Lobbying,Public Capital and Endogenous Growth

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Abstract

This paper investigates the impact of lobbying on economic growth via a heterogeneous-firm model. Lobbying activity is endogenized by the introduction of the effective usage of public capital in the production sector. Given the assumption that firms are heterogeneous in productivity, their effective usages of public capital will inevitably be different in the equilibrium and, hence, so will be the output. This research shows: if public capital contributes more in a more productive society, then the total output in the decentralized economy where lobbying activity is allowed dominates that in the centralized economy where public capital is equally assigned. This paper concludes that public capital can be socially optimally allocated with the "accidental" help of lobbying activity. The result of this model is completely independent of distribution of productivity.

Key words: Lobbying, Public Capital, Endogenous Growth

JEL code: E 62, H11, H 54

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1 Introduction

Most public capital such as infrastructure capital is generally considered as non-rival goods. While many researchers have investigated the congestion effect, few papers concern the distributional effects. By distributional effects, we mean that the firm with the highest productivity may be able to acquire the most effective usage of public capital in the production. For instance, a new highway plan is brought to the congress to discuss whether it will be built in Michigan or Indiana. Ford, most of whose factories are in Michigan, will lobby the congressmen to vote for the location of Michigan. Toyota, most of whose factories are in Indiana, will lobby the congressmen to vote for the location of Indiana. The reason is obvious that the closer to them the new highway the less their cost will be.

The main contributions of this paper are the following. Firstly, to my best knowledge this paper is the first one to build up a model with heterogeneous firms to examine the distributional effect of public capital and investigate the impact of lobbying on economic growth. Secondly, this paper shows that lobbying activity plays an "auction market" role on public capitals allocation. That is, the firm with highest productivity will get the largest amount of public capitals by hiring the most lobbyists. Lobbying is therefore a welfare-improving activity if the weighted average productivity is sensitive enough to the power of public capital in the production. And the result is completely independent of distribution of productivity, which makes it a general model to investigate the effect of lobbying activity on economic growth through public capital.

Let's take a look at some figures as the evidences of the lobbying activity. In 2010, there are 12964 lobbyists spending 3.51 billion US dollars on lobbying activities in the US (opensecret.org). United States is not the only country where firms spend a lot of money on lobbying. Between 1985 and 1997, over 35,000 European firms chose to directly develop European lobbying capabilities, according to Coen (1998). Lehmann (2003) in his European parliament working paper writes:

> The exact number of formal business associations that are politically active at the EU level is difficult to estimate for several reasons. First of all, there are various ways of accessing EU institutions and politics, and there is a variety of businesses. Some of these key players seek visibility while others prefer relative anonymity. The internal organization of firms and their public affairs capacities are also very diversified. They engage in EU 'public affairs' from different territorial locations. For instance, Mazey and Richardson mention that there are far more than 20 flights per day from London to Brussels, many of which carry representatives from various interest groups and companies to do regular business with the EU institutions. Similar observations could certainly be made about the Thalys high speed train now running every 30 minutes between Paris and Brussels.
>
> According to different directory listings and the European Commission database there are approximately 950 business interest associations, more than 1300 EU level groups of all types and around 300 transnational firms with government relations offices in Belgium.

Lehmann points out the important role that lobbying plays in the relation of the politicians and the business world in Europe.

The questions are: Why do those companies pay huge amount of money on lobbying activity? Does it have anything to do with the production? If so, what will be the effect of this new input, the lobbyists, on growth? This paper attempts to answer these questions in the following sections.

One of the most important public capitals in the production is infrastructure capital. Aschauer (1989a, 1989b) first started the investigation of the effect of infrastructure on economic growth. His empirical study shows that infrastructure capitals such as highways and airports are important in

determining the productive force. The infrastructure capital also crowds in private capital because they function as complementary input in the production. Sanchez-Robles (1998), Canning and Pedroni (1999) and Esfahani and Ramirez (2003) further developed Aschauer (1989a, 1989b)'s reduced form method to the structural method. The advantage of using the structural form is that it can address the issues of endogeniety and causality, which makes the positive effect of infrastructure on economic growth more convincing. Esfahani and Ramirez (2003) used a structural model and find that the growth rate of infrastructure has a great impact on the GDP growth rate. However, they also pointed out that this impact depends on institutional and economic characteristics that affect the steady-state asset-GDP ratios as well as the adjustment rates to the steady-state.

Theorists of infrastructure capital also have done substantial research on this subject. Glomm and Ravikumar (1994) examined the implication of capital accumulation via a one-sector model. In their research infrastructure is introduced as an external input to the private production functions. They found that the optimal tax rate was independent of the degree of nonrivalry of the public good. Fernald (1999) found that the largest component of infrastructure, roads, have a disproportional effect on those US industries that involve more in vehicles, meaning that vehicle-intensive industries benefit more from road-building. This disproportional use of roads is similar to the distributive effect produced by lobbying activity of the firms with different productivity mentioned in the introduction. Given this, I shall continue to survey some papers regarding the relationship between lobbying and public policy.

Lobbying is an activity that can influence politicians' decision on public policy. There are two basic viewpoints about the effect of lobbying on economic growth: one is that lobbying activity distorts the optimal allocation of resources so the economy will end up with the second-best equilibrium; the other opinion is that lobbying activity corrects the distortion of optimal allocation of resources by government via the information function of lobbying so the economy will possibly arrive at the optimal equilibrium where there is no distortion. Mork (1993) derived the result that the growth rate in the equilibrium with lobbying is higher than the cases when lobbying and

policy are both prohibited. His conclusion was built upon the argument that lobbying may lead policy makers not to ignore the welfare-improving opportunity. Lagerlof (1997) also showed that lobbying could improve welfare if it functions like an information transmission. But he also pointed out that even in a setting where lobbying plays exclusively an informational role, it is not necessarily welfare improving. Grossman and Helpman (1994) developed the model of "protection for sale," and Mitra (1999) extended the model by endogenizing the formation of lobbying. Mitra concluded that free trade could be an equilibrium choice whether the government is highly responsive to the lobbying activity or not. Lane and Tornell (1996) and Benhabib and Rustichini (1996) proved the negative effect of lobbying on economic growth. They showed from a distributive view that the economy with lobbying would grow more slowly than the one without lobbying.

Two relevant papers by Mohtadi and Roe (1998, 2003). Mohtadi and Roe (1998) internalized the spill-over effect of lobbying activity in a general dynamic model and showed that the welfare of the economy with lobbying is greater than that of the economy without lobbying. Their theoretical model also finds that an economy with relatively higher public capital than private capital will spend more on lobbying for public investments. In their 2003 paper, they replaced lobbying with rent seeking and developed a two-sector model to investigate the relationship between rent seeking as well as the level of democracy and economic growth rate in a very similar general dynamic growth model. The basic result of Mohtadi and Roe (2003) is that there is an inverted U-shape relation between rent seeking and economic growth and hence a U-shape relation between the level of democracy and economic growth.

Melitz (2003) provides a tractable model with heterogeneous firms for this paper to follow. The distinction, however, is also very obvious. He explores different decisions by firms whether to sell domestically, export or set up an affliate in foreign countries. And his model is a one-period model without physical capital or public capital. But without his groundbreaking work in setting up the model with heterogeneous firms, this paper would not find the way to get to the conclusions.

2 The environment

2.1 Households

This economy is a two-period economy. There is a representative household in this economy. The household provides raw labor and physical capital in the second period. This representative household owns all the firms in this economy. There is a single non-storable consumption good which is valued by the household according to the utility function

$$logC_1 + \rho logC_2 \tag{1}$$

where C_1 and C_2 are the consumptions of the representative household in period 1 and 2. The household supplies one unit of labor inelastically. And the household maximizes (1)

subject to

$$\begin{cases} C_1 + K = (1-\tau)\bar{e} \\ C_2 = RK + w. \end{cases} \tag{2}$$

where K is the saving of the household in period 1, which is rented to a mass N firms. $\bar{e}$ is the endowment received by the household in period 1, τ is the tax rate on the endowment by government in period 1 to finance government spending or public capital in period 2, R is the gross return of the savings, w is the wage rate of labor.

2.2 Production

There are a mass N firms in this economy. They are heterogeneous in the sense that different total factor productivities A are given to different firms.A follows a certain distribution and $p(A)$ denotes the probability density function of A.One thing special about firms is that they divide labors hired from households into two categories: workers and lobbyists. Workers work in the factory directly producing output while lobbyists perform lobbying activity to increase the productivity of public capital in the production function. Despite their different types of jobs, both worker and lobbyist have the same wage rate in the equilibrium given the assumption that they are the same type of labor. The production function is decreasing return to scale in three inputs: physical capital, labor, and lobbyist given the total public capital

provided by government. Each firm produces output y_i by choosing physical capital input k_i, labor input l_i^Y and lobbyist input l_i^G given the public capital G in period 2 according to the following technology,

$$y_i = A_i(k_i)^\alpha (l_i^Y)^\beta (\frac{l_i^G}{L^G} G)^\gamma, \tag{3}$$

where $\alpha, \beta, \gamma > 0, \alpha + \beta + \gamma < 1$ and A_i denotes the different total factor productivity,k_i is the amount of physical capital rented by the firm i, l_i^Y and l_i^G are the amounts of workers and lobbyists hired to produce final good y_i , superscript Y and G of l_i are to distinguish between labor and lobbyist; L^G is the total stock of lobbyists in the economy in equilibrium; G is the public capital such as infrastructure capital, affected by the internal choice of lobbyist which is different from the external set-up of infrastructure capital in Glomm and Ravikumar (1994). We assume that physical capital depreciates at 100 percent. Moreover, when firms choose the optimal amount of lobbyists they perfectly foresee the total stock of lobbyists in the equilibrium and take it as given. Hence, firms have an incentive to hire as many lobbyists as they can to increase the productivity of infrastructure capital without concerning the possible increase of negative externality. Because the production function exhibits decreasing return to scale in three inputs and firms are heterogeneous in terms of productivity, there may be different profits earned by different firms in equilibrium.

2.3 Public sector

Public good evolves according to

$$G = \tau \bar{e} \tag{4}$$

Government investment in public good is financed by taxing the endowment of households at a uniform tax rate. There is asymmetric information about firms' productivities between government and firms themselves. Government only knows the productivity of firms follows a certain distribution but does not know the exact productivity of any firms. Individual firms, however, are revealed their own productivities.

2.4 Equilibrium

Household and firms take fiscal policy as given when making their decisions. The representative household's problem in this economy is to choose (C_1, C_2, K) to maximize

$logC_1 + \rho logC_2$

subject to

$$\begin{cases} C_1 + K = (1-\tau)\bar{e} \\ C_2 = RK + w. \end{cases}$$

where w is the wage rates of worker and lobbyist, R is the gross rental rate on physical capital, and τ is the uniform tax rate.

In period 2, in a competitive market firm i's problem is to choose physical capital input k_i , labor input l_i^Y and lobbyist input l_i^G given the public capital G to maximize

$\pi_i = A_i(k_i)^\alpha (l_i^Y)^\beta (\frac{l_i^G}{L^G}G)^\gamma - Rk_i - wl_i^Y - wl_i^G$

subject to

$l_i^Y < L^Y \leq 1$, $l_i^G < L^G \leq 1$,$k_i \leq K, \alpha, \beta, \gamma > 0, \alpha + \beta + \gamma < 1$

We can now define a competitive equilibrium with externality for this economy. Let (G, τ) be an arbitrary fiscal policy with a set of allocations $(C_1, C_2, K, k_i, l_i^Y, l_i^G)$ together with prices (R,w) such that

- (i) (C_1, C_2, K) solves the representative household's problem,
- (ii) (k_i, l_i^Y, l_i^G) solves the firm i's problem and
- (iii) Capital market, labor market and goods market clear as the following

  (a) $K = S$; the total demand for physical capital equals to the total supply of physical capital which is also the saving of the household;

(b) $L^G + L^Y = 1$; total labor demand of firms equals to total labor supply by household;

(c) $L^Y = \sum_{i=1}^{N} l_i^Y$;total worker demand of firms equals to total worker supply by household

(d) $L^G = \sum_{i=1}^{N} l_i^G$;total lobbyist demand of firms equals to total lobbyist supply and

(e) $C_1 + K + G = \bar{e}$; $C_2 = Y$; total consumption in period 1 plus total physical capital as well as public capital should be equal to total endowment; total consumption in period 2 should be equal to the total output, where $\sum_{i=1}^{N} y_i = Y$.

The first condition is standard. A new characteristic of the second condition is that production firms need to choose the optimal amount of the lobbyist together with the worker and the physical capital to maximize their profits. The final condition is that goods market, worker market, lobbyist market and hence total labor market need to clear. There are two important characteristics of this model. One special characteristic of this equilibrium is that the total stock of lobbyist is the negative externality in this model. The other is that since the production function is decreasing return to scale, there will be positive profits in period 2. But we assume that household receives those total profits at the end of period 2 so it does not go into the household budget constraint.

3 Decentralized Economy with lobbyists

In the decentralized economy, firms hire lobbyists to get as much usage of public good as they can. So the production function is as follows.

$$y_i = A_i(k_i)^{\alpha}(l_i^Y)^{\beta}(\frac{l_i^G}{L^G}G)^{\gamma}, \alpha, \beta, \gamma > 0, \alpha + \beta + \gamma < 1 \tag{5}$$

$\frac{l_i^G}{L^G}G$ represents the effective usage of public capital affected by the internal choice of hired lobbyists,l_i^G, given the forseen total stock of lobbyists, L^G, and total public capital,G.

Firm i solves the following profit-maxmizing problem:

$\pi_i = A_i(k_i)^{\alpha}(l_i^Y)^{\beta}(\frac{l_i^G}{L^G}G)^{\gamma} - Rk_i - wl_i^Y - wl_i^G$

Subject to

$l_i^Y < L^Y < 1$, $l_i^G < L^G < 1$,$k_i < K, \alpha, \beta, \gamma > 0, \alpha + \beta + \gamma < 1$

The first order conditions are as follows:

$$\frac{\partial \pi}{\partial k_i} = \alpha A_i k_i^{\alpha-1}(l_i^Y)^{\beta}(l_i^G)^{\gamma}(\frac{G}{L^G})^{\gamma} - R = 0 \tag{6}$$

$$\frac{\partial \pi}{\partial l_i^Y} = \beta A_i k_i^{\alpha}(l_i^Y)^{\beta-1}(l_i^G)^{\gamma}(\frac{G}{L^G})^{\gamma} - w = 0 \tag{7}$$

$$\frac{\partial \pi}{\partial l_i^G} = \gamma A_i k_i^{\alpha}(l_i^Y)^{\beta}(l_i^G)^{\gamma-1}(\frac{G}{L^G})^{\gamma} - w = 0 \tag{8}$$

Then we solve for:

$$l_i^G = [A_i\gamma(\frac{\alpha}{\gamma}\frac{w}{R})^{\alpha}(\frac{\beta}{\gamma})^{\beta}(\frac{G}{L^G})^{\gamma}\frac{1}{w}]^{\frac{1}{1-\alpha-\beta-\gamma}} \tag{9}$$

$$l_i^Y = \frac{\beta}{\gamma}[A_i\gamma(\frac{\alpha}{\gamma}\frac{w}{R})^{\alpha}(\frac{\beta}{\gamma})^{\beta}(\frac{G}{L^G})^{\gamma}\frac{1}{w}]^{\frac{1}{1-\alpha-\beta-\gamma}} \tag{10}$$

$$k_i = \frac{\alpha}{\gamma}\frac{w}{R}[A_i\gamma(\frac{\alpha}{\gamma}\frac{w}{R})^{\alpha}(\frac{\beta}{\gamma})^{\beta}(\frac{G}{L^G})^{\gamma}\frac{1}{w}]^{\frac{1}{1-\alpha-\beta-\gamma}} \tag{11}$$

After we solve for w and R, which are endogenous, we have the following individual firm's decision rule:

$$l_i^G = \frac{\gamma}{\beta+\gamma}\frac{A_i^{\frac{1}{1-\alpha-\beta-\gamma}}}{A_{DE}} \tag{12}$$

$$l_i^Y = \frac{\beta}{\beta+\gamma}\frac{A_i^{\frac{1}{1-\alpha-\beta-\gamma}}}{A_{DE}} \tag{13}$$

$$k_i = \frac{\alpha\rho}{(\alpha+\beta+\gamma+\alpha\rho)}\bar{e}(1-\tau)\frac{A_i^{\frac{1}{1-\alpha-\beta-\gamma}}}{A_{DE}} \tag{14}$$

where $A_{DE} = \int_0^\infty NA^{\frac{1}{1-\alpha-\beta-\gamma}} p(A)dA$

From the above, we can see that individual firm's choice of worker, lobbyist and physical capital are all increasing in own productivity given the weighted total productivity A_{DE}. Hence, in equilibrium more productive firms hire more lobbyists to gain more effective usage of public capital. This reflects the fact that in the economy where hiring lobbyists is allowed the most productive firm will try to hire the most lobbyists to increase its outputs. But if firms are able to choose whether to stay in the economy with lobbyists or the one without, highly productive firms intend to stay in the economy where no lobbyists are allowed. Proposition 1 and 2 later will show the discussion in detail.

The individual output in decentralized economy is the following:

$$\begin{aligned} y_i = {} & \alpha^\alpha \beta^\beta \rho^\alpha \tau^\gamma (1-\tau)^\alpha \bar{e}^{\alpha+\gamma} \\ & \cdot(\alpha+\beta+\gamma+\alpha\rho)^{-\alpha}(\beta+\gamma)^{-\beta} A_{DE}^{-\alpha-\beta-\gamma} A_i^{\frac{1}{1-\alpha-\beta-\gamma}} \end{aligned} \tag{15}$$

Thus the aggregate output in decentralized economy is the following:

$$\begin{aligned} Y_{DE} = {} & \alpha^\alpha \beta^\beta \rho^\alpha \tau^\gamma (1-\tau)^\alpha \bar{e}^{\alpha+\gamma} \\ & \cdot(\alpha+\beta+\gamma+\alpha\rho)^{-\alpha}(\beta+\gamma)^{-\beta} N^{1-\alpha-\beta-\gamma} \tilde{A} \end{aligned} \tag{16}$$

where $\tilde{A} = [\int_0^\infty A^{\frac{1}{1-\alpha-\beta-\gamma}} p(A)dA]^{1-\alpha-\beta-\gamma}$ is a weighted average of the firm productivity levels A and is independent of the number of firms N.

4 Centralized Economy with equal assignment

In this centralized economy, firms are not allowed to hire lobbyists. Gov-

ernment knows the distribution of productivity but does not know the individual ones. So government assigns equal share of public good usage to each firm.

And the production function becomes,

$$y_i = A_i(k_i)^{\alpha}(l_i^Y)^{\beta}(\frac{G}{N})^{\gamma}, \tag{17}$$

Then the individual firm's decision rule is as follows:

$$l_i^Y = \frac{A_i^{\frac{1}{1-\alpha-\beta}}}{A_{CE}} \tag{18}$$

$$k_i = \frac{\alpha\rho}{\alpha+\beta+\alpha\rho}\bar{e}(1-\tau)\frac{A_i^{\frac{1}{1-\alpha-\beta}}}{A_{CE}} \tag{19}$$

And then the individual output in the solution of the model in centralized economy is the following:

$$y_i = \alpha^{\alpha}\rho^{\alpha}(\alpha+\beta+\alpha\rho)^{-\alpha}\tau^{\gamma}(1-\tau)^{\alpha}\bar{e}^{\alpha+\gamma}\frac{A_i^{\frac{1}{1-\alpha-\beta}}}{A_{CE}^{\alpha+\beta}}N^{-\gamma} \tag{20}$$

where $A_{CE} = \int_0^{\infty} NA^{\frac{1}{1-\alpha-\beta}}p(A)dA$

And the aggregate output in the solution of the model of centralized economy is the following:

$$Y_{CE} = \alpha^{\alpha}\rho^{\alpha}(\alpha+\beta+\alpha\rho)^{-\alpha}\tau^{\gamma}(1-\tau)^{\alpha}\bar{e}^{\alpha+\gamma}N^{1-\alpha-\beta-\gamma}\hat{A} \tag{21}$$

where $\hat{A} = [\int_0^{\infty} A^{\frac{1}{1-\alpha-\beta}}p(A)dA]^{1-\alpha-\beta}$ is another weighted average of the firm productivity levels A and is independent of the number of firms N.

5 Propositions

Proposition 1 *The output of the decentralized economy with lobbyists will dominate that of the centralized economy if the following condition holds:*

$$\epsilon_{\gamma 1} > \frac{\alpha\gamma}{\alpha+\beta+\gamma\alpha\rho} + \frac{\beta\gamma}{\beta+\gamma} \tag{22}$$

where, $\epsilon_{\gamma 1} = \frac{\partial \tilde{A}}{\tilde{A}} \frac{\gamma}{\partial \gamma}$.

Proposition 1 says that lobbyists are beneficial to social outputs if the weighted average productivity, $\tilde{A}$, is sensitive enough to the power of public good in the production, γ. This condition means relatively high variation of the weighted average productivity occurs when there is a small change in the share of public capital's contribution to the final output. Therefore proposition 1 implies if the weighted average productivity of firms is positively responsive to the change of public capital's contribution share in the production, then lobbying activity helps to allocate common resources in the most efficient way. In other words, if public capital contributes more in a more productive society lobbying activity is beneficial to this society in terms of final outputs.

Another important point is that proposition 1 is independent of distribution of productivity. Therefore our main result is a general result. As long as public capital plays a more important role in a highly productive society lobbying makes the society better off.

Proposition 2 *There is a unique cutoff productivity level* A^**, at which the profit of decentralized firm equals to the one of centralized firm. That means it is more profitable for any firms with productivity lower than* A^* *to stay in the decentralized economy while less profitable for any firms with higher productivity to do so. (See figure 1) And the* A^* *is equal to*

$\frac{1}{(1-\alpha-\beta-\gamma)^3(\frac{\beta}{\beta+\gamma}+\frac{\alpha}{\alpha+\beta+\gamma+\alpha\rho}-\frac{\epsilon_{\gamma 2}}{\gamma}+\frac{1}{1-\alpha-\beta-\gamma})}$. *(See Lemma 1)*

The proof of the existence and uniqueness is in the appendix. Proposition 2 results mainly from the trade-off faced by firms that more workers or lobbyists they would like to use in the production. If hiring lobbyists brings more profits than otherwise, they will reduce workers to hire lobbyists because the total available labor is fixed.

Lemma 1 *The profit of decentralized firms will be higher than that of centralized firms if the following condition holds:*

$$0 < A_i < \frac{1}{(1-\alpha-\beta-\gamma)^3(\frac{\beta}{\beta+\gamma}+\frac{\alpha}{\alpha+\beta+\gamma+\alpha\rho}-\frac{\epsilon_{\gamma 2}}{\gamma}+\frac{1}{1-\alpha-\beta-\gamma})}, \quad (23)$$

where,
$\epsilon_{\gamma 2} = \frac{\partial \tilde{A}'}{\tilde{A}'}\frac{\gamma}{\partial \gamma}$, $\tilde{A}' = [\int_0^\infty A^{\frac{1}{1-\alpha-\beta-\gamma}} p(A)dA]^{-\alpha-\beta-\gamma}$.

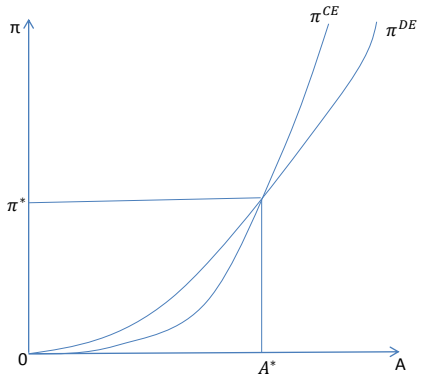

Figure 1: Cutoff productivity by the comparison of profits

One important economic explanation of Lemma 1 is that firms with the productivity that is higher than A^* will choose to stay in an economy with no lobbyists while less productive ones will choose to stay in the economy with lobbyists.

6 Political Economy of Regime Switch

Obviously more productive firms would not want to waste labor in the lobbying activity if they were able to choose between the two regimes. On the contrary, less productive firms could make up for part of their disadvantages by competing for public capitals in the decentralized economy. Of course, in the real world, most productive firms are in developed countries where lobbyists are allowed. But if we see corruption as the extreme case of allowing the most lobbyists in the economy, you will see why most high productive firms stay in the US or Western Europe where the level of lobbying is relatively low compared to some Eastern European countries or most Asian countries where the level of lobbying is high enough for the whole economy to be corruptive.

From figure 1, we can see that low productive firms would rather choose decentralized form of public good assignment to make more profits. High productive firms, on the other hand, would rather choose equal assignment of public good to make more profits.

7 Some Simulation Results

To show our results more clearly, we pick some specific distributions and some values for the parameters to do simulations. For the parameters of the production function,α, β and γ, we let them be 0.6,0.3 and 0.05. And we use 0.95 for the discount factor and 0.3 for the tax rate in both two economies. And for the endowment and the number of firms, we randomly use 10 and 5000 because they don't matter at all in terms of economic meanings.

Finally, after those values of the parameters are chosen, in order to solve this model, we require ϕ, one of the two parameters of the Pareto distribution, to be bigger than 20.[1]

[1]To solve for $A_{DE} = \int_{A_{min}}^{\infty} N A_i^{\frac{1}{1-\alpha-\beta-\gamma}} p(A) dA = \phi[\frac{1-\alpha-\beta-\gamma}{(1-\alpha-\beta-\gamma)\phi-1}] A_{min}^{\frac{1}{1-\alpha-\beta-\gamma}} N$

where $p(A) = \phi \frac{A_{min}^{\phi}}{A^{\phi+1}}$ is the probability density function of A.

, it is required that $\phi > \frac{1}{(1-\alpha-\beta-\gamma)}$

Parameters	Values	Target
α	0.6	Capital income share
β	0.3	Labor income share
γ	0.05	Lobbyist income share
ρ	0.95	discount rate
τ	0.3	Tax rate
e	10	Endowmen
N	5000	Number of Firms

Table 1: Benchmark Calibration

7.1 Pareto Distribution of Productivity

The probability distribution function of the Pareto distribution is:

$p(A) = \phi \frac{A_{min}^{\phi}}{A^{\phi+1}}$,where $\phi > 2$ and A_{min} is the minimum productivity.

So in the decentralized economy, since $A_{DE} = \phi[\frac{1-\alpha-\beta-\gamma}{(1-\alpha-\beta-\gamma)\phi-1}]A_{min}^{\frac{1}{1-\alpha-\beta-\gamma}}N$ we have the final total output as follows

$$\begin{aligned} Y_{DE} &= \alpha^{\alpha}\beta^{\beta}\rho^{\alpha}\tau^{\gamma}(1-\tau)^{\alpha}\bar{e}^{\alpha+\gamma} \\ &\cdot\phi^{1-\alpha-\beta-\gamma}(\frac{1-\alpha-\beta-\gamma}{(1-\alpha-\beta-\gamma)\phi-1})^{1-\alpha-\beta-\gamma} \\ &\cdot(\alpha+\beta+\gamma+\alpha\rho)^{-\alpha}(\beta+\gamma)^{-\beta}N^{1-\alpha-\beta-\gamma}A_{min} \end{aligned} \tag{24}$$

And in the centralized one, since $A_{CE} = \phi[\frac{1-\alpha-\beta}{(1-\alpha-\beta)\phi-1}]A_{min}^{\frac{1}{1-\alpha-\beta}}N$ we have the final total output as follows

$$Y_{CE} = \alpha^{\alpha}\rho^{\alpha}\tau^{\gamma}(1-\tau)^{\alpha}\bar{e}^{\alpha+\gamma}\phi^{1-\alpha-\beta}(\tfrac{1-\alpha-\beta}{(1-\alpha-\beta)\phi-1})^{1-\alpha-\beta}$$
$$\cdot(\alpha+\beta+\alpha\rho)^{-\alpha}N^{1-\alpha-\beta-\gamma}A_{min} \tag{25}$$

Result 1 *With the same tax rate in the two economies, the total outputs in the decentralized economy with lobbyists will surpass the ones in the centralized economy without lobbyists as the rise of the variance of the productivity but given the same mean of the productivity.*

Result 1 is a numerical result,so the proof is showed in figure 2,in which ϕ is one of the two parameters of the Pareto distribution and y_{de} as well as y_{ce} represent the total outputs of the decentralized and centralized economy, respectively. When ϕ goes up, variance of the Pareto distribution goes down given the mean.Therefore, when $1/\phi$ is high enough, or variance is high enough, the outputs in the decentralized economy (solid line) is above the ones in the centralized economy (dotted line).

The economic intuitions are as follows. With large variance of the productivity but given the same mean, equal assignment of the common resources, such as the usage of congested highways, will not bring efficiency. Lobbyists can help allocate the usage of the common resources efficiently by channeling the information of the productivity of individual firms to the government. After hiring the most lobbyists, the most productive firm will get the most usage of the common resources and hence produce the most outputs. One thing to note is that we keep the mean of the productivity unchanged while we change the variance, which is to make sure that lobbyists do improve the total outputs without the help of the improved total productivity. With the mean being constant, higher variance requires more uneven usages of public capital in order to increase the efficiency and hence the total outputs.

Result 2 *From figure 2,we can see that ϕ is a key factor influencing the comparison of the outputs in two economies. Specifically, when we set $\phi =$ 21, the outputs in the decentralized economy always dominate the ones in the centralized economy against tax(see figure 3). But when we set $\phi =$*

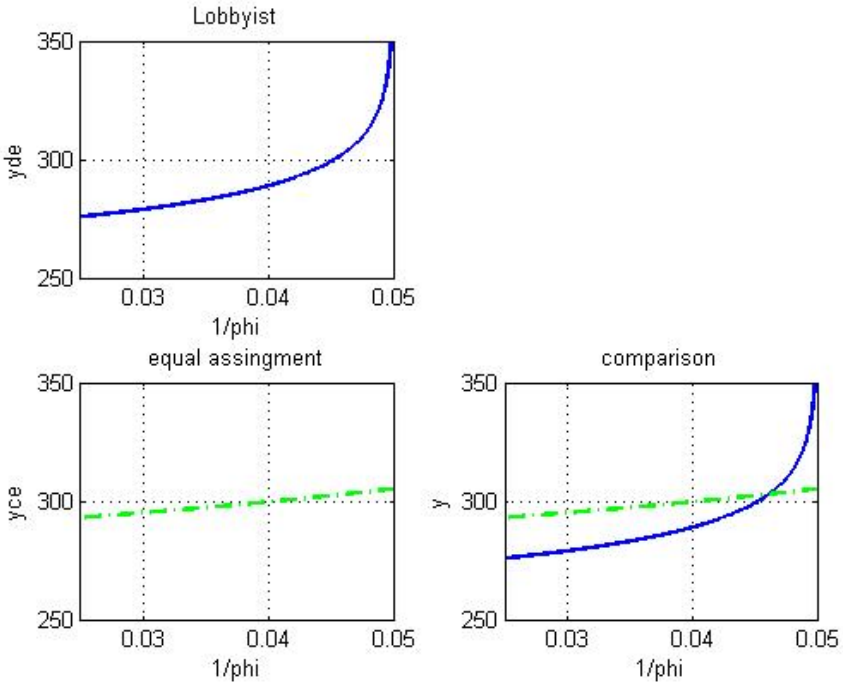

Figure 2: mean preserving spread (note:variance rises as 1/phi rises given the mean)

22, *the opposite result comes out(see figure 4). Therefore, the dominance between two economies in terms of total outputs relies on the parameters of the distributions but it is independent of tax rates. This is reflected in the condition of the Proposition 1, which is the weighted average productivity.*

This result further shows that if the productivities of firms are very diverse equal assignment of public good will not be as beneficial as competitive usage of public good through lobbying activity.

Result 3 *With the same tax rate in the two economies, the total utility in the decentralized economy with lobbyists will dominate the one in the centralized economy without lobbyists as the rise of the variance of the productivity but given the same mean of the productivity.*

Result 3 is showed in figure 5.

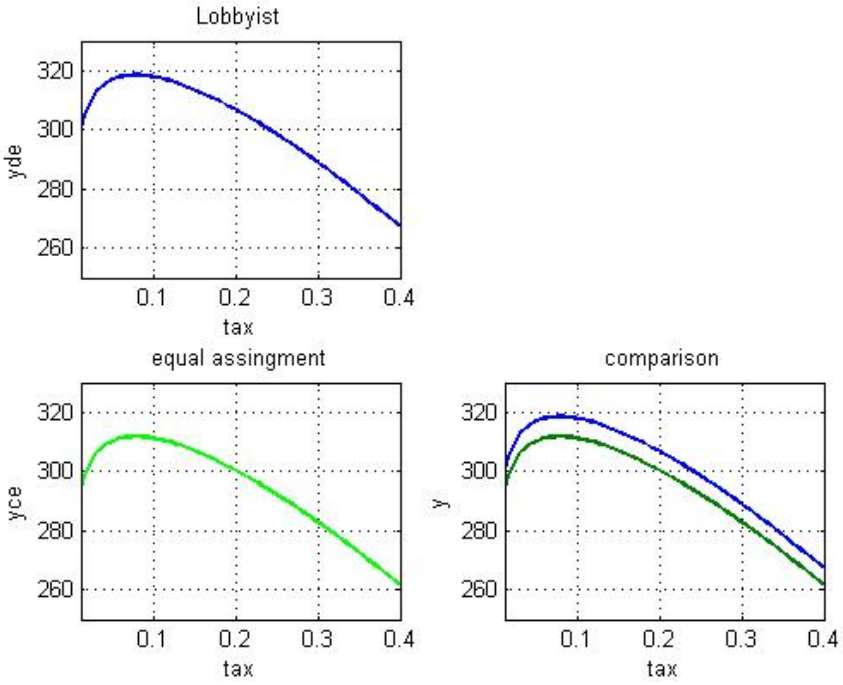

Figure 3: Tax output comparison when phi=21

7.2 Uniform distribution

If we replace Pareto distribution with Uniform distribution, we will have the following results:

Since now $A_{DE} = N\frac{1}{A_{max}-A_{min}}\frac{1-\alpha-\beta-\gamma}{2-\alpha-\beta-\gamma}(A_{max}^{\frac{1-\alpha-\beta-\gamma}{2-\alpha-\beta-\gamma}} - A_{min}^{\frac{1-\alpha-\beta-\gamma}{2-\alpha-\beta-\gamma}})$

, and

$A_{CE} = N\frac{1}{A_{max}-A_{min}}\frac{1-\alpha-\beta}{2-\alpha-\beta}(A_{max}^{\frac{1-\alpha-\beta}{2-\alpha-\beta}} - A_{min}^{\frac{1-\alpha-\beta}{2-\alpha-\beta}})$we have the final total output as follows:

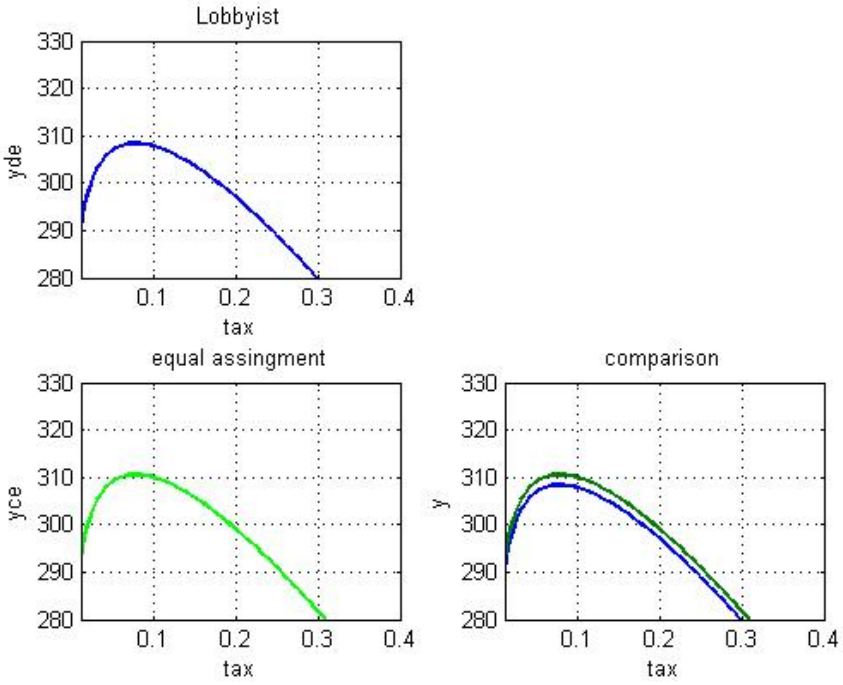

Figure 4: Tax output comparison when phi=22

$$Y_{DE} = \alpha^{\alpha}\beta^{\beta}\rho^{\alpha}\tau^{\gamma}(1-\tau)^{\alpha}\bar{e}^{\alpha+\gamma}$$

$$\cdot(\tfrac{1}{A_{max}-A_{min}})^{1-\alpha-\beta-\gamma}(\tfrac{1-\alpha-\beta-\gamma}{2-\alpha-\beta-\gamma})^{1-\alpha-\beta-\gamma}(A_{max}^{\frac{1-\alpha-\beta-\gamma}{2-\alpha-\beta-\gamma}} - A_{min}^{\frac{1-\alpha-\beta-\gamma}{2-\alpha-\beta-\gamma}})^{1-\alpha-\beta-\gamma} \quad (26)$$

$$\cdot(\alpha+\beta+\gamma+\alpha\rho)^{-\alpha}(\beta+\gamma)^{-\beta}N^{1-\alpha-\beta-\gamma}$$

and

$$Y_{CE} = \alpha^{\alpha}\rho^{\alpha}\tau^{\gamma}(1-\tau)^{\alpha}\bar{e}^{\alpha+\gamma}$$

$$\cdot(\tfrac{1}{A_{max}-A_{min}})^{1-\alpha-\beta}(\tfrac{1-\alpha-\beta}{2-\alpha-\beta})^{1-\alpha-\beta}(A_{max}^{\frac{1-\alpha-\beta}{2-\alpha-\beta}} - A_{min}^{\frac{1-\alpha-\beta}{2-\alpha-\beta}})^{1-\alpha-\beta} \quad (27)$$

$$\cdot(\alpha+\beta+\alpha\rho)^{-\alpha}N^{1-\alpha-\beta-\gamma}$$

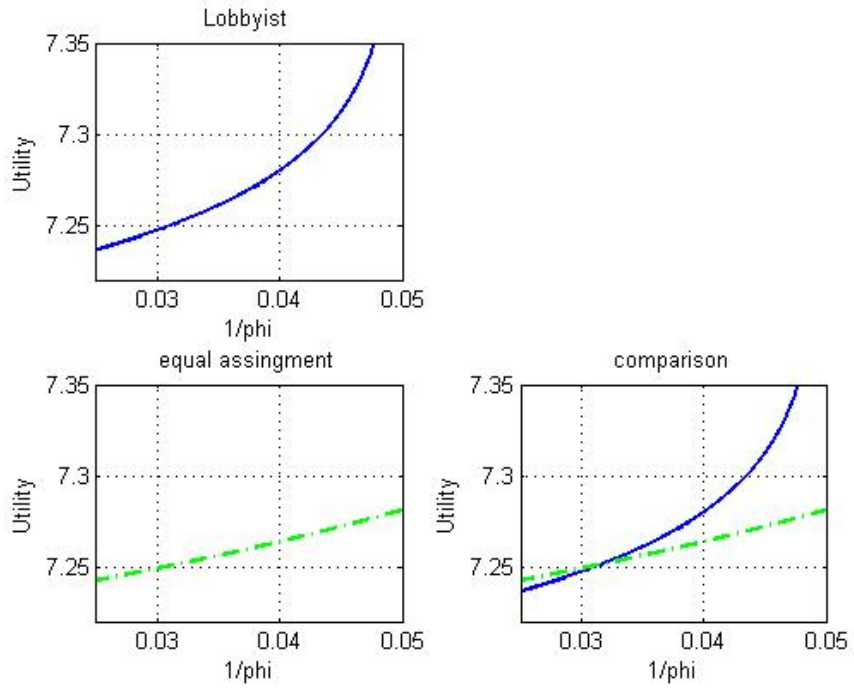

Figure 5: Mean Preserving Comparison of utility (note:variance rises as 1/phi rises given the mean)

Therefore the comparison of the outputs is showed in figure 6.

We can see from figure 6 that the output in the decentralized economy will dominate the one in the centralized economy if the variance rises enough given the same mean of uniform distribution.

8 Conclusion

This paper has described and analyzed how lobbying activity can affect economic growth through public capital in a heterogeneous-firm model. Historic and recent evidences both show lobbying exists for reasons. And this paper has explored and discovered some of them.

The results of this simple one-sector model show that heterogeneity plays

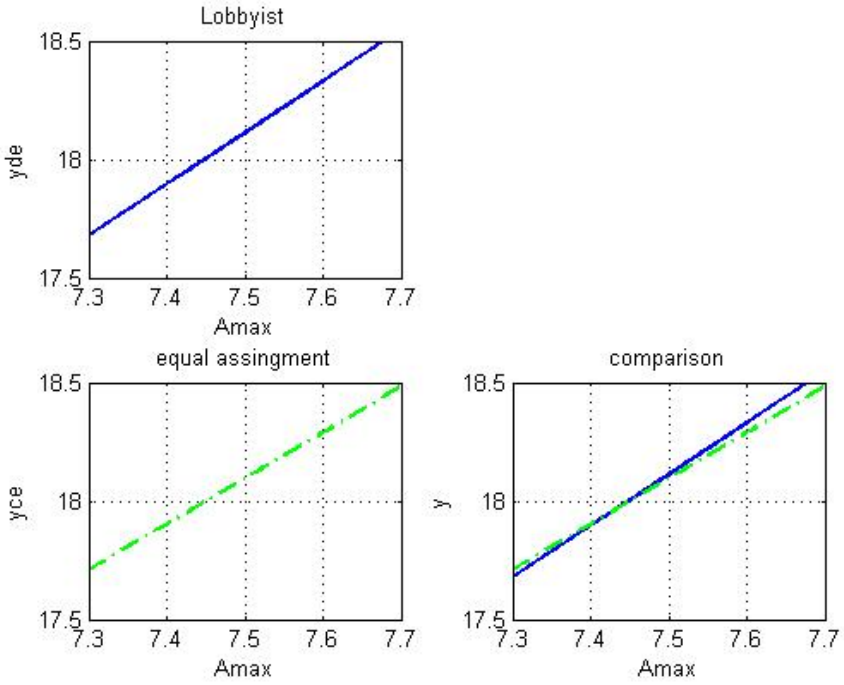

Figure 6: Uniform distribution with mean preserving spread (note:variance rises as Amax rises given the mean)

an important role in the allocation of effective usage of public capitals. The most productive firm hires the most lobbyists to gain the most effective usage of public capitals and hence has the most individual outputs. Compared to the centralized economy where heterogeneity does not affect the allocation of public capitals, decentralized economy does have the advantage in generating more total outputs if the weighted average productivity is positively sensitive enough to the power of public capitals in the production. In other words, if public capital contributes more in a more productive society the equal assignment of the effective usage of public capitals will be less advantageous in generating total outputs.

This paper also shows the existence and uniqueness of the cutoff productive firm that would like to swtich between two regimes in order to make more profits. More productive firms will choose to stay in the centralized economy

where there is no waste of labor in the lobbying activity while less productive firms can make more profits if they choose to stay in the decentralized economy competing for public capitals. This seems counter-intuitive. But the key finding is that if firms were able to choose between two regimes, more productive firms would choose to make the most out of labor in the production rather than waste some of them in the lobbying activity. In the real world, if we see corruption as the case where the most lobbyists are allowed , we will understand why more productive firms are in the western countries where there are relatively less lobbyists compared to Asian or American countries.

The immediate extension of this paper would be to include analysis of taxes' impact on outputs in the two regimes. Once tax is changeable, we may be able to see how different tax rates will affect results of the comparison between two regimes. But since that is not the focus of this paper, we would like to leave it to the new project. Although this model emphasizes the important role that firms' heterogeneity plays in the allocation of public capital, which also highlights the trade-off between workers and lobbyists hired by firms, the lack of analysis of other costs of lobbying activity in the production needs to be paid attention to. Those other costs including the one of the extreme lobbying activity, corruption, may have huge impacts on the comparisons between the two regimes. And a different model may be needed to address the related issues.

Appendix

Proof of Proposition 1

Since we want to compare the following two expressions:

$$\begin{aligned} Y_{DE} &= \alpha^{\alpha}\beta^{\beta}\rho^{\alpha}\tau^{\gamma}(1-\tau)^{\alpha}\bar{e}^{\alpha+\gamma} \\ &\cdot(\alpha+\beta+\gamma+\alpha\rho)^{-\alpha}(\beta+\gamma)^{-\beta}N^{1-\alpha-\beta-\gamma}\tilde{A} \end{aligned} \tag{28}$$

where $\tilde{A} = [\int_0^{\infty} A^{\frac{1}{1-\alpha-\beta-\gamma}} p(A)dA]^{1-\alpha-\beta-\gamma}$

and,

$$Y_{CE} = \alpha^{\alpha}\rho^{\alpha}(\alpha+\beta+\alpha\rho)^{-\alpha}\tau^{\gamma}(1-\tau)^{\alpha}\bar{e}^{\alpha+\gamma}N^{1-\alpha-\beta-\gamma}\hat{A} \tag{29}$$

where $\hat{A} = [\int_0^{\infty} A^{\frac{1}{1-\alpha-\beta}} p(A)dA]^{1-\alpha-\beta}$

we can set $h(x) = \beta^{\beta}(\alpha+\beta+x+\alpha\rho)^{-\alpha}(\beta+x)^{-\beta}\tilde{A(x)}$,where $\tilde{A(x)} = [\int_0^{\infty} A_i^{\frac{1}{1-\alpha-\beta-x}} p(A)dA]^{1-\alpha-\beta-x}$. So if $\frac{\partial h(x)}{\partial x} > 0$ at the range of $x > 0$, then $h(\gamma) > h(0)$ since $\gamma > 0$. And therefore $Y_{DE} > Y_{CE}$ because the rest parts they both have are exactly the same.

So now let's prove $\frac{\partial h(x)}{\partial x} > 0$ at the range of $x > 0$.

$\frac{\partial h(x)}{\partial x} = \beta^{\beta}(\alpha+\beta+x+\alpha\rho)^{-\alpha}(\beta+x)^{-\beta}\tilde{A(x)}(\epsilon_{x1} - \frac{\alpha x}{\alpha+\beta+x+\alpha\rho} - \frac{\beta x}{\beta+x})$
Obviously we need to have the following condition hold:

$\epsilon_{x1} > \frac{\alpha x}{\alpha+\beta+x\alpha\rho} + \frac{\beta x}{\beta+x}$

where,
$\epsilon_{x1} = \frac{\partial A(\tilde{x})}{A(\tilde{x})} \frac{x}{\partial x}$ and E[.] is the expectation sign.

Thus, after we replace x with γ Proposition 1 is proved.

Proof of Proposition 2 and Lemma 1

Since we want to compare the following two expressions:

$$\begin{aligned} \pi_i^{DE} &= (1-\alpha-\beta-\gamma)\alpha^\alpha \beta^\beta \rho^\alpha \tau^\gamma (1-\tau)^\alpha \bar{e}^{\alpha+\gamma} \\ &\cdot(\alpha+\beta+\gamma+\alpha\rho)^{-\alpha}(\beta+\gamma)^{-\beta} N^{-\alpha-\beta-\gamma} \tilde{A}' A_i^{\frac{1}{1-\alpha-\beta-\gamma}} \end{aligned} \tag{30}$$

where $\tilde{A}' = [\int_0^\infty A^{\frac{1}{1-\alpha-\beta-\gamma}} p(A)dA]^{-\alpha-\beta-\gamma}$

and,

$$\pi_i^{CE} = (1-\alpha-\beta)\alpha^\alpha \rho^\alpha (\alpha+\beta+\alpha\rho)^{-\alpha} \tau^\gamma (1-\tau)^\alpha \bar{e}^{\alpha+\gamma} N^{-\alpha-\beta-\gamma} \tilde{A}'' A_i^{\frac{1}{1-\alpha-\beta}} \tag{31}$$

where $\tilde{A}'' = [\int_0^\infty A^{\frac{1}{1-\alpha-\beta}} p(A)dA]^{-\alpha-\beta}$

we can set $g(x) = \beta^\beta(\alpha+\beta+x+\alpha\rho)^{-\alpha}(\beta+x)^{-\beta} A(\tilde{x})_2 A_i^{\frac{1}{1-\alpha-\beta-x}}(1-\alpha-\beta-x)$. So if $\frac{\partial g(x)}{\partial x} > 0$ at the range of $x > 0$, then $g(\gamma) > g(0)$ since $\gamma > 0$. And therefore $\pi_i^{DE} > \pi_i^{CE}$ because the rest parts they both have are exactly the same.

So now let's prove $\frac{\partial g(x)}{\partial x} > 0$ at the range of $x > 0$.

$\frac{\partial g(x)}{\partial x} = \beta^{\beta}(\alpha+\beta+x+\alpha\rho)^{-\alpha}(\beta+x)^{-\beta}\tilde{A(x)}^{'}A_i^{\frac{1}{1-\alpha-\beta-x}}(1-\alpha-\beta-x)(\frac{\epsilon_{x2}}{x}+\frac{1}{(1-\alpha-\beta-x)^3A_i}-\frac{\beta}{\beta+x}-\frac{\alpha}{\alpha+\beta+x+\alpha\rho}-\frac{1}{1-\alpha-\beta-x})$

where,
$\epsilon_{x2} = \frac{\partial \tilde{A(x)}^{'}}{\tilde{A(x)}^{'}}\frac{x}{\partial x}$ and E[.] is the expectation sign.

So if $0 < A_i < \frac{1}{(1-\alpha-\beta-x)^3(\frac{\beta}{\beta+x}+\frac{\alpha}{\alpha+\beta+x+\alpha\rho}-\frac{\epsilon_{x2}}{x}+\frac{1}{1-\alpha-\beta-x})}$, $\frac{\partial g(x)}{\partial x} > 0$.

And therefore, $\pi_i^{DE} > \pi_i^{CE}$. So Lemma 1 is proved. Moreover, since $g(x)$ is monotonically increasing at the range $x > 0$, the crossover point of $g(\gamma)$ and $g(0)$ is unique. Its existance is also proved in the proof of Lemma 1.

References

[1] Alesina, A., Rodrik, D., 1994. *Distributive politics and economic growth.* The Quarterly Journal of Economics, Vol.109, No.2, 465-490.

[2] Aschauer, D., 1989. *Does public capital crowd out private capital?* Journal of Monetary Economics 24, 171-188.

[3] Aschauer, D., 1989. *Is public expenditure productive?* Journal of Monetary Economics 23, 177-200.

[4] Esfahani, H., Ramirez, M., 2003. *Institution, infrastructure, and economic growth.* Journal of Development Economics 70, 443-477.

[5] Fernald, J., 1999. *Roads to prosperity? Assessing the link between public capital and productivity.* The American Economic Review, Vol. 89, No. 3, 619-638.

[6] Glomm, G., Ravikuman, B., 1994. *Public investment in infrastructure in a simple growth model.* Journal of Economic Dynamics and Control 18, 1173-1187.

[7] Gramlich, Edward, 1994. *Infrastructure investment: A review essay.* Journal of Economic Literature. (September) 1176-1196.

[8] Grossman, G., Helpman, E., 1994. *Protection for sale.* The American Economic Review, Vol. 84, No. 4, 833-850.

[9] Melitz, Marc J.,2003. *The impact of trade on intra-industry reallocations and aggregate industry productivity.* Econometrica, Vol. 71, No.6, 1695-1725.

[10] Mitra, D., 1999. *Endogenous lobby formation and endogenous protection: a long-run model of trade policy determination.* The American Economic Review, Vol. 89, No. 5, 1116-1134.

[11] Mohtadi, H., Roe, T., 1998. *Growth, lobbying and public goods.* European Journal of Political Economy, Vol. 14, 453-473.

[12] Mohtadi, H., Roe, T., 2003. *Democracy, rent seeking, public spending and growth.* Journal of Public Economics 87, 445-466.

[13] Mork, K., 1993. *Living with lobbying: a growth policy co-opted by lobbyists can be better than no growth policy at all*. Scand. J. of Economics 95(4), 597-605.

[14] Murphy, K., Shleifer, A., Vishny, R., 1991. *The allocation of talent: implications for growth*. The Quarterly Journal of Economics, Vol. 106, No. 2, 503-530.