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Ragnar Torvik



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ABSTRACT

Many natural-resource-abundant countries have established petroleum funds as part of their strategy to manage their resource wealth. This paper examines reasons that such funds may be established, discusses how these funds are organized, and draws some policy lessons. The paper then develops a theory of how petroleum funds may affect the economic and political equilibrium of an economy, and how this depends on the initial institutions. A challenge with petroleum funds is that they may produce economic and political incentives that undermine their potential benefits. An alternative to establishing petroleum funds is to use revenues to invest domestically in sectors such as infrastructure, education, and health. Such investments have the potential to produce a better economic, as well as institutional, development. This is particularly the case if the initial institutions are weak.

Keywords: Fiscal policy, Extractive industries, Resource curse, Sovereign wealth fund

JEL Classification: E21, E62, Q32, Q38

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* BI Norwegian Business School, and Department of Economics, Norwegian University of Science and Technology, N-7491 Trondheim, Norway. E-mail: ragnar.torvik@ntnu.no

1. INTRODUCTION

Countries that are rich in nonrenewable resources, such as petroleum, face many challenges—as well as opportunities—in their revenue management and institutional design. On average, these countries have experienced low economic growth, little democracy, great social unrest, and erosion of their institutional quality (Gelb, 1988; Sachs and Warner, 1995; Lynn, 1997; Collier and Hoeffler, 1998; Ross, 2001a, 2001b; Mehlum et al., 2006; van der Ploeg, 2011). Such outcomes have sparked an interest in policy solutions to deal with these possibly unfavorable effects of resource abundance. However, a major issue with the literature on the so-called resource curse is that it is mainly positive; it describes the economic and political outcomes resulting from resource abundance but offers little policy advice. Therefore, an essential next step in the development of this literature should be to develop its normative implications: how should policies and institutions be designed so that resource abundance produces favorable, rather than unfavorable, economic and political outcomes?

The present paper is concerned with one of the key questions that petroleum producers face: whether to establish a petroleum fund. Although such funds come in different versions, a distinction is often made between two different purposes of such funds. On the one hand, savings funds, or future generations funds, are sovereign wealth funds that aim to transfer petroleum wealth into long-term financial wealth. They are a vehicle for long-term management of petroleum revenues. Stabilization funds, on the other hand, are funds that aim to prevent short-term fluctuations in revenues turning into short-term fluctuations in government spending. For instance, the copper fund in Chile ensures that the government spends less than total revenue when resource prices are high, but more when prices are low. This paper is mainly concerned with savings funds, and thus, the focus is largely on long-term issues rather than short-term macroeconomic fluctuations. One should bear in mind, however,

that saving funds may have favorable short-term stabilizing effects on the economy. Considered in isolation, this may be an argument in favor of establishing a petroleum fund, but it is only briefly noted in this paper, given our focus on long-term issues.

The first petroleum fund established was the Kuwait Investment Authority in 1953. Subsequent petroleum funds include the Alberta Heritage Savings Trust Fund in Canada, established in 1976, the Alaska Permanent Fund, established the same year, and the Norwegian Government Pension Fund Global, established in 1990. In recent years, petroleum funds have been launched in many petroleum-producing countries, including an increasing number of African states. For example, countries including Angola, Chad, and Nigeria, have established sovereign wealth funds to manage their petroleum revenues. It is likely that the main reason for the increasing numbers of such petroleum funds is the experience with the existing funds, which have been viewed favorably, as a beneficial way both to manage the petroleum wealth and to channel petroleum incomes into public budgets. However, while such funds can contribute to reaching the long-term income potential from oil and gas resources, they can also have the opposite effect. A key determinant of success is the initial quality of the institutions in place. Unfortunately, much of the policy advice seems to neglect this issue. A key difference is whether institutions are inclusive or extractive (Acemoglu and Robinson, 2012). Moreover, as will be argued below, the institutions themselves may be endogenous to the decision to establish a petroleum fund.

The rest of the paper is organized as follows. In Section 2, the reasons that a petroleum fund can produce favorable economic and political outcomes are discussed. Section 3 presents some policy decisions that should be made if a government chooses to establish a petroleum fund. Experiences with existing petroleum funds in North America, Norway, and in African countries, are discussed. Section 4 develops a model to discuss policy options for resource incomes, with the emphasis on the

trade-off between investing in financial wealth through a petroleum fund and investing in infrastructure or human capital. At the center of the analysis are the possible consequences of the allocation of entrepreneurs between productive activities and unproductive rent-seeking, and how decisions in the future depend on policy design in the present. This framework is then extended to discuss how the future equilibrium institutional quality depends on the decision to establish a petroleum fund in the present, and how private investments today may depend on the decision to establish such a fund. Section 5 offers some concluding remarks.

2. WHY PETROLEUM FUNDS?

There are at least two important characteristics of oil and gas income that distinguish it from the income gained by producing and selling most other goods and services. First, what is often termed petroleum income is not really income in the conventional sense but the selling off of one type of asset (nonrenewable natural resource assets) and replacing it with another (dollars). Second, few prices vary so much, and so unexpectedly, as do petroleum prices. The windfall nature of petroleum income raises additional challenges for resource revenue management. In this section, I discuss how such characteristics affect the decision to establish a petroleum fund, and how much of the petroleum wealth should be set aside in a fund. First, I discuss the arguments from the macroeconomic literature, before briefly turning to the (arguably less developed) political economy literature on the topic.

2.1. Macroeconomics and Petroleum Funds

A natural starting point for the macroeconomics of petroleum funds is the permanent income hypothesis. With the discovery of petroleum wealth, consumption possibilities are higher. As shown by e.g. van der Ploeg and Venables (2011), in its simplest version, the permanent income hypothesis allows a constant and permanent increase in consumption. To achieve this, while petroleum revenues

are flowing, a sufficient amount of the revenues must be invested, and a sovereign wealth fund must be built up to a size such that the increase in consumption can be maintained forever. Such a future generations fund is an open economy version of the Hartwick (1977) rule, in that petroleum wealth is reinvested to keep the total wealth of a nation, and its genuine savings, unchanged.

A poor economy on the convergence path to higher income, or with positive technological progress, has future generations that are better off than its current generations. This is an argument for increasing consumption more in the present than in the future. Thus, under this argument, less of the resource wealth should be channeled into a petroleum fund. Matsen and Torvik (2005) show that with endogenous technological progress, a countervailing mechanism may be in operation: van Wijnbergen (1984) argues that there are dynamic Dutch disease effects, in that consumption of petroleum income shifts production toward sectors with weaker learning by doing. Then, this effect, in isolation, favors less consumption in the present and, thus, increased investments in the petroleum fund. The rate of return in the petroleum fund must, from a societal viewpoint, take into account not only the world market rate of return but also the fact that more consumption today pushes the rate of technological progress down.

van der Ploeg and Venables (2011) discuss the trade-off for developing countries between investing domestically and setting up a petroleum fund to invest in foreign financial assets. They show that for capital-scarce countries—arguably relevant for many developing countries—more of the petroleum wealth should be invested domestically. van der Ploeg and Venables (2012) discuss additional effects when developing countries have domestic absorption constraints, making it difficult to scale up investments rapidly. This suggests advantages from establishing a so-called parking fund, where petroleum revenues are “parked” until they can be put to better use in the domestic economy.

Turning to petroleum price uncertainty, additional arguments for a petroleum fund emerge. As discussed by van der Ploeg and Venables (2012), petroleum price uncertainty may be addressed in part by a stabilization fund for precautionary saving. In addition, a stabilization fund may help to transform volatile income streams into more stable government spending. This has a stabilizing effect on the economy, ensuring that the cycles in the resource sector are not magnified by procyclical use of resource income. It also allows for a more stable provision of public services.

2.2. Political Economy and Petroleum Funds

Political economy arguments are important in the analysis of Hassler et al. (2017, p. 127). Their analysis, which involves a simulation of Uganda, acknowledges that developing countries face borrowing constraints, but they argue that the size of the resulting welfare loss “is most likely to be very small”. They therefore conclude in favor, arguing that: “Hence, given that having a sovereign wealth fund along with a simple, but rigid, spending constraint provides more transparency and helps decrease the potential negative political side effects associated with increased spending, adopting such a construction seems like a well motivated policy measure.”

One political economy argument in favor of establishing a petroleum fund is that in political equilibrium, policy will typically be too shortsighted; spending will be too high, and savings too low. The initial literature discussing this, in particular Persson and Svensson (1989) and Alesina and Tabellini (1990), implies that the conditions for such shortsightedness easily occur: with political disagreement and a positive probability of losing political power, the incumbent will discount the future too much. A petroleum fund, supported by a fiscal policy rule, means that policy is less captivated by day-to-day political decisions. This can help to ensure that a more socially desirable, long-term perspective is taken in choosing a policy to deal with petroleum assets. Such a long-term

perspective is particularly important in countries that derive much of their income from selling nonrenewable resources.

Robinson et al. (2006) extend this literature to include endogenous resource extraction and the spending of resource income, as well as an endogenous reelection probability. They show how a political incumbent can positively influence his/her reelection probability by providing patronage to political supporters. In equilibrium, as a result, there is too much resource extraction and public spending, and the public sector is inefficient. Matsen et al. (2016) study petro populism, showing that with imperfect information about how much resource income is being spent, politicians of all types indulge in excessive resource extraction, and rational, forward-looking voters in fact reward policies that they realize cannot be sustained over time. A petroleum fund narrows the gap between the political and the socially desirable equilibrium, both by making fiscal policy more rule based, to counter the mechanism in Robinson et al. (2006), and by improving transparency, to counter the mechanism in Matsen et al. (2016).

Turning again to petroleum price uncertainty, political economy mechanisms may provide further arguments, in addition to those from the macroeconomic literature, for establishing a petroleum fund. Robinson et al. (2017) extend the approach of optimal resource extraction in van der Ploeg (2010) to a political economy setting, showing that volatility in itself may be a source of inefficient resource extraction, in joint interaction with efforts by politicians to increase patronage. The reason for this is that politicians oversupply public goods to their own constituency relative to other groups. In turn, because spending is not smoothed over groups, the future volatility in the provision of public goods is higher, and the incentives to vote for one's own politician (so as to receive public goods) are weaker. To counter this, the incumbent politician increases resource extraction to provide more patronage and to increase his/her probability of reelection. Thus, price volatility, in

political equilibrium, pushes resource extraction away from the socially efficient path, and too much resource income is used to expand an inefficient public sector. Thus, a petroleum fund supported by a fiscal rule may move policy closer to the socially efficient equilibrium.

The present paper brings additional political economy arguments into the debate about establishing petroleum funds in developing countries, focusing on two new mechanisms, both of which are counter to the favorable arguments, discussed above, for establishing a petroleum fund. First, in this paper, I take into account the fact that when the initial institutions are weak, the collection of resource wealth in a petroleum fund makes such wealth lootable. If, alternatively, resource wealth is transferred into domestic human capital or infrastructure, then the wealth is harder to loot. As a consequence, as will be shown, the political equilibrium with a petroleum fund may be worse from a societal viewpoint than the political equilibrium without such a fund. Second, the quality of institutions may be endogenous to the establishment of a petroleum fund. Such a fund increases the possibilities for politicians to expropriate public wealth. However, to be able to do so, they might first need to dismantle existing institutions that limit expropriation. Thus, a petroleum fund may provide incentives for the dismantling of favorable institutions, or, alternatively, may weaken the incentives to establish such institutions if they do not exist in the first place.

3. EXPERIENCES WITH PETROLEUM FUNDS

Several petroleum funds, particularly the Alaska Permanent Fund and the Government Pension Fund Global in Norway, are widely viewed as contributing to good management of natural resource wealth. Many countries have drawn inspiration from the institutional designs of these petroleum funds. In particular, when establishing a petroleum fund, three questions need to be addressed. First, how much of the petroleum revenues will be channeled into the fund? Second, how will the investment of the fund be managed? Third, how will payments out of the fund be decided?

The various petroleum funds that have been established provide different solutions to these questions. The experiences with these solutions have produced some important policy lessons.

An important lesson from the funds established in countries with strong institutions comes from comparing the funds in Alaska and Norway with the fund in Alberta, Canada: when the investment decisions and the management of the funds are made independently of politicians and political decisions, as in Alaska and Norway, their performance has been better. The initial experiences from the fund in Alberta show how political decisions and political management eroded the values in the fund, led to overspending and a smaller than intended fraction of the petroleum revenues being transferred into the fund, and resulted in investment decisions that did not meet economic criteria. The experiences in Alaska and Norway have been more positive as a result of the arm's length distance between political decisions and the management of the fund. For a detailed summary of these experiences, see Torvik (2011).

There are also important lessons that can be drawn from the petroleum funds on the African continent. A challenge with setting up these funds has been that the initial institutions in place have generally been weaker than those in North America and Norway. On the one hand, one could argue that this makes the establishment of a petroleum fund more important, as poor political decisions on how to spend resource revenues may be more likely to occur. Thus, the potential payoffs from establishing a new institution such as a petroleum fund might be higher. On the other hand, one could argue that the weak initial institutional and democratic infrastructure makes the establishment of such a fund more risky because there is a higher probability that the fund will not be managed and used as intended. One could also argue, in line with the arguments about capital-constrained developing countries, discussed above, that the need for public investments is typically higher in African countries than in mature industrialized countries. This implies that the optimal trade-off between current and

future spending is shifted toward the present. Then, a petroleum fund and, in particular, a future generations fund, which is primarily motivated by the saving of resource income for the future, is less relevant.

Some of the initial experiences with petroleum funds in Africa are not favorable. One particular example is the fund established in Chad. The country, assisted by the World Bank, established a future generations fund where petroleum revenues were set aside. The fund was set up as part of an agreement with the World Bank, which involved financing of a pipeline from Chad to a port in neighboring Cameroon. However, when political tensions erupted in Chad, the fund was raided by the president and spent on military purposes. As a response, the World Bank aborted its relations with the regime. Another example is Angola, which established a petroleum fund in 2008. In 2013, the son of President Dos Santos was appointed head of its board of directors, and his daughter was appointed head of the national oil company Sonangol in 2016.

Such experiences raise the issue of whether the true objective of the petroleum funds is optimal resource management from the viewpoint of society or whether the institutional arrangements are established to maintain the economic and political power of the current elite. Moreover, as emphasized by van der Ploeg and Venables in the case of Nigeria (2012, p. 328).

A stabilization fund that is vulnerable to looting is worse than no fund at all. Nigeria's experience saw its stabilization fund (the Excess Crude Account) rise to \$30 billion in 2008 only to fall to zero by 2011, with most of the withdrawals unaccounted for. Essentially, this was a transfer from well-intentioned politicians who set up the fund to the less well intentioned who ran it down.

Additional African countries may become major petroleum producers in the near future. One example is Tanzania, which commenced exploration for oil and gas in the 1950s. The first discoveries were made in the 1970s, and commercial production started in 2004. Since 2010, huge natural gas reserves have been discovered offshore on the southern coast, and a key question is whether investors will proceed with plans for an LNG project, which has investment costs the size of Tanzania's GDP. Anticipating the possibility of the project proceeding, in 2015, Tanzania adopted legislation for the establishment of a resource fund, and a fiscal rule stating that natural gas revenue of up to 3% of GDP can be spent every year, with revenues above this level saved. Although it is too early to assess the implications of this, the IMF (2016, p. 52) has noted that "the transparency provisions" of the legislation "could be strengthened." Cappelen et al. (2016) investigate how increased gas revenues affect private expectations of corruption in Tanzania, and they find that such expectations have increased.

In the next section, I discuss some political economy arguments that are relevant to the decision to establish a fund, and how this decision should depend on the initial institutional equilibrium. To shed some light on such questions, I first develop a simple framework of the political economy of petroleum funds.

4. A SIMPLE POLITICAL ECONOMY MODEL OF PETROLEUM FUNDS

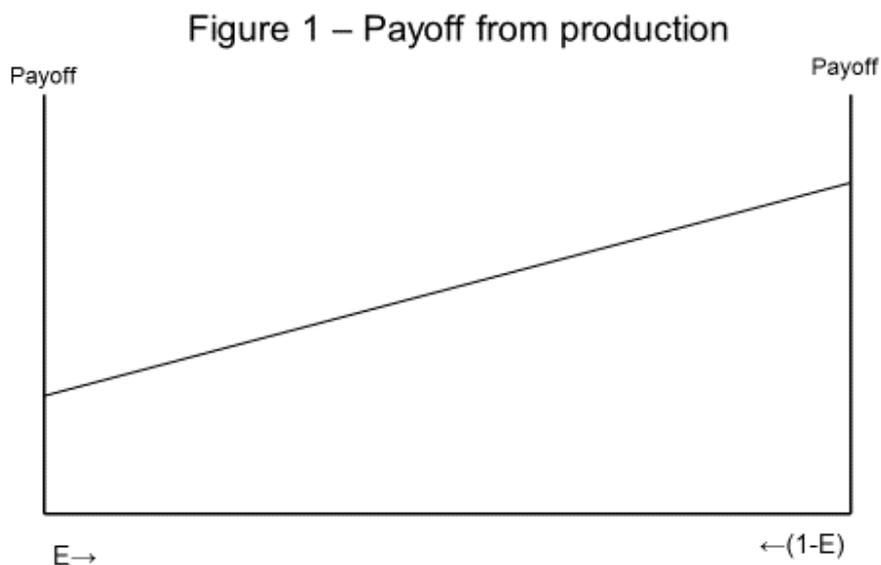
Consider a country with incomes derived from natural resources. Let us assume initially that a fund is established based on the institutional design of the funds in Alaska and Norway. To see how the consequences of this may unfold, I use backward induction and start with the implications for the future, before returning to discussion of the implications for the present.

In the Alaskan and Norwegian petroleum funds, all investments are in financial assets. Once this fund has had time to accumulate financial assets, it may attract rent-seeking, corruption, or

grabbing if a country's institutions are not sufficiently strong to prevent it. If it is assumed that the institutions are not sufficiently strong, the relative payoff for entrepreneurs in the future will shift toward rent-seeking, away from production.

To consider the possible future implications, assume that entrepreneurs allocate their time or activities between production and rent-seeking, where the latter encompasses lobbying, rent-seeking, political embezzlement of funds, grabbing, and other such behavior. Let the payoff for an entrepreneur who chooses productive activities be increasing with the number of other entrepreneurs who choose the same activity. There are several reasons that this is the case. One reason, as clarified by Murphy et al. (1989), is increasing returns to scale, in that more entrepreneurs imply more efficient production. Higher production increases the size of the market, which in turn implies higher sales and profits for each entrepreneur. Note, however, that in contrast to Murphy et al. (1989), increasing returns to scale in the conventional sense is not necessary for the payoff for each entrepreneur to be increasing in the aggregate number of entrepreneurs who undertake production. In the present model, entrepreneurs who are not engaged in production are engaged in rent-seeking as their alternative activity, and this has negative external effects on the entrepreneurs engaged in production. More entrepreneurs engaged in production means fewer entrepreneurs engaged in rent-seeking. Thus, a situation of "fewer predators and more prey" increases the individual payoff for productive entrepreneurs, even in the absence of increasing returns to scale technology in production. There may be other reasons for the existence of such a relationship. For instance, higher production means higher employment, less crime, and higher profits for each entrepreneur, as in the model of Mehlum et al. (2005), which has constant returns to scale in production. Thus, increasing returns to scale in production is a possible, but not a necessary, condition for the payoff for each entrepreneur to be increasing in the aggregate number of entrepreneurs.

In Figure 1, the share of entrepreneurs engaged in production, denoted by E , is measured from the left to the right of the graph. The individual payoff is increasing when a larger proportion of the entrepreneurs are engaged in production and, consequently, a smaller number are engaged in rent-seeking.



The income from production also depends on the quality of the public sector. In particular, if the quality of the infrastructure is higher, this is an advantage for entrepreneurs in private firms, pushing their profits, and thus the payoff curve in Figure 1, up. If the education and skill levels of the population are higher, this has the same effect. Finally, the payoff for entrepreneurs depends on the quality of institutions. Strong institutions protect private property rights from public and private predation, and ensure that government employees act in accordance with the interests of society, rather than their own narrow personal interests; as a result, strong institutions increase the income from undertaking production.

This insight may be summarized in the following, where future income possibilities from production, which is termed Y , are given by a function of: (i) the future share of entrepreneurs engaged in production, E ; (ii) the quality of public infrastructure and the investments that have been made in health and education, which is termed G ; and (iii) the quality of institutions, which is termed I :

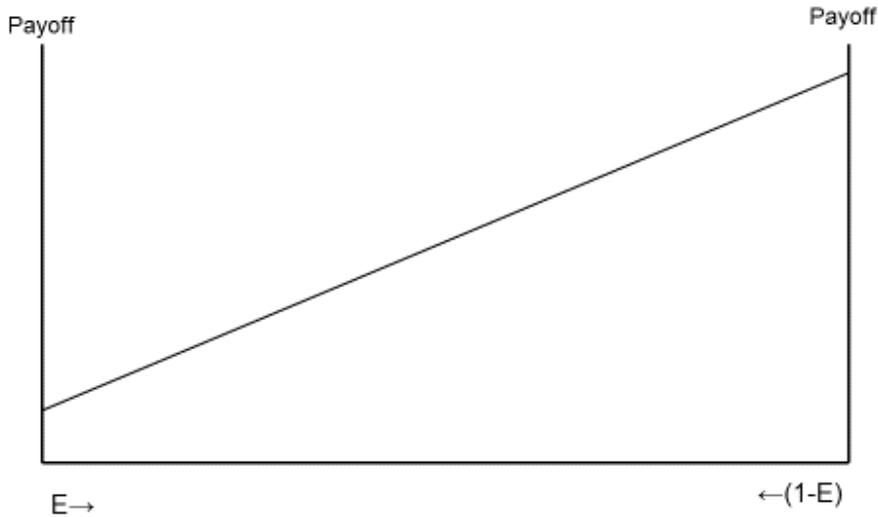
$$Y = Y(E, G, I), \tag{1}$$

where:

$$\frac{dY}{dE} > 0, \frac{dY}{dG} > 0, \frac{dY}{dI} > 0.$$

Next, I discuss the future payoff from undertaking rent-seeking. The larger is the share of entrepreneurs undertaking production and, consequently, the smaller is the share of entrepreneurs undertaking rent-seeking, the higher is the payoff to each individual rent-seeker. When there are many productive entrepreneurs and few rent-seekers, there are many targets on which to prey, so to speak, and few predators with which to compete. From the viewpoint of an individual rent-seeker, this implies increased income possibilities. Figure 2 shows the payoff from rent-seeking, which is increasing in the share of entrepreneurs undertaking production (and decreasing in the share of entrepreneurs undertaking rent-seeking, termed $1-E$, which is measured from the right to the left).

Figure 2 – Payoff from rent-seeking



In addition, the income possibilities from rent-seeking are affected by the possibilities for appropriating income from other sources, not just the private entrepreneurs. In particular, if there are public sector financial funds, they may attract political rent-seeking, making it economically more tempting to enter into politics. Finally, strong institutions prevent the possibilities for various forms of rent-seeking. Thus, other things being equal, strong institutions decrease the income from undertaking rent-seeking.

I use X to denote the individual income from undertaking rent-seeking, and P to denote the availability of lootable public funds. The above discussion may then be summarized in the following equation:

$$X = X(E, P, I), \tag{2}$$

where:

$$\frac{dX}{dE} > 0, \frac{dX}{dP} > 0, \frac{dX}{dI} < 0.$$

4.1. The Equilibrium in the Future

An equilibrium is defined in the conventional way, where there is an equilibrium if no agent, after observing what all other agents do, would want to change his/her chosen occupation. Thus, the equilibrium concept is a subgame perfect equilibrium, and following the standard procedure, I apply backward induction.¹

I make the following assumptions on the payoff functions.

$$\text{Assumption 1A: } Y(0, G, I) > X(0, P, I), Y(1, G, I) < X(1, P, I)$$

$$\text{Assumption 1B: } \frac{dX}{dE} > \frac{dY}{dE}$$

The first part of Assumption 1A states that if no entrepreneurs are engaged in production, and all entrepreneurs are engaged in rent-seeking, then the individual payoff from production is higher than that from rent-seeking. If this were not the case, there would exist a stable equilibrium where no entrepreneurs would choose to undertake production. The second part of Assumption 1A states that if

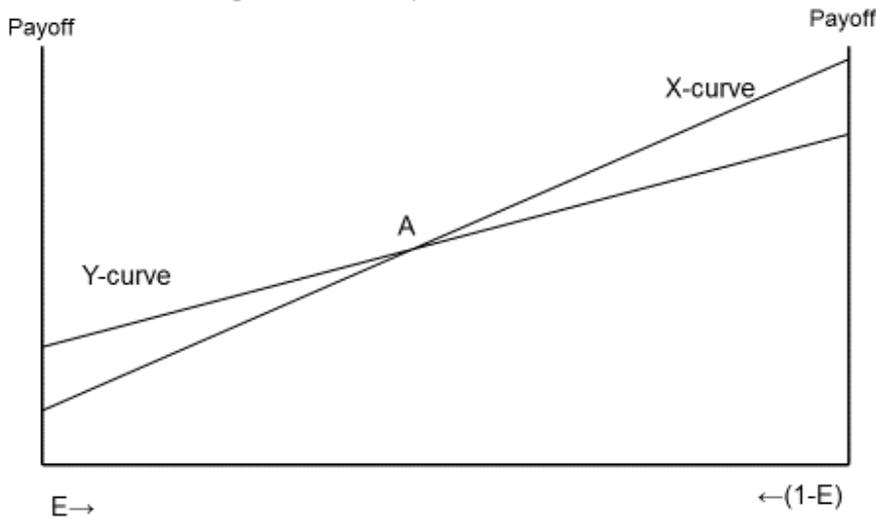
¹ In game theory, a subgame perfect equilibrium (or subgame perfect Nash equilibrium) is an equilibrium such that the players' strategies constitute a Nash equilibrium in every subgame of the original game. A common method for determining subgame perfect equilibria in the case of a finite game is backward induction. This is an iterative process for solving finite extensive form or sequential games. First, one determines the optimal strategy of the player who makes the last move of the game. Then, the optimal action of the next-to-last moving player is determined taking the last player's action as given. The process continues in this way backward in time until all players' actions have been determined.

all entrepreneurs are engaged in production and no entrepreneurs are engaged in rent-seeking, then the individual payoff for a rent-seeker would exceed that for a producer. If this were not the case, there would exist a stable equilibrium where all entrepreneurs choose productive activities and no entrepreneurs choose rent-seeking. Assumption 1A thus allows me to restrict attention to situations that are not corner solutions of the model. It is important to note that such corner solutions are perfectly possible. For instance, a corner solution where there are no producers may result if the institutional quality is sufficiently poor. Likewise, a corner solution where there are no rent-seekers may result if the institutional quality is sufficiently strong.

Assumption 1B ensures that the equilibrium of the model is unique. The existence of an equilibrium is ensured by Assumption 1A, but with the additional Assumption 1B, there can never be more than one value of E where the payoff from production equals the payoff from rent-seeking. Thus, as a result of Assumption 1A, an equilibrium always exists, and as a result of Assumption 1B, the equilibrium is unique. Moreover, because of conventional stability arguments, this equilibrium is stable.

Figure 3 shows the two payoff functions, and the intersection of these payoff functions determines the future equilibrium allocation of entrepreneurs between production and rent-seeking, denoted by point A, as well as their future income level.

Figure 3 – Equilibrium allocation



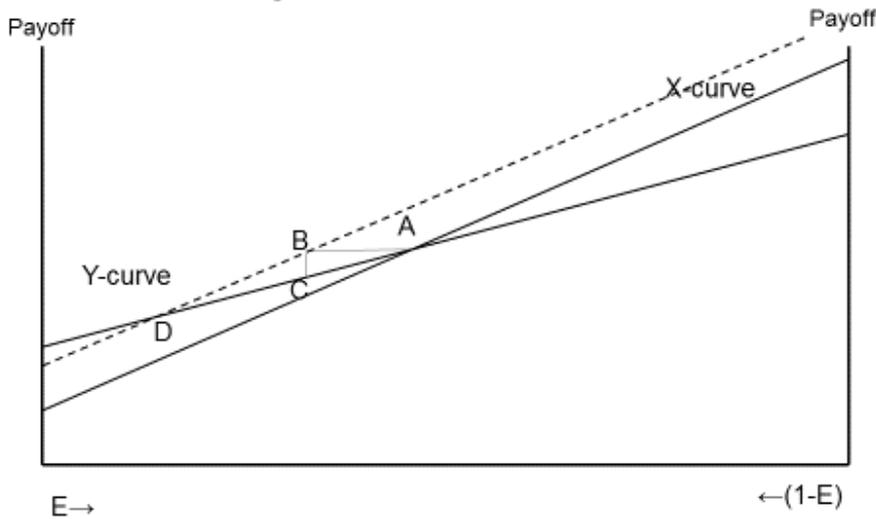
4.2. Current Policy Decisions and the Future Equilibrium

Consider now how the policy decisions in the present affect the future equilibrium. I assume that the country under consideration receives income from the sale of petroleum in the present and must decide how to invest these proceeds. The size of the resource income to be transformed into either foreign financial assets, infrastructure, or human capital, is given by W .

First, assume that the country decides to use all the resource income to establish a petroleum fund; i.e., $dF = W$. I note from Equation (1) that this does not affect the payoff function for producers and, from Equation (2), that it shifts the payoff from rent-seeking up. The effect of this policy decision on the future equilibrium is shown in Figure 4, with the new payoff function from rent-seeking represented by the dotted curve. I note that, paradoxically, the increased income opportunities generated by the presence of a petroleum fund reduce future income.

The intuition behind this result is that when the individual payoff is shifted in favor of rent-seeking, more entrepreneurs choose to rent-seek, and fewer entrepreneurs choose to undertake regular production. To understand why this reduces aggregate income, assume that a sufficient number of entrepreneurs shift out of rent-seeking and into production, so that the income from rent-seeking falls to the initial level of income from production. This is represented in the figure by the movement from point A to point B. At point B, however, the income from production is lower than it was initially, as it has shifted to point C. The reason for this is that at points B and C, there are fewer entrepreneurs and more rent-seekers than there were at point A. Thus, there are still incentives to move out of production and into rent-seeking, as seen by the fact that point B, which represents the income of rent-seekers, is higher than point C, which represents the income of producers. To equalize the future income from the two activities with the petroleum fund in place, we have to move to point D, which is not only lower than point A and B but also lower than point C.

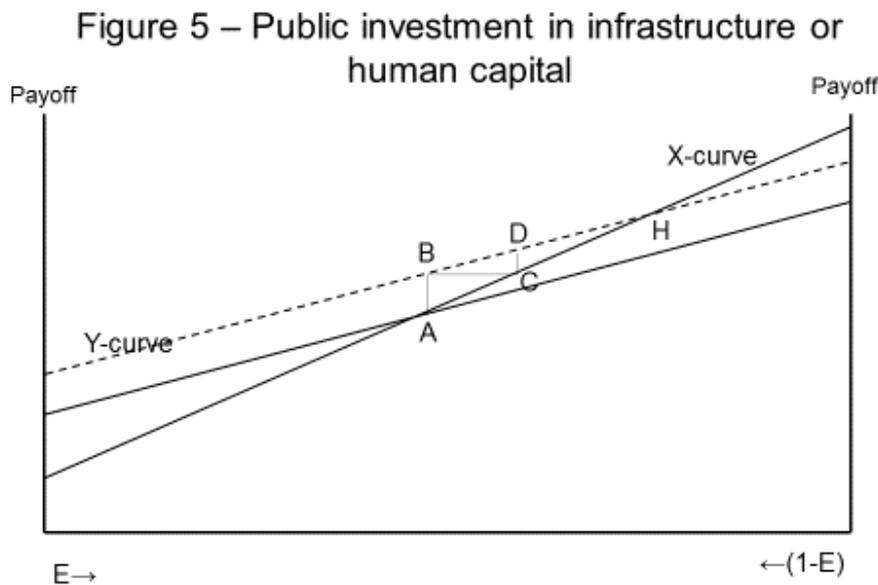
Figure 4 – Petroleum Fund



Therefore, the potential challenge in the future equilibrium is that a petroleum fund may invite rent-seeking; it represents a future income that is lootable. The cost of this rent-seeking exceeds the wealth in the petroleum fund; the rent-seeking has costs for society in addition to the funds that are being appropriated by rent-seekers. The economic equilibrium shifts in favor of rent-seekers and against producers. This shift, in turn, sets in motion further downward spirals in the economy: the decline in the number of producers diminishes their positive externalities on the rest of the economy, whereas the increase in the number of rent-seekers increases their negative externalities on the rest of the economy. Thus, in equilibrium, more income opportunities actually produce less aggregate income.

Next, consider an alternative policy: instead of investing the proceeds from natural resources in a fund, they are invested in infrastructure, health, and/or education. In the model, this is represented by $dG = W$. Note that in this case, the curve for rent-seekers does not shift, but the curve for producers shifts up.

The effect of this policy decision on the future equilibrium is shown in Figure 5, with the new payoff function from production represented by the dotted curve. Note that in contrast to the case with a petroleum fund, the future equilibrium involves higher income. Moreover, the increase in income is higher than the increased income opportunities for the entrepreneurs engaged in production (because the vertical distance from points A to H exceeds the vertical distance from points A to B). Thus, the effect of this policy on the future equilibrium is radically different from that of a petroleum fund.



The reason for this result is that this policy decision increases the positive externalities created by entrepreneurs and decreases the negative externalities created by rent-seekers. To see this, consider Figure 5 again. When the income opportunities for entrepreneurs increase, then, for a given allocation of entrepreneurs between production and rent-seeking, the income of the entrepreneurs in production increases from point A to point B. However, as the income of rent-seekers (again for a given allocation of entrepreneurs) is given by point A, it is more attractive to be a producer than it is

to be a rent-seeker. Therefore, entrepreneurs shift from rent-seeking and into production. To see why this process eventually creates an increase in the future income that exceeds the increased income level created by the investments alone, consider a situation where entrepreneurs move out of rent-seeking and into production until the income from rent-seeking is the same as at point B. This allocation of entrepreneurs is given by point C. At the allocation of entrepreneurs represented by point C, however, the income of entrepreneurs engaged in production is given by point D, which exceeds the income at point C. Consequently, even more entrepreneurs move into production and out of rent-seeking. To reestablish equality between the entrepreneurs undertaking production and rent-seeking, we have to move to point H.

Investments in infrastructure, health, and/or education have properties that make them attractive from the viewpoint of society. First, such investments are favorable to entrepreneurs undertaking production because the availability of better infrastructure or a better workforce increases the profitability of production. This makes production more attractive, which is a benefit to society at large. Second, such investments are harder to expropriate than are financial investments. This means that the government crowds in private entrepreneurs engaged in production and crowds out rent-seekers. Third, because of this combination, the government's policy decision in the present has the effect of magnifying the future positive externalities from production and dampening the future negative externalities from rent-seeking.

In sum, although the model is highly stylized and simplified, it suggests that when a country's initial institutions are weak, investing in assets that are not easily expropriated may induce incentives for the future allocation of scarce entrepreneurial resources that are beneficial; in other words, assets that are hard to expropriate create positive externalities. On the other hand, investing in assets that

may be expropriated more easily may induce incentives for the allocation of entrepreneurial talents that are not beneficial; that is, assets that are easy to expropriate create negative externalities.

In the model above, I have only illustrated the equilibrium consequences of these two policy options for the income of entrepreneurs. However, the difference in aggregate income between the two policies may be even greater, as entrepreneurs engaged in production are more likely to create better income opportunities and increase demand for workers, whereas entrepreneurs engaged in rent-seeking, if anything, pull workers out of productive activities and into unproductive, or even destructive, activities.

A crucial assumption, however, is that the investments made in human capital and infrastructure do in fact involve a higher productive stock of such capital. As experienced in many countries, the problem remains that investments from resource incomes can produce “white elephants” rather than investments that benefit the society at large (Robinson and Torvik, 2005). Furthermore, as experienced in East Africa, despite policies increasing funds to health and/or education, there may be a limited effect on actual policy outcomes in these areas (e.g., see Reinikka and Svensson, 2004). If such problems are important, the arguments above in favor of public investments become weaker or nonexistent. Then, a possible policy implication is that establishing a parking fund, where the proceeds from selling petroleum rest until they can be invested productively in the domestic economy, may be beneficial. Again, however, the risks with establishing such a fund, emphasized above, may remain.

4.3. Endogenous Institutional Quality

So far, I have assumed that the future institutional quality is given and is independent of the policy decision made in the present. I now extend the model by making the future quality of institutions endogenous.

First, consider the situation where a petroleum fund has been established. For those with political power, this represents an opportunity to appropriate resources. To do so, however, as explained in Ross (2001a), the institutions of the country where the fund is established must be weak, such that the fund is lootable. This creates an incentive to erode the existing institutions. In the future, therefore, there is a danger that the institutional quality may be worse if a petroleum fund has been established than if it has not. Formally, this situation can be represented by an equation where the quality of future institutions depends on the assets in the petroleum fund:

$$I = I(P), \tag{3}$$

where:

$$\frac{dI}{dP} < 0.$$

Inserting this into Equations (1) and (2) yields:

$$Y = Y(E, G, I(P)), \tag{1'}$$

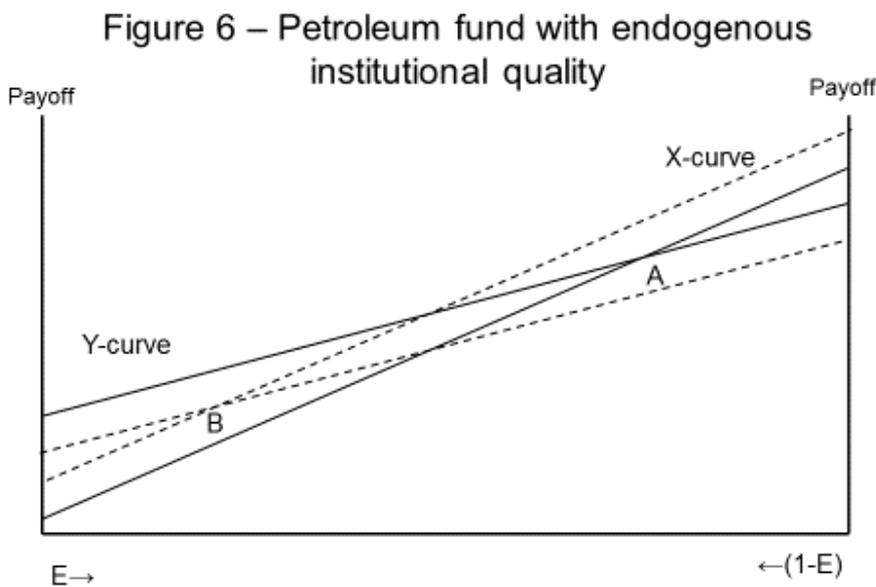
and

$$X = X(E, P, I(P)). \tag{2'}$$

First, note that in contrast to the above section, the payoff function for producers is no longer independent of the establishment of a petroleum fund. When a petroleum fund results in an erosion of institutional quality, then the future payoff for producers decreases with the establishment of such a fund. Second, note that the payoff of rent-seekers now increases, not only because of the establishment

of the fund itself but also because such a fund reduces institutional quality, making future rent-seeking activity even more profitable compared with production.

This is represented in Figure 6 by a downward shift in the payoff for producers and an upward shift in the payoff for rent-seekers. The future equilibrium shifts from point A to point B, with the new equilibrium involving fewer producers, more rent-seekers, and lower total income. Moreover, note that the fall in income is greater than the initial fall in income for producers. The reason is that the fall in the payoff for producers increases the incentives to move out of production, which has a cumulative effect, increasing the incentives to move out of production even more. There is an institutional multiplier effect, which, unfortunately, pushes production further down exactly because production is pushed down in the first place.



Next, consider a situation where the resource income is used to provide public goods that increase infrastructure or human capital. This may also affect the quality of institutions in the future, and several mechanisms may be in play. An investment in human capital may increase the quality of

institutions in itself, and importantly, human capital is more difficult to expropriate than financial capital. Therefore, the incentives to erode future institutions by appropriating resources are likely to be weaker than is the case for financial investments, or even to be reversed, with investments in human capital. Human capital investments to a broad cross section of society empower citizens and may increase their demand for inclusive institutions. With regard to investments in infrastructure, again, the income generated in the private sector by such investments is harder to expropriate than financial capital. Of course, this can also be achieved partly through taxation – but only if there is something to tax. In fact, increased private incomes may be an incentive to build state capacity for taxation, which may have a beneficial effect on institutional quality.

To capture such ideas, I now assume that the future institutional quality is increasing in the public investments; i.e., I allow for:

$$I = I(G, P), \tag{4}$$

where:

$$\frac{dI}{dG} > 0.$$

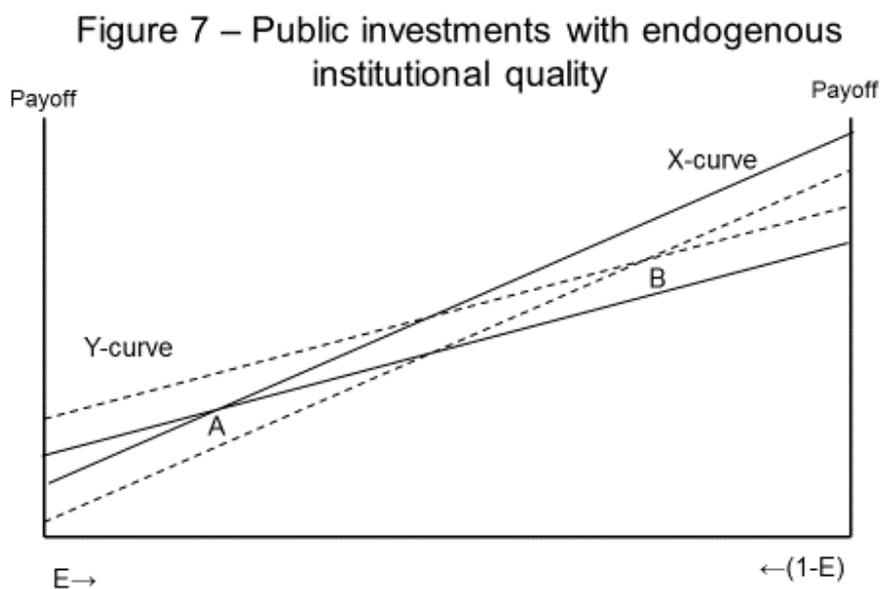
Inserting this into Equations (1') and (2') yields:

$$Y = Y(E, G, I(G, P)), \tag{1''}$$

and

$$X = X(E, P, I(G, P)), \tag{2''}$$

I illustrate the effect of using resource income for public investments in Figure 7. If public investments improve institutional quality, then the payoff function for producers shifts up, whereas the payoff function for rent-seekers shifts down. As illustrated, the future equilibrium then shifts from point A to point B, with increased income and production, and a reduced number of rent-seekers. Note that there is a multiplier effect, in that the increase in the payoff from production attracts even more producers into production, increasing the payoff from production even more. The important difference from the case of the financial investment is that this time, the multiplier is positive. For this reason, the increase in future income exceeds the direct effect of the increase in public investments.



4.4. Private Investments

Up to this point, I have assumed that the future income is determined by the future allocation of entrepreneurs between production and rent-seeking. In addition to this allocation of entrepreneurs,

however, the future equilibrium is likely to be dependent on the level of private savings and investments today. Increased savings and investments in the present add to the future capital stock and, therefore, increase future production and income.

van der Ploeg and Venables (2011) discuss how private consumers may dampen, or offset, the effects of a petroleum fund. Ricardian consumers anticipate that their wealth includes the petroleum fund, which may lead to what van der Ploeg and Venables term “the Ricardian Curse”, whereby prudent government policy may result in a private consumption boom. According to Esanov and Kuralbayeva (2011, p. 152), this is exactly what happened in Kazakhstan, where the “behavior of the private sector put at risk prudent government policies and the entire economy.” Mohn (2016) finds that consumers in Norway responded in a similar way, although the response was more modest, with a 1% point increase in the government savings rate inducing a 0.18% reduction in the household savings rate. The approach developed in the present paper indicates new mechanisms that drive private responses following the establishment of a petroleum fund. If the establishment of a petroleum fund erodes institutional quality, decreases future production, and increases future rent-seeking, then the incentives for private savings and investments may also decrease. However, note that, in contrast to the Ricardian Curse, it is the bleak future prospects, rather than the bright ones, that reduce private savings and investments.

On the other hand, if resource income is used for public investments, the picture may be more favorable. If such investments increase future production, improve institutional quality, and decrease future rent-seeking, then the incentives for private investments in the present are improved. In this case, the future increase in private incomes is magnified by increased savings and investments. Again, note the contrast between this mechanism and the Ricardian Curse. In the present model, as in Barro (1990), increased provision of public goods crowds in private investments, although the mechanism

in this paper, which operates through reduced rent-seeking and improved institutions, differs from Barro (1990).

5. CONCLUDING REMARKS

An increasing number of petroleum-exporting countries have established sovereign wealth funds. Some initial lessons from these funds can now be drawn. In some states or countries, including Alaska and Norway, the establishment of petroleum funds seems to have had favorable outcomes. In others, such as Alberta, the design of the fund was not sufficiently robust to fulfill its intentions. Thus, even when the initial institutions are strong, a petroleum fund may not work to enhance economic development. The main differences between the experiences of Alaska and Norway on the one hand, and those of Alberta on the other, seem to be found in the details of the design of the petroleum funds and, in particular, in the degree of independence from political decisions.

In countries where the initial institutions are weaker, such as in Chad and Angola, experience shows that the challenges of establishing a petroleum fund are not isolated to the design of the fund itself. Significant challenges arise as a result of a weak institutional and democratic infrastructure combined with funds that may be easily expropriated. In combination, these factors may produce political incentives that are damaging not only for economic activity but also for the future quality of institutions and for incentives to invest in the private sector. By investing petroleum incomes in education, health, and infrastructure, on the other hand, such incentives may be weakened or even reversed. At the same time, the need for such human capital and infrastructure investments is higher, simply because their level is lower in the first place.

With reference to developing countries, the analysis in this paper suggests that the combination of a strong need for investment in human capital and domestic infrastructure, and the potentially adverse effects of a petroleum fund on institutional quality, indicates that a petroleum fund

should not be established; instead, incomes from petroleum should be invested domestically. However, as emphasized in Section 2, there are other factors that, when present, dilute this argument or even suggest the opposite conclusion. Several of these factors, including the existence of a substantial gap between the political equilibrium and the socially optimal equilibrium, may be particularly relevant to developing countries. Policy choices in weakly institutionalized settings involve difficult trade-offs, and these trade-offs are likely to produce different answers to our policy question in countries facing different challenges.

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