this sector. The equation (211) is positive in case of $\beta > \alpha$, and the labor resource used in rent-seeking increases. The equation (212) is negative, and the labor in the services sector will decrease with increasing demand in the energy sector.

The effect of the increasing demand for energy on the commodities markets

From the differentiations of the equations (80) and (98) with respect to β we get

$$\frac{\mathrm{d}{x_T}^l}{\mathrm{d}\beta} = \frac{1}{2\gamma} > 0, \tag{213}$$

and

$$\frac{\mathrm{d}{x_N}^l}{\mathrm{d}\beta} = -\frac{(\beta+8\alpha)}{18\gamma} < 0. \tag{214}$$

Increasing demand in the energy sector also increases the output in this sector because the equation (213) is positive. The equation (214) will be negative, and increasing demand for energy will decrease output in this sector.

A marginal effect of β on the total output is

$$\frac{dY^l}{d\beta} = \frac{9-\beta-8\alpha}{18\gamma}. \quad (215)$$

This is sum of the equations (213) and (214). Here, total output is the sum of quantities in the energy and services sectors with given world prices (Hindricks, and Myles, 2013). The sign of the equation (215) is positive in case of $\beta < 9 - 8\alpha$, and the increasing demand for energy will contribute to the level of total output.

The equations (211), (212) and (215) give the following proposition:

Proposition 2

When there is a rent seeking collusion in the energy sector:

i. Under increasing demand for energy the rent-seeking activities are facilitated if the boom is sufficiently small.

ii. Increasing demand for energy will contribute to total output under the condition of $\beta < 9 - 8\alpha$.

The analysis in the case of collusion with rent-seeking activities describes that the resource movement effect occurs, and the output in the services sector decreases. The equations (212) and (214) support this conclusion. By referring to the equation (212), it is clear that the resource movement effect does not depend on the parameter values in the rent seeking collusion case, and labor inputs will move from the services sector to the energy sector by engaging in either in rent-seeking activities or production of energy. Here, the production of energy also does not depend on any parameter values due to the equation (210).

The equation (211) is a variable of degree ($l_L{}^l$) of rent-seeking activities in the model, and the increasing demand for energy facilitates workers to engage in rent-seeking in the energy sector in the case of $\beta > \alpha$. Profit-seeking activities also happen in the energy sector because rent-seeking depends on parameter values. Firms use some labor inputs for the production of energy.

For the third argument of the proposition, the equation (215) is used, and increasing demand for energy increases total output under the parameter condition of $\beta < 9 - 8\alpha$.

3) Analysis of mergers with rent-seeking case

The effect of the increasing demand for energy on the labor markets

Differentiating labor inputs in the equations (141), (152) and (153) with respect to β give

$$\frac{d{l_{TM}}^{l}}{d\beta} = \frac{\alpha}{2\gamma} > 0, \tag{216}$$

$$\frac{d{l_L}^{l}}{d\beta} = \frac{\beta-\alpha}{8\gamma}, \tag{217}$$

and

$$\frac{d{l_N}^{l}}{d\beta} = \frac{\alpha-\beta-4}{8\gamma}. \tag{218}$$

The equation (216) is positive and, hence, increasing demand in the energy sector increases the labor in this sector. The equation (217) is also positive, and the labor resource used in rent-seeking increases in the mergers case depending on parameter values. The equation (218) also depends on parameter values, meaning that resource movement effect will occur under increasing demand for energy depending on parameter values.

The effect of the increasing demand for energy on the commodities markets

From the differentiations of the equations (138) and (156) with respect to β we get

$$\frac{d{x_{TM}}^{l}}{d\beta} = \frac{1}{2\gamma} > 0, \tag{219}$$

and

$$\frac{\mathrm{d}x_N{}^l}{\mathrm{d}\beta} = \frac{\alpha-\beta-4}{8\gamma}. \tag{220}$$

Increasing consumption in the energy sector also increases the output in this sector because the equation (219) is positive. The equation (220) depends on parameter values, so increasing demand for energy will decrease output in this sector depending on parameter values.

A marginal effect of β on the total output depends on parameter values

$$\frac{dY^l}{d\beta} = \frac{\alpha-\beta}{8\gamma}. \tag{221}$$

This is the sum of the equations (219) and (220). Here, total output is the sum of quantities in the energy and services sectors with given world prices (Hindricks, and Myles, 2013).

The equations (217), (218) and (221) give the following proposition:

Proposition 3

When there is a rent seeking mergers in the energy sector:

i. If the boom is sufficiently small, then the rent-seeking activities are facilitated because of increasing demand for energy.

ii. Increasing demand for energy may decrease the total output with sufficiently small degree of the boom.

In the case of mergers with rent-seeking activities, the resource movement effect occurs under parameter values by referring to the equation (217). It supports the first argument of the proposition. Labor inputs will move from the services sector to the energy sector by engaging in either in rent-seeking activities or production of energy. The production of energy also does not depend on any parameter values due to the equation (216).

The equation (217) shows the rent-seeking activities ($l_L{}^l$) in the model, and the increasing demand for energy facilitates workers to engage in rent-seeking in the energy sector depending on the parameter values. Again, rent seeking merger case might negatively affect the economy due to dissipation of resources.

The equation (221) shows that increasing demand for energy may decrease total output under certain parameter values (with sufficiently small degree of the boom), and it supports the third argument of the proposition. In general, rent seeking merger case does not have serious negative implications in both chapters (under resource movement effect and increasing demand for energy) because rent-seeking occurrence as well as reduction of total output depends on parameter values.

4) Analysis of the Stackelberg rent-seeking case

The effect of the increasing demand for energy on the labor markets

Differentiating the labor inputs in the equations (177), (178), (191) and (192) with respect to β, we get

$$\frac{dl_T{}^{SD}}{d\beta} = \frac{\alpha}{2\gamma} > 0, \quad (222)$$

$$\frac{dl_T{}^{SF}}{d\beta} = \frac{\alpha}{4\gamma} > 0, \quad (223)$$

$$\frac{dl_L{}^l}{d\beta} = \frac{\beta-\alpha}{36\gamma}, \quad (224)$$

and

$$\frac{dl_N{}^l}{d\beta} = -\frac{(26\alpha+\beta)}{36\gamma} < 0. \quad (225)$$

The equations (222) and (223) are positive, and increasing demand in the energy sector increases the labor in this sector. The equation (224) is also positive in the case of $\beta > \alpha$, and the labor resource used in rent-seeking will increase in this case. The equation (225) is strictly negative, and labor in the services sector will unambigously decrease, meaning that resource movement effect will occur under increasing demand for energy.

The effect of the increasing demand for energy on the commodities markets

From the differentiations of the equations (172) and (173) with respect β, we get

$$\frac{dx_{Tsd}{}^{l}}{d\beta} = \frac{1}{2\gamma} > 0, \tag{226}$$

$$\frac{dx_{Tfl}{}^{l}}{d\beta} = \frac{1}{4\gamma} > 0, \tag{227}$$

and

$$\frac{\mathrm{d}x_{N}{}^{l}}{\mathrm{d}\beta} = -\frac{(26\alpha+\beta)}{36\gamma} < 0. \tag{228}$$

Increasing consumption in the energy sector also increases the output in this sector due to the positive signs of the equations of (226) and (227). The equation (228) is strictly negative, so output will decrease in this sector.

A marginal effect of β on the total output depends on parameter values

$$\frac{dY^{l}}{d\beta} = \frac{27-26\alpha-\beta}{36\gamma}. \tag{229}$$

This is the sum of the equations (226), (227) and (228). Here, total output is the sum of quantities in the energy and services sectors with given world prices (Hindricks, and Myles, 2013). The equation (229) is positive (negative) if

$\beta > 27 - 26\alpha$.

The equations (224), (225) and (229) give the following proposition:

Proposition 4

When there is a Stackelberg rent seeking in the energy sector:

i. Increasing demand for energy the will facilitate rent-seeking activities if the boom is sufficiently small.

ii. Increasing demand for energy will contribute to total output with the condition of $\beta > 27 - 26\alpha$.

For the first argument in the case of Stackelberg rent-seeking, the resource movement effect occurrence is clear under the equation (225), and labor inputs will move from the services sector to the energy sector by engaging in either rent-seeking activities or production of energy. The production of energy does not depend on parameter values under the equations (222) and (223).

Under the equation (224) the second argument is supported, and it shows that rent-seeking activities $({l_L}^l)$ will be facilitated due to the increasing demand for energy under the case of $\beta > \alpha$, and workers will engage in rent-seeking in the energy sector under certain parameter values.

For the third argument the equation (229) is used, and it shows that increasing demand for energy increases total output under certain parameter values ($\beta > 27 - 26\alpha$), and it supports the third argument of the proposition. Furthermore, in the rent seeking Stackelberg competition case, the economy is harmed much less than other cases. Although increasing demand for energy has a strong effect on the economy. Again, the reason is related to only dominant firm's rent-seeking activities, and the follower firm will prefer to join profit-seeking activities.

3. Conclusion

This chapter also concentrates on the rent seeking analysis in the previous chapters, but analyzes how labor inputs and total output are affected under the increasing demand for energy.

The preceding chapters explain labor inputs and total output by differentiating the variables on the technological advancement (the boom (α)). Here, these variables are differentiated on the intercept (increasing demand (β)) in order to analyze the impact of the increasing demand for energy on the above-mentioned variables. Under the increasing consumption in the energy sector, the resource movement effect will unambiguously occur under a rent seeking monopoly, collusion and Stackelberg cases in the energy sector, which means that labor inputs will move to the energy sector from the services sector. Rent-seeking activities will be facilitated due to increasing demand for energy under ceratin parameter values. In all cases, the increasing demand for energy contributes to the total output under parameter values. Furthermore, this chapter is not the alternative to the outcomes of previous chapters; it is rather an extension of the previous models by analyzing the labor inputs and total output under the increasing demand for energy by contributing to rent-seeking literature.

Chapter 6

Monopoly Rent-seeking in the Case of Azerbaijan[2]

1. Introduction

As it is seen from the previous theoretical chapters, rent-seeking is harmful for society because monopolies artificially create profitable opportunities for themselves without production. Several studies tried to measure rent-seeking as a result of dissipation of resources in a society, but those papers have different techniques for rent-seeking measurements due to the fact that there is no unique formula for rent-seeking analysis (Dougan, 1991; Mauro, 1995; McNutt, 1997; Brumm, 1999; Mixon and Wilkinson, 1999; Laband and McClintock, 2001; Cole and Chawdhry, 2002; Mixon, 2002; Sobel and Garrett, 2002; Antwi and Adams, 2003; Laband, 2004; Jarvis, 2005; Lamb, 2006; Liebman and Reynolds, 2006; Reynolds, 2006; Calderon and Chong, 2007; Rodriguez-Alvarez et al., 2007). Especially, Del Rosal (2011) developed a survey paper where he classified rent-seeking analysis by referring to the previous studies. He classifies rent-seeking as follows:

- *1. Indirect measures: Government regulations can be considered as the rent-seeking activity.*

[2] This chapter is published in a peer-reviewed journal:

Muradov, A. (2022). Energy Sector's Monopoly Rent-Seeking and Supplementary Time-Series Analysis in The Case of Azerbaijan. *Anadolu University Journal of Faculty of Economics*, 4 (1), 36-49.

Also, this chapter's section 2 is derived from the publication (peer-reviewed journal):

Muradov, A. (2021). The Importance of Natural Resources for The Azerbaijani Economy. *Economics, Business and Organization Research*, 3 (1) , 117-131.

- *2. The accounting perspective: As expenditures in rent seeking the direct measures can be taken.*
- *3. Aggregate approach: The impact of rent-seeking on economic development is analyzed as the macroeconomic basis.*
- *4. Other studies: There is no unique feature which can be assigned to this group. There might be some characteristics from previous groups but they do not belong to them.*

As it is seen above, previous studies have flexible approach to rent-seeking depending on various situations and variables. Hence, it is possible to apply different rent-seeking analysis depending on various countries' situation. Azerbaijan will be chosen in this chapter as a case for rent-seeking analysis through general equilibrium model. This is because there are no previous studies which measure rent-seeking in natural resource industry of Azerbaijan, and it will be the new contribution to the literature. The chapter also uses unique approach for the measurement of rent-seeking which will be the increasing energy prices within a country. The difference (discrepancy) between global oil prices and domestic gasoline prices actually increases during the crises due to decreasing oil prices. Domestic gasoline prices usually decrease with decreasing oil prices. In Azerbaijan, the opposite direction occurs, which makes it interesting for the research because monopolies increase the domestic gasoline prices in order to cover the losses. So, local gasoline prices can be used as a rent-seeking tool for the analysis due to increasing discrepancy. Resource dissipation is a problem in Azerbaijan which is similar to other former Soviet countries, and there is an urgency to conduct a research for determining the problem.

The chapter will describe the background information about the resource sector in Azerbaijan. A new general equilibrium model for a monopoly rent-seeking will be analyzed here for explaining monopoly rent-seeking in Azerbaijan. The model shows that monopolies will use increasing local gasoline prices as a tool for gaining the rent in Azerbaijan. Moreover, this chapter will use supplementary time-series analysis (tentative) for explaining the behaviour of monopolies in Azerbaijan (for illustrative purposes). This supplementary analysis will be future research topic for monopoly rent-seeking analysis in Azerbaijan. The data for global crude oil price and domestic gasoline prices in Azerbaijan will be used for explaining the relations between those two variables through cointegration analysis. There is a cointegration between two variables, and we will have clear ideas on unusual increasing gasoline prices in Azerbaijan because of the cointegration relationships.

2. Natural Resource Industry in Azerbaijan and Its Impact on the Economy[3]

Azerbaijan gained its independence from the USSR (Soviet Union) in 1991 (Muradov, 2018), and the “Contract of the Century” which was signed in 1994, created investment opportunities for the corporations such as British Petroleum, Lukoil, Chevron, Ramco, Statoil, and so forth. They invested financial resources in the natural resource industry for the exploration and extraction. The investments in the resource industry were the major reasons that the GDP had increased from around 3 billion USD (1995) to 75 billion USD (2014) (World Bank, 2022). Furthermore, the “Contract of the 21st Century” in 2013 is another major contract which helps the country to be the gas exporter to the European market as well (Muradov, 2021).

[3] This chapter’s descriptive part about the natural resource industry in Azerbaijan is fully published in a peer-reviewed journal. This chapter’s section 2 is derived from that publication:

Muradov, A. (2021). The Importance of Natural Resources for The Azerbaijani Economy. *Economics, Business and Organization Research*, 3 (1) , 117-131.

Although the country struggles for developing the non-oil sector (mainly due to institutional problems) and decreasing corruption, Azerbaijan developed faster and created better business environment for the international companies unlike other post-Soviet oil-rich Central Asian countries. The poverty reduction (4,8 % in 2019 (Asian Development Bank, 2022)) and decreasing unemployment rate (6% in 2020 (World Bank, 2022)) were the important achievements in the last decade but country's regional socio-economic development projects were inadequate for the economic diversification. Macroeconomic instability is another problem because Azerbaijan's dependency on the export of natural resources makes it vulnerable to the external factors such as the changing oil prices and the production level (Rosenberg and Saavalainen, 1998). This is because there is an increasing gap between the oil and non-oil sector, and the economy is heavily dependent mostly on the export of the natural resources. Furthermore, new institutional reforms are necessary in order to decrease the vulnerability of the economy towards the external factors. The diminishing oil production hinders the economic growth because natural resources play crucial roles for GDP growth. Majority of the investment projects go to the natural resource industry and, thus, this slows down diversification of the economy. Ibadoglu (2008) is also negative about this issue and states that the country should immediately facilitate the diversification in order to escape the long-run economic stagnation.

3. The Model

There are three markets in the model which are services, energy and labor (input). Services are perfectly competitive market and energy market is monopolistic. The model consists of the household, the competitive firm (services) and the monopoly firm (energy). The households (with the same income level) maximize their utility depending on budget constraint. Services sector's firms' economic profit is zero because it is perfectly competitive (price takers and maximize their profits). The monopoly in the energy sector is the price maker and it can increase price for gaining extra profits due to inelastic demand for energy. We can consider the impacts of other markets and understand the outside factos on the economy under the general equilibrium model.

1.1 Services sector

We assume that there are two goods such as services and energy. The input in each sector is labor. Services are produced with constant return to scale, and one unit of labor can produce one unit of output. The production function in services sector Q_N is

$$Q_N(l_N) = l_N, \tag{230}$$

where l_N is labor input in services sector. The labor input and output relation will be as

$$l_N = Q_N. \tag{231}$$

Profit maximization is

$$\max_{l_N} P_N F_N(l_N) - w_N l_N, \tag{232}$$

where P_N is the price of good in the services sector and w is the wage in this sector.

The first order condition is

$$P_N = w. \tag{233}$$

We assume P_N is numeraire, therefore $P_N = 1$ and $w = 1$.

3.2 Energy sector

The monopoly production function in the energy sector Q_T is

$$Q_T(l_T) = \alpha l_T, \quad (234)$$

where l_T is labor input in the energy sector and α (α>0) is a parameter about technological advancement (boom). The profit equation of a monopoly is:

$$\Pi_T = P_T Q_T - w l_T. \quad (235)$$

From the equation (234) we get

$$l_T = \frac{Q_T}{\alpha}. \quad (236)$$

Adding the equation (236) into the equation (235)

$$\Pi_T = \left(P_T - \frac{w}{\alpha}\right) Q_T, \quad (237)$$

where P_T is the price of good, Q_T total quantity and w is the wage in the energy sector.

3.3 Households

Households purchase energy and services for maximizing utility subject to the budget constraint. We assume every household has the same labor hours and dividend income, which means that they have the same level of income.

Utility maximization is

$$\max_{c_T, c_N} \mathrm{U}(c_T,\ c_N) = (\beta c_T{}^{-\frac{1-\sigma}{\sigma}} + \gamma c_N{}^{-\frac{1-\sigma}{\sigma}})^{\frac{-\sigma}{1-\sigma}}, \quad (238)$$

subject to

$$P_T c_T + P_N c_N = \bar{l} w + \Pi_T + \Pi_N, \quad (239)$$

where $U(c_T,\ c_N)$ is a utility function, c_T is the amount of consumption in the energy sector, c_N is the amount of consumption in the services sector. $\bar{l}$ is a labor supply (number of labor hours) of the whole economy. The market is competitive in the services sector

$$\Pi_N = 0, \quad (240)$$

and in the energy sector, we have the monopoly. Π_T is controlled by the monopolist. From marginal rate of substitution and the first order conditions

$$MRS = (\frac{C_N}{C_T})^{\frac{1}{\sigma}} \frac{\beta}{\gamma}, \tag{241}$$

and

$$MRS = \frac{P_T}{P_N}. \tag{242}$$

Due to the assumption of $P_N = 1$, and solving the problem yields demand for goods:

$$c_T = c_N (\frac{\beta}{P_T \gamma})^{\sigma}. \tag{243}$$

From the budget equation we get

$$c_T = \frac{\bar{l} w}{(\frac{P_T \gamma}{\beta})^{\sigma} + \frac{w}{\alpha}}, \tag{244}$$

and

$$c_N = \frac{\bar{l} w}{(\frac{P_T \gamma}{\beta})^{\sigma} + \frac{w}{\alpha}} (\frac{P_T \gamma}{\beta})^{\sigma}. \tag{245}$$

3.4 Market equilibrium condition

(l_T, l_N) is a pair of labor at equilibrium in each sector. An equilibrium condition of labor market is

$$l_T + l_N = \bar{l}. \tag{246}$$

From the market equilibrium condition $c_T = Q_T$ and $c_N = Q_N$. The total quantities in the energy and services sectors will be

$$Q_T = \frac{\bar{l}w}{(\frac{P_T\gamma}{\beta})^{\sigma}+\frac{w}{\alpha}} \ , \tag{247}$$

and

$$Q_N = \frac{\bar{l}w}{(\frac{P_T\gamma}{\beta})^{\sigma}+\frac{w}{\alpha}}(\frac{P_T\gamma}{\beta})^{\sigma}. \tag{248}$$

3.5 The effect of the boom and price

By adding the energy sector's quantity (Q_T) (247) into the monopoly profit equation (237) we get

$$\Pi_T = \left(P_T - \frac{w}{\alpha}\right)\frac{\alpha\bar{l}w}{\left(\alpha\left(\frac{\gamma P_T}{\beta}\right)^{\sigma}+w\right)}\,. \tag{249}$$

The differentiation of the monopoly profit on the price (P_T) (250) and the boom (α) (251) we get

$$\frac{d\Pi_T}{dP_T} = \frac{\alpha\bar{l}\mathrm{w}(\mathrm{w}\left(\sigma\left(\frac{P_T\gamma}{\beta}\right)^{\sigma}+P_T\right)-\alpha(\sigma-1)P_T\left(\frac{P_T\gamma}{\beta}\right)^{\sigma})}{P_T(\alpha(\frac{P_T\gamma}{\beta})^{\sigma}+w)^2}, \tag{250}$$

and

$$\frac{d\Pi_T}{d\alpha} = \frac{\bar{l}wP_T}{\alpha(\frac{P_T\gamma}{\beta})^{\sigma}+w}. \tag{251}$$

The equation (250) shows the marginal effect of price on the profit. The equation (251) shows the marginal effect of the boom on the profit. If σ <1 (inelastic) the equation (250) is positive. The marginal effects of the boom (251) and price (250) on the profit are different here. If profit decreases during the boom (251), then monopolies can increase price (250) and cover their losses. This situation actually occurs in the Azerbaijani energy market (subsection 3.6 and figure 7). Azerbaijani State Oil Company (SOCAR, 2022) shows similar pattern in terms unsatisfactory profits under the resource abundance and increasing gasoline prices in order to cover the losses. SOCAR's debt obligations (due to unsatisfactory profits in spite of the boom) increased for more than 7 times between the years of 2008-2017. The monopoly uses the price for rent-seeking activities, and it can infinitely increase profit by increasing the price. However, it does not do so due to political reasons in order to control people's behavior under political stability. This behavior is observable in Azerbaijani economy where the energy sector monopolies increase the prices during the crisis times in order to cover the costs. This behavior is also observable from the above-mentioned differentiations (250 and 251) by looking at P_T. The energy sector's monopoly can change P_T depending on α (boom) by checking the political situation within a country. Increasing P_T (policy variable) during the crises times is necessary for covering the losses, but the level of P_T will be controlled depending on people's reaction.

3.6 Supplementary empirical analysis

As it is mentioned above, supplementary time-series analysis (tentative) is conducted here for illustrative purposes. Data analysis is used for supporting the claim in the theoretical model, and explain the rent-seeking behavior of energy sector monopolies in Azerbaijan. This subsection will be the future comperehensive research topic. Here, this analysis will give us preliminary ideas about empirical analysis of rent-seeking in the case of Azerbaijan.

The chapter uses the first group of data as a domestic gasoline price per liter (octane-95) in dollar terms in Azerbaijan. The second group of data is a global crude oil price per liter (Brent oil) in dollar terms. The period from the first quarter of 2001 to the second quarter of 2021 is analzyed. Azerbaijan is relatively new country, therefore the data is limited and gasoline price is available from the year of 2001. We received domestic gasoline prices (Figure 7, blue line) from the Tariff (price) Council of Azerbaijan Republic (2022). The global oil prices are obtained from the US Energy Information Administration (2022) (Figure 7, red line). The chapter uses Gretl econometric software for data analysis.

We check the stationarity (means and variances are constant over time) of the variables through unit root test, and Augmented Dickey-Fuller (ADF) (1979, 1981) is used here for that purpose. After the unit root test, Engle-Granger Cointegration Test (1987) as well as Johansen Cointegration Test (1991, 1995) is used for the long-run relationship between those variables. ADF test result might showt the non-stationarity of the variables, but their linear combinations can be stationary. This is the main idea behind the concept of cointegration. Cointegration tests help to understand the long-run relationship between the variables showing that they wander (move) together (Hendry and Juselius, 2000).

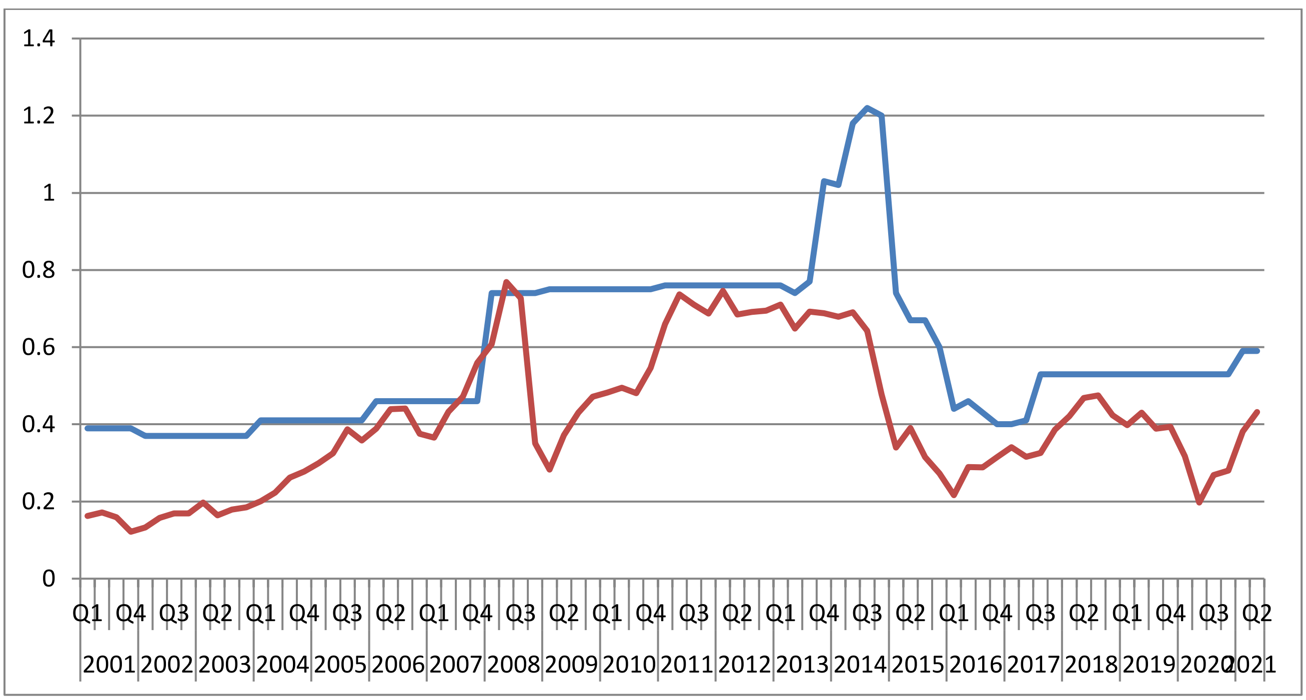

Figure 7. Time series plots for variables.

3.6.1 Unit-root test results

A stationary time series means that its properties do not depend on the time at which the series is observed (Kwiatkowski et al., 1992). In other words, properties such as mean, variance and so forth are constant over time.

For the unit root tests with constant, lag four is used along with logs of variables. Number of observations is 82. In order to check whether the above-mentioned variables are stationary or not, the ADF test is used for each variable separately.

Table 2. Unit-root test results (oil price and gasoline price)

Variables	ADF I(0)	P values	ADF I(1)	P values
LOILP	-2.45241	0.1275	-4.23401	0.0005724
LGASP	-2.37309	0.1495	-3.93441	0.001802

Table 2 shows the results of the ADF unit root test for oil and gasoline prices for levels and the first differences of the log values. Both variables are non-stationary in their levels (I(0)) and become stationary when they are first differenced (I(1)).

From table 1 we get the following estimation for oil price (LOILP):

$$\underset{}{\Delta\, y_{oilp,t}} = \underset{(0.0454423)}{-0.0874615} - \underset{(0.0431741)}{0.105881\mathrm{y}_{oilp,t-1}} + \underset{(0.114175)}{0.193623\mathrm{y}_{oilp,t-2}} - \underset{(0.117389)}{0.0677300\mathrm{y}_{oilp,t-3}} \qquad (252)$$

The value in parentheses below the estimate is the standard error. The null hypothesis of the ADF test is that the time series has a unit root and it is not stationary. If we reject this hypothesis then we conclude that the series is stationary. To not reject the null means that the level is not stationary. Here, the test statistic for the stationarity of the oil price is -2.45241 which has a p-value of 0.1275. Nonstationarity of the oil price cannot be rejected in this case at the usual 1%, 5% or 10% levels of significance.

For the gasoline price (LGASP) we get the following estimation:

$$\underset{}{\Delta \mathrm{y}_{gasp,t}} = \underset{(0.0246775)}{-0.0471643} - \underset{(0.0382597)}{0.0907935\mathrm{y}_{gasp,t-1}} + \underset{(0.113368)}{0.134465\mathrm{y}_{gasp,t-2}} - \underset{(0.115223)}{0.0630140\mathrm{y}_{gasp,t-3}} \quad (253)$$

Here, the test statistic for the stationarity of the oil price is -2.37309, which has a p-value of 0.1495. Nonstationarity of the gasoline price also cannot be rejected in this case at the usual 1%, 5% or 10% levels of significance.

3.6.2 Engle-Granger Cointegration Test result

The Engle-Granger Cointegration Test is used to determine if the global oil and gasoline prices are cointegrated. For the Engle–Granger test (1987) procedure, firstly it is necessary to test each series for a unit root using an ADF test, and it is shown in the previous section (3.6.1). Cointegration is tested after regressing one variable on the other and, afterwards, it is necessary to check if the residuals of the estimated regression equation are stationary. Cointegration will be supported if the null hypothesis of non-stationarity is not rejected for each of the variables (section 3.6.1), and the null is rejected for the residuals (Table 3).

Table 3. Testing for a unit root in residuals

T value	P value
−3.169	0.0753

There is evidence for a cointegrating relationship because the unit-root hypothesis is not rejected for the individual variables (section 3.6.1), and the unit-root hypothesis is rejected for the residuals at the 10% level from the cointegrating regression (Table 3). This is because null hypothesis (H_0: there is a unit root, H_1: there is no unit-root) is rejected with 10% level of significance ($p = 0.07531 < 0.1$). Hence, both of the variables move together in a long-run due to cointegrating relationship with 10% level of significance.

3.6.3 Johansen Cointegration Test results

For the Johansen's cointegration test, the following equation is used:

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} + .. + A_p y_{t-p} + B x_t + \varepsilon_t, \tag{254}$$

where y_t is vector of non-stationary I(1) variables, the vector x_t includes a set of exogenous variables. The vector ε_t is a vector white noise (not predictable series, like a sequence of random numbers) (Johnston and Dinardo, 1996, p. 287). The trace statistic and maximal eigenvalue statistic are used in order to do inferences about the number of cointegrating relations (Johnston and Dinardo, 1996, p. 302). In the trace statistic, the null hypothesis is tested that there are at most r cointegrating vectors against the alternative hypothesis which is r or more cointegrating vectors. The maximal eigenvalue statistic tests the null hypothesis of r cointegrating vectors against the alternative of r+1 cointegrating vectors. Johansen test results for variables are reported at table 4.

Table 4. Johansen Cointegration Test results

Rank	**Eigenvalue**	**Trace test**	**p-value**	**Lmax test**	**p-value**
0	0.18725	22.368	[0.0234]	16.793	[0.0337]
1	0.066512	5.5750	[0.2344]	5.5750	[0.2339]

We test its rank (r) sequentially in order to figure out the number of cointegrating relations. The null hypothesis ($r = 0$) shows that there is no cointegration if it is not rejected. Then we continue to the next rank and check if the null hypothesis rejected or not. Here, we test two series, so the two tests are $r = 0$ and $r = 1$.

Lmax and trace tests are used for finding the number of cointegrating vectors. It is recommended to use trace statistic in case of a conflict between these two statistics (Johansen and Juselius, 1990). Table 4 does not show any conflict between these two statistics. The eigenvalues in table 4 are given from largest to smallest. At the rank 0, $r = 0$ is rejected because p-value is smaller than the 5% significance level ($p = 0.02601 < 0.05$ (trace test); $p = 0.0337 < 0.05$ (Lmax test)). However, at the rank 1, the p-value is larger than 5% significance level ($p = 0.2346 > 0.05$ (trace test); $p = 0.2339 > 0.05$ (Lmax test)). We fail to reject $r = 1$, which means that the rank of matrix is one, and there is one cointegration relationship. Hence, it is possible to form one stationary series from a linear combination of two series tested.

Table 5. Johansen Cointegrating vectors

Y LGASP	X LOILP	C Constant
1.0000 (0.00000)	-0.69954 (0.11320)	-0.11656 (0.12109)

Table 5 demonstrates the cointegrating vectors, and it is seen that oil price and domestic gasoline prices move opposite ways due to the negative coefficient sign (-0.69954) for the oil price. It supports the theoretical model and claim that local monopolies usually increase gasoline price during the crises. They use domestic gasoline prices as a rent-seeking tool for political purposes. Consumers do not gain from the increasing gasoline prices because it is wasted by the monopolies and politicians (rent-seeking). Stable gasoline prices during the increasing exports of oil is helpful for the political stability. On the other hand, the local monopolies within the country keep gasoline prices stable (or decrease) when they receive sufficient revenues from the export of oil.

4. Conclusion

The chapter explains the rent seeking behavior of monopolies in Azerbaijan. The rent-seeking is theoretically analyzed under general equilibrium theoretical setting by explaining the energy sector monopoly behavior, and it shows how the profits are affected under the boom and increasing price. The marginal effects of price and the boom on profit shows that monopolies can cover their losses during if profits decrease under the boom. Price will be the rent-seeking tool in the model, meaning that monopolies can increase or decrease the price depending on the political situation within the country. The chapter also uses supplementary time-series analysis (tentative) in order to show the unusual behaviour of monopolies in Azerbaijan. This supplementary empirical analysis will give initial ideas about the monopoly rent-seeking in the case of Azerbaijan (future research topic). The chapter takes the data for global crude oil price and Azerbaijani domestic gasoline prices (rent-seeking for this chapter). There is a cointegration between two variables through Johansen Cointegration Test and Engle Granger Test. The model explained why local monopolies irrationally increase gasoline prices in Azerbaijan. The reason is that they can cover their losses locally during decreasing global oil prices. However, during the increasing exports of oil, they usually do not increase prices. Empirically this behavior is also supported because of the cointegration relationships between the above-mentioned variables.

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